

APPENDIX 7A

Technical Specifications – Divisions 2 through 33

SECTION 024116 - STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of buildings and structures[**and site improvements**].
2. Demolition and removal of site improvements adjacent to a building or structure to be demolished.
3. **[Abandoning in-place] [Removing]** below-grade construction.
4. Disconnecting, capping or sealing, and **[abandoning in-place] [removing]** site utilities.
5. Salvaging items for reuse by Owner.

B. Related Sections:

1. Section 011000 "Summary" for use of the premises and phasing requirements.
2. Section 013233 ""Photographic Documentation" for preconstruction photographs taken before building demolition.
3. Section 024119 "Selective Demolition" for partial demolition of buildings, structures, and site improvements.
4. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade site improvements not part of building demolition.
5. Section 330500 "Common Work Results for Utilities" for shutting off, disconnecting, removing, and sealing or capping utilities.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner[**ready for reuse**]. Include fasteners or brackets needed for reattachment elsewhere.

- C. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or recycled.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.
- C. Coordinate with Owner's **[archaeologist]** **[historical adviser]**, who will establish special procedures for removal and salvage.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified refrigerant **[demolition firm]** **[professional engineer]** **[recovery technician]**.
- B. Proposed **[Protection]** **[Environmental-Protection]** **[Dust-Control]** **[and]** **[Noise-Control]** Measures: Submit informational report, including Drawings, that indicates the measures proposed for protecting individuals and property[, **for environmental protection**] [, **for dust control**] **[and]** [, **for noise control**]. Indicate proposed locations and construction of barriers.
 - 1. Adjacent Buildings: Detail special measures proposed to protect adjacent buildings to remain[**including means of egress from those buildings**].
- C. Schedule of Building Demolition Activities: Indicate the following:
 - 1. Detailed sequence of demolition work, with starting and ending dates for each activity.
 - 2. Temporary interruption of utility services.
 - 3. Coordination for shutoff and capping[**or re-routing**] and continuation of utility services.
 - 4. Locations of temporary protection and means of egress[, **including for other tenants affected by building demolition operations**].
 - 5. Coordination of Owner's continuing occupancy of adjacent buildings and partial use of premises.
- D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
- E. Predemolition **[Photographs]** **[or]** **[Video]**: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be

misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before the Work begins.

- F. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
- G. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.6 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized experience in demolition work similar in material and extent to that indicated for this Project.
- B. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.
- E. Predemolition Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>**.
 - 1. Inspect and discuss condition of construction to be demolished.
 - 2. Review structural load limitations of existing structures.
 - 3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review and finalize protection requirements.
 - 5. Review procedures for **[noise control] [and] [dust control]**.
 - 6. Review procedures for protection of adjacent buildings.
 - 7. Review items to be salvaged and returned to Owner.

1.7 PROJECT CONDITIONS

- A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.
- B. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.
 - 1. Provide not less than **[72] <Insert number>** hours' notice of activities that will affect operations of adjacent occupied buildings.

2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.
 - a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.
 - C. Owner **[tenant]** assumes no responsibility for buildings and structures to be demolished.
 1. Conditions existing at time of inspection for bidding purpose will be maintained by **[Owner] [tenant]** as far as practical.
 2. Before building demolition, Owner will remove the following items:
 - a. **<Insert items to be removed by Owner and or tenant>**.
 - D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 1. Hazardous materials will be removed by **[Owner] [tenant]** before start of the Work.
 2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify DEN Project Manager **[and tenant]** . Hazardous materials will be removed by Owner under a separate contract.
 - E. Hazardous Materials: Hazardous materials are present in buildings and structures to be demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
 1. Hazardous material remediation is specified elsewhere in the Contract Documents.
 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
 3. **[Owner] [Tenant]** will provide material safety data sheets for materials that are known to be present in buildings and structures to be demolished because of building operations or processes performed there.
 - F. On-site storage or sale of removed items or materials is not permitted.
- 1.8 COORDINATION
- A. Arrange demolition schedule so as not to interfere with **[Owner's on-site operations] [tenant's on-site operations] [or] [operations of adjacent occupied buildings]**.
- 1.9 CONSTRUCTION WASTE MANAGEMENT
- A. Construction waste shall be managed in accordance with provisions of Section 017419

"Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS [Not Used]

2.1 SOIL MATERIALS

- A. Satisfactory Soils: Comply with requirements in Section 312000 "Earth Moving."

PART 3 - EXECUTION

3.1 DEMOLITION CONTRACTOR

- A. Demolition Contractor: Subject to compliance with requirements, provide one of the following:
 - 1. **<Insert, in separate subparagraphs, name of Contractor prequalified to perform the Work of this Section>.**
 - 2. or approved equal.

3.2 EXAMINATION

- A. Survey existing conditions and correlate with requirements indicated to determine extent of building demolition required.
- B. Verify that utilities have been disconnected and capped before starting demolition operations.
- C. Review Project Record Documents of existing construction provided by [**Owner**] [**tenant**]. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- D. Inventory and record the condition of items to be removed and salvaged. Provide [**photographs**] [**or**] [**video**] of conditions that might be misconstrued as damage caused by salvage operations. Comply with Section 013233 "Photographic Documentation."
- E. When unanticipated mechanical, electrical, or structural elements are encountered, investigate and measure the nature and extent of the element. Promptly submit a written report to DEN Project Manager.
- F. [**Perform**] [**Engage a professional engineer to perform**] an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.

1. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- G. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

3.3 PREPARATION

- A. Refrigerant: Remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction before starting demolition.
- B. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished.
1. **[Owner] [Tenant]** will arrange to shut off indicated utilities when requested by Contractor.
 2. Arrange to shut off indicated utilities with utility companies.
 3. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
 4. Cut off pipe or conduit a minimum of **24 inches (610 mm)** below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
- C. Existing Utilities: See plumbing and electrical Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.
1. Remove **[and recycle]** refrigerant from air-conditioning equipment before starting demolition.
- D. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of demolition.
- E. Salvaged Items: Comply with the following:
1. Clean salvaged items of dirt and demolition debris.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to storage area **[designated by Owner] [designated by tenant] [indicated on Drawings]**.
 5. Protect items from damage during transport and storage.

3.4 PROTECTION

- A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.
- B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during demolition. When permitted by DEN Project Manager, items may be removed to a suitable, protected storage location during demolition [**and cleaned**] and reinstalled in their original locations after demolition operations are complete.
- C. Existing Utilities: Maintain utility services to remain and protect from damage during demolition operations.
 - 1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by [**Owner**] [**tenant**] and authorities having jurisdiction.
 - 2. Provide temporary services during interruptions to existing utilities, as acceptable to [**Owner**] [**tenant**] and authorities having jurisdiction.
 - a. Provide at least [**72**] <Insert number> hours' notice to DEN Project Manager if shutdown of service is required during changeover.
- D. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Section 015210 "Temporary Facilities."
 - 1. Protect adjacent buildings and facilities from damage due to demolition activities.
 - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
 - 3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
 - 4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
 - 6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
 - 7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.
- E. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.5 DEMOLITION, GENERAL

- A. General: Demolish indicated buildings and structures [**and site improvements**] completely. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
 2. Maintain fire watch during and for at least **<Insert number>** hours after flame cutting operations.
 3. Maintain adequate ventilation when using cutting torches.
 4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Engineering Surveys: During demolition, perform surveys to detect hazards that may result from building demolition activities.
- C. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from **[Owner] [tenant]** and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
 2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- D. Explosives: Use of explosives is not permitted.

3.6 DEMOLITION BY MECHANICAL MEANS

- A. Remove **[buildings and structures] [and] [site improvements]** intact when permitted by authorities having jurisdiction.
- B. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.
- C. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.
- D. Salvage: Items to be removed and salvaged are indicated **[on Drawings.] [below:]**
1. Doors and door hardware.
 2. Windows.
 3. Cabinets.
 4. Mirrors.
 5. Chalkboards.
 6. Tackboards.

7. Marker boards.
 8. Plumbing fixtures.
 9. **<Insert items to be salvaged>**.
- E. Concrete: Cut concrete full depth at junctures with construction indicated to remain, using power-driven saw, then remove concrete between saw cuts.
- F. Masonry: Cut masonry at junctures with construction indicated to remain, using power-driven saw, then remove masonry between saw cuts.
- G. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished at junctures with construction indicated to remain, then break up and remove.
- H. Structural Steel: Dismantle field connections without bending or damaging steel members. Do not use flame-cutting torches unless otherwise authorized by [**DEN Project Manager**] [**authorities having jurisdiction**].
- I. Transport steel trusses and joists as whole units without dismantling them further.
- J. Carpet[**and Pad**]: Remove in large pieces and roll tightly after removing demolition debris, trash, adhesive, and tack strips.
- K. Building Components: Remove [**metal gratings**] [**metal ladders**] [**doors**] [**windows**] [**door hardware**] [**cabinets**] [**mirrors**] [**chalkboards and marker boards**] [**tackboards**] [**toilet accessories**] [**plumbing fixtures**] [**and**] [**light fixtures**], as whole units, intact and undamaged.
- L. Elevators: Remove as whole units as much as practical.
- M. Equipment: Disconnect equipment at nearest fitting connection to services, complete with service valves. Remove as whole units, complete with controls.
- N. Below-Grade Construction: Abandon foundation walls and other below-grade construction. Cut below-grade construction flush with grade.
- O. Below-Grade Construction: Demolish foundation walls and other below-grade construction that are within footprint of new construction and extending [**5 feet (1.5 m)**] **<Insert dimension>** outside footprint indicated for new construction. Abandon below-grade construction outside this area.
1. Remove below-grade construction, including basements, foundation walls, and footings, [**completely**] [**to at least 6 inches (150 mm) below grade**] [**to at least 12 inches (300 mm) below grade**] [**to depths indicated**].
- P. Below-Grade Construction: Demolish foundation walls and other below-grade construction.
1. Remove below-grade construction, including basements, foundation walls, and footings, [**completely**] [**to at least 6 inches (150 mm) below grade**] [**to at least 12 inches (300 mm) below grade**] [**to depths indicated**].

- Q. Existing Utilities: Abandon existing utilities and below-grade utility structures. Cut utilities flush with grade.
- R. Existing Utilities: Demolish existing utilities and below-grade utility structures that are within **[5 feet (1.5 m)] <Insert dimension>** outside footprint indicated for new construction. Abandon utilities outside this area.
1. Fill abandoned utility structures with **[satisfactory soil materials] [recycled pulverized concrete]** according to backfill requirements in Section 312000 "Earth Moving."
 2. Piping: Disconnect piping at unions, flanges, valves, or fittings.
 3. Wiring Ducts: Disassemble into unit lengths and remove plug-in and disconnecting devices.
- S. Existing Utilities: Demolish and remove existing utilities and below-grade utility structures.
1. Piping: Disconnect piping at unions, flanges, valves, or fittings.
 2. Wiring Ducts: Disassemble into unit lengths and remove plug-in and disconnecting devices.

3.7 DEMOLITION BY EXPLOSIVES

- A. Explosives: Use of explosives is not permitted.
- B. Explosives: Perform explosive demolition according to governing regulations.
1. Obtain written permission from authorities having jurisdiction before bringing explosives to, or using explosives on, Project site.
 2. Do not damage adjacent structures, property, or site improvements when using explosives.
- C. Comply with recommendation in specialty explosives consultant's report.

3.8 SITE RESTORATION

- A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.
- B. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with **[satisfactory soil materials] [recycled pulverized concrete] [recycled pulverized masonry]** according to backfill requirements in Section 312000 "Earth Moving."
- C. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.9 REPAIRS

- A. Promptly repair damage to adjacent buildings caused by demolition operations.
- B. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
- C. Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

3.10 RECYCLING DEMOLISHED MATERIALS

- A. General: Separate recyclable demolished materials from other demolished materials to the maximum extent possible. Separate recyclable materials by type.
 - 1. Provide containers or other storage method approved by DEN Project Manager for controlling recyclable materials until they are removed from Project site.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Stockpile materials away from demolition area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - 5. Transport recyclable materials off [**Owner**] [**Tenant**]'s property and legally dispose of them.
- B. Recycling Haulers and Markets: List below is provided for information only. Subject to compliance with requirements, provide one of the following:
 - 1. **<Insert names and telephone numbers of local recycling haulers and firms buying re-recyclable materials.>**
 - 2. or approved equal.
- C. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling building demolition materials shall accrue to[**Owner**] [**Tenant**] [**Contractor**].
- D. Asphalt: Grind asphalt to maximum 4-inch size.
- E. Asphalt: Break up and transport asphalt to asphalt recycling facility.
- F. Concrete: Remove reinforcement and other metals from concrete and sort with other metals. Pulverize concrete to maximum [**1-1/2-inch**] [**4-inch**] size.
- G. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
 - 1. Pulverize masonry to maximum [**3/4-inch**] [**1-inch**] [**1-1/2-inch**] [**4-inch**] size.
 - 2. Clean and stack undamaged, whole masonry units on wood pallets.

- H. Wood Materials: Sort and stack members according to size, type, and length. Separate dimensional and engineered lumber, panel products, and treated wood materials.
- I. Metals: Separate metals by type.
 - 1. Structural Steel: Stack members according to size, type of member, and length.
 - 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- J. Roofing: Separate organic and glass-fiber shingles and felts. Remove nails, staples, and accessories.
- K. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.
- L. Carpet[**and Pad**]: Store clean, dry carpet [**and pad**] in a closed container or trailer provided by Carpet Reclamation Agency.
- M. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs.
- N. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinkler heads, and other components by type and size.
- O. Lighting Fixtures: Separate lamps by type and protect from breakage.
- P. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.
- Q. Conduit: Reduce conduit to straight lengths and store by type and size.

3.11 DISPOSAL OF DEMOLISHED MATERIALS

- A. Except for items or materials indicated to be [**recycled,**] reused, salvaged, reinstalled, or otherwise indicated to remain on [**Owner's**] [**tenant's**] property, remove demolition waste materials from Project site [**and legally dispose of them in an EPA-approved landfill acceptable to authorities having jurisdiction**]. See Section 017419 "Construction Waste Management and Disposal" for recycling and disposal of demolition waste.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Do not burn demolished materials.
- C. Disposal: Transport demolished materials and dispose of at designated spoil areas on [**Owner's**] [**Tenant's**] property.
- D. Disposal: Transport demolished materials off [**Owner's**] [**Tenant's**] property and legally dispose of them.

3.12 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.
 - 1. Clean roadways of debris caused by debris transport.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION **024116**

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.
4. Repair procedures for selective demolition operations.

- B. Related Requirements:

1. Section 011000 "Summary" for restrictions on the use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 024116 "Structure Demolition" for demolition of buildings and structures.
3. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain DEN's property, demolished materials shall become the Contractor's property and shall be removed from the Project site.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 5. Review areas where existing construction is to remain and requires protection.
 - 6. **<Insert agenda items>**.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
 - 1. For firms and persons specified in Section 014510 "Contractor Quality Control" to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
 - 2. For refrigerant recovery technician.
- B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property [, **for environmental protection**] [, **for dust control**] [**and**] [, **for noise control**], and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate. Indicate proposed locations and construction of barriers.
- C. Submit Schedule of Selective Demolition Activities. Indicate the Following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's DEN's and other tenant's on-site operations are uninterrupted.

2. Interruption of utility services. Indicate how long utility services will be interrupted.
 3. Do not interrupt utility services without prior written request and approval from DEN Project Manager and authorities having jurisdiction.
 4. Coordination for shutoff, capping, and continuation of utility services.
 5. Use of elevator and stairs.
 6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
- E. Predemolition Photographs or Video: Submit before Work begins.
- F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- G. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.
- B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
- C. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI A10.6 and NFPA 241.
- C. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

- A. When there are occupied portions of buildings immediately adjacent to selective demolition area, conduct selective demolition so DEN's or tenant's operations will not be disrupted.
1. Provide not less than 72 hours' notice to DEN Project Manager of activities that will affect DEN's or tenant's operations.
- B. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.
- C. DEN assumes no responsibility for condition of areas to be selectively demolished. DEN will maintain conditions existing at time of inspection for bidding purpose as far as practical.
- D. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
1. Before selective demolition, Owner will remove the following items:
 - a. **<Insert items to be removed by Owner>.**
- E. Notify DEN Project Manager of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- F. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
1. Hazardous materials will be removed by Owner before start of the Work.
 2. If suspected hazardous materials are encountered, do not disturb; immediately notify DEN Project Manager. Hazardous materials will be removed by Owner under a separate contract.
- G. Hazardous Materials: Hazardous materials are present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
1. Hazardous material remediation is specified elsewhere in the Contract Documents.
 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
 3. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.

- H. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by [**12 inches (300 mm)**] <Insert dimension> or more.
- I. Storage or sale of removed items or materials on-site is not permitted.
- J. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:
 - 1. <Insert warranted system>.
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.
 - 1. If possible, retain original installer or fabricator to patch the exposed Work listed below that is damaged during selective demolition. If it is impossible to engage the original installer or fabricator, engage another recognized experienced and specialized firm.
 - a. Ornamental metal.
 - b. Preformed metal panels.
 - c. Firestopping.
 - d. Terrazzo.
 - e. Wall covering.
 - f. ProCoat paint finishes.
 - g. HVAC enclosures, cabinets, or covers.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 REPAIR MATERIALS

- A. Use repair materials identical to existing materials.
- B. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that, when installed, will match the visual and functional performance of existing materials, as approved by DEN Project Manager.
- C. Use materials whose installed performance equal or surpass that of existing materials.
- D. Comply with material and installation requirements specified in individual specification sections.

2.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.
- C. LEED Requirements for Building Reuse:
 - 1. Credit MR 1.1[**and Credit MR 1.2**]: Maintain existing building structure (including structural floor and roof decking) and envelope (exterior skin and framing, excluding window assemblies and nonstructural roofing material) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
 - 2. Credit MR 1.3: Maintain existing interior nonstructural elements (interior walls, doors, floor coverings, and ceiling systems) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
 - 3. Credit MR 1.2[**and Credit MR 1.3**]: Maintain existing nonshell, nonstructural components (walls, flooring, and ceilings) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.

- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- E. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to DEN Project Manager.
- F. **[Perform] [Engage a professional engineer to perform]** an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
 - 2. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- G. Survey of Existing Conditions: Record existing conditions by use of **[measured drawings] [preconstruction photographs] [preconstruction videotapes] [and] [templates]**.
 - 1. Comply with requirements specified in Section 013233 "Photographic Documentation."
 - 2. Inventory and record the condition of items to be removed and salvaged. Provide **[photographs] [or] [video]** of conditions that might be misconstrued as damage caused by salvage operations.
 - 3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
 - 1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."
 - 2. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by the DEN Project Manager and authorities having jurisdiction.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Arrange to shut off indicated utilities and obtain prior written approval with DEN Project Manager and utility companies.
 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
- C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Comply with requirements for access and protection specified in Section 015210 "Temporary Facilities."
 2. Do not close or obstruct roads, streets, walks, walkways, or other adjacent occupied or used facilities without written authorization from the DEN Project Manager and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
 3. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
 4. Protect existing site improvements, appurtenances, and landscaping.
 5. Erect a plainly visible fence around drip lines of individual trees or around perimeter drip lines of groups of trees.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.
- D. Temporary Enclosures: Provide temporary enclosures for protection of existing buildings and construction projects, both in progress and completed, from exposure, foul weather and other construction operations. Provide temporary weather tight enclosures for building exteriors.
1. Where heating or cooling is needed and permanent enclosures are not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
 2. Contractor shall be responsible for any damage to existing conditions due to inadequate temporary enclosures or due to failure of temporary enclosures.
- E. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
- ### 3.4 SELECTIVE DEMOLITION, GENERAL
- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain[**fire watch and**] portable fire-suppression devices during flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 9. Dispose of demolished items and materials promptly.[**Comply with requirements in Section 017419 "Construction Waste Management and Disposal."**]
- B. Reuse of Building Elements: Project has been designed to result in end-of-Project rates for reuse of building elements as follows. Do not demolish building elements beyond what is indicated on Drawings without DEN Project Manager's approval.
1. Building Structure and Shell: **[75] [100]** percent.
 2. Nonshell Elements: 50 percent.
 3. Nonshell Elements: **[40] [60]** percent.
- C. Removed and Salvaged Items:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to DEN.
 4. Transport items to DEN's storage area as designated by the DEN Project Manager.
 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 2. Paint equipment to match new equipment, with coatings of equal color, finish and performance of new equipment.
 3. Pack or crate items after cleaning and repairing. Identify contents of containers.
 4. Protect items from damage during transport and storage.
 5. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by DEN Project Manager, items may be removed to a suitable, protected storage location during selective demolition[**and cleaned**] and reinstalled in their original locations after selective demolition operations are complete.

3.5 PATCHING AND REPAIRS

- A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.
- B. Patching: Comply with Specification Section 017330 "Cutting and Patching".
- C. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
 - 1. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.
- D. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.
- E. Floors and Walls: Where walls or partitions that are demolished extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - 1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements as specified in other sections of these specifications.
 - 2. Where patching occurs on a painted surface, apply primer and intermediate paint coats over the patch and apply a final paint coat over the entire unbroken surface containing the patch. Provide additional coats until the patch blends with adjacent surfaces.
 - 3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
- F. Ceilings: Patch, repair or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least **3/4 inch (19 mm)** at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." [**Do not use methods requiring solvent-based adhesive strippers.**]
- F. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section <Insert Section number> "<Insert Section title>" for new roofing requirements.
 - 1. Remove existing roof membrane, flashings, copings, and roof accessories.
 - 2. Remove existing roofing system down to substrate.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be [**recycled,**] reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site [**and legally dispose of them in an EPA-approved landfill**].
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 - 4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
 - 5. Disposal shall be in accordance with Division 32 requirements.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.9 SELECTIVE DEMOLITION SCHEDULE

- A. Existing [Items] [Construction] to be Removed: <Insert description of items and construction to be removed>.

- B. Existing Items to Be Removed and Salvaged: **<Insert description of items to be removed and salvaged>**.
- C. Existing Items to Be Removed and Reinstalled: **<Insert description of items to be removed and reinstalled>**.
- D. Existing Items to Remain: **<Insert description of items to remain>**.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION **024119**

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
 - 4. Suspended slabs.
 - 5. Concrete toppings.
 - 6. Building frame members.
 - 7. Building walls.
- B. Related Sections:
 - 1. Section 033300 "Architectural Concrete" for general building applications of specially finished formed concrete.
 - 2. Section 035320 "Concrete Topping" for emery- and iron-aggregate concrete floor toppings.
 - 3. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.
 - 4. Section 321313 "Concrete Paving (CDOT)" for concrete pavement and walks.
 - 5. Section 321316 "Decorative Concrete Paving" for decorative concrete pavement and walks.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 2. Product Data for Credit IEQ 4.3: For **[liquid floor treatments] [and] [curing and sealing compounds]**, documentation including printed statement of VOC content.
 3. Design Mixtures for Credit ID 1.1: For each concrete mixture containing fly ash as a replacement for Portland cement or other Portland cement replacements, and for equivalent concrete mixtures that do not contain Portland cement replacements.
- C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments. Concrete materials representing current production shall be tested and used to fabricate trial mix data. The testing lab shall submit and certify the results of all tests and/or certificates of all materials and calculations used to develop the 7-day and 28-day compressive strength test results and applicable reference specifications.
1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement according to ACI 315 "Details and Detailing of Concrete Reinforcement". Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement. Include special reinforcement required for openings through concrete structures.
- E. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.
1. Design and engineering of formwork are Contractor's responsibility.
 2. Submit shop drawings showing all formwork and sequencing of all vertical concrete walls 8 feet or more in height. Coordinate pour breaks in architectural exposed exterior concrete walls so that pour breaks occur at the top or bottom of a reveal. Show form tie locations. Provide uniform form tie spacing at architecturally exposed exterior concrete walls.
 3. Shop drawings to be prepared by a Colorado Professional Engineer.
 4. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

- F. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - 1. Location of construction joints is subject to approval of the DEN Project Manager. Do not proceed with work unless construction joint shop drawings are approved by Owner.
- G. Samples: For [waterstops] [vapor retarder] <Insert products>.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For [Installer] [manufacturer] [testing agency].
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Fiber reinforcement.
 - 6. Waterstops.
 - 7. Curing compounds.
 - 8. Floor and slab treatments.
 - 9. Bonding agents.
 - 10. Adhesives.
 - 11. Vapor retarders.
 - 12. Semirigid joint filler.
 - 13. Joint-filler strips.
 - 14. Repair materials.
 - 15. Structural epoxy for reinforcing.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates.[**Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.**]
- E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.

1.6 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for formwork and shoring and reshoring installations that are similar to those indicated for this Project in material, design, and extent.
- C. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- D. Testing Agency Qualifications: An independent testing agency, acceptable to the DEN Project Manager and the City of Denver, and all authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- F. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."
- G. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specifications for Structural Concrete," [**Sections 1 through 5.**] [**Sections 1 through 5 and Section 7, "Lightweight Concrete."**]
 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

- H. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- I. Mockups: Cast concrete [**slab-on-grade**] [**and**] [**formed-surface**] panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.
1. Build panel approximately [**200 sq. ft. (18.6 sq. m) for slab-on-grade**] [**and**] [**100 sq. ft. (9.3 sq. m) for formed surface**] <Insert area> in the location indicated or, if not indicated, as directed by DEN Project Manager.
 2. Notify DEN Project Manager minimum seven (7) days in advance of dates and times when mockups will be constructed.
 3. Obtain DEN Project Manager's approval of mockups before starting construction.
 4. If DEN Project Manager determines that mockups do not meet requirements, demolish and remove them from the site and cast another until the mockup is approved.
 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 6. Demolish and remove mockups when directed by DEN Project Manager.
 7. Approved mockups may become part of the completed Work if approved by DEN Project Manager, and undisturbed at time of Substantial Completion.
- J. Preinstallation Conference: Conduct conference at [**Project site**] [**location and time as determined by DEN Project Manager**] <Insert location>.
1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - e. Special concrete finish subcontractor.
 2. Review [**special inspection and testing and inspecting agency procedures for field quality control,**] [**concrete finishes and finishing,**] [**cold- and hot-weather concreting procedures,**] [**curing procedures,**] [**construction contraction and isolation joints, and joint-filler strips,**] [**semirigid joint fillers,**] [**forms and form removal limitations,**] [**shoring and reshoring procedures,**] [**vapor-retarder installation,**] [**anchor rod and anchorage device installation tolerances,**] [**steel reinforcement installation,**] [**floor and slab flatness and levelness measurement,**] [**concrete repair procedures,**] and concrete protection.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending

and damage.[**Avoid damaging coatings on steel reinforcement.**] Store reinforcement above the ground on platforms, skids or other supports.

- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.
- C. Avoid damaging coatings on steel reinforcement.
- D. Repair damaged epoxy coatings on steel reinforcement according to ASTM D 3963/D 3963M.
- E. Damaged or non-conforming materials shall be removed from the Project Site and replaced with new satisfactory materials at no additional cost to Owner.
- F. Deliver packaged materials to Project Site in original, unopened, and undamaged containers plainly labeled with manufacturer's name, product name and designation, expiration period for use, mixing instructions for multi-component materials and other pertinent data. Store and handle materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breakage, and other causes.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- F. Chamfer Strips: Wood, metal, PVC, or rubber strips, **3/4 by 3/4 inch** (19 by 19 mm), minimum.
- G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- H. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- I. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than **1 inch** (25 mm) to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes no larger than **1 inch** (25 mm) in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25] [60] <Insert number>** percent.
- B. Reinforcing Bars: ASTM A 615/A 615M, **Grade 60** (Grade 420), deformed.
- C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- D. Galvanized Reinforcing Bars: **[ASTM A 615/A 615M, Grade 60 (Grade 420)] [ASTM A 706/A 706M]**, deformed bars, ASTM A 767/A 767M, **[Class I] [Class II]** zinc coated after fabrication and bending.
- E. Epoxy-Coated Reinforcing Bars: **[ASTM A 615/A 615M, Grade 60 (Grade 420)] [ASTM A 706/A 706M]**, deformed bars, **[ASTM A 775/A 775M] [or] [ASTM A 934/A 934M]**,

epoxy coated, with less than 2 percent damaged coating in each 12-inch (300-mm) bar length.

- F. Stainless-Steel Reinforcing Bars: ASTM A 955/A 955M, **Grade 60** (Grade 420), [**Type 304**] [**Type 316L**], deformed.
- G. Steel Bar Mats: ASTM A 184/A 184M, fabricated from [**ASTM A 615/A 615M, Grade 60** (Grade 420)] [**ASTM A 706/A 706M**], deformed bars, assembled with clips.
- H. Plain-Steel Wire: ASTM A 82/A 82M, [**as drawn**] [**galvanized**].
- I. Deformed-Steel Wire: ASTM A 496/A 496M.
- J. Epoxy-Coated Wire: ASTM A 884/A 884M, Class A, Type 1 coated, [**as-drawn, plain**] [**deformed**]-steel wire, with less than 2 percent damaged coating in each 12-inch (300-mm) wire length.
- K. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.
- L. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- M. Galvanized-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from galvanized-steel wire into flat sheets.
- N. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A coated, Type 1, [**plain**] [**deformed**] steel.

2.3 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, **Grade 60** (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.
- B. Epoxy-Coated Joint Dowel Bars: ASTM A 615/A 615M, **Grade 60** (Grade 420), plain-steel bars, ASTM A 775/A 775M epoxy coated.
- C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 775M.
- D. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
1. Portland Cement: ASTM C 150, [Type I] [Type II] [Type I/II] [Type III] [Type V], [gray] [white]. [Supplement with the following:]
 - a. Fly Ash: ASTM C 618, [Class F] [Class F or C].
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
 2. Blended Hydraulic Cement: ASTM C 595, [Type IS, Portland blast-furnace slag] [Type IP, Portland-pozzolan] [Type I (PM), pozzolan-modified Portland] [Type I (SM), slag-modified Portland] cement.
- B. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33, [Class 3S] [Class 3M] [Class 1N] <Insert class> coarse aggregate or better, graded. Provide aggregates from a single source [with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials].
1. Maximum Coarse-Aggregate Size: [1-1/2 inches (38 mm)] [1 inch (25 mm)] [3/4 inch (19 mm)] nominal.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
 3. Combined Aggregate Gradation: Well graded from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 sieve, and less than 8 percent may be retained on sieves finer than No. 50.
- D. Lightweight Aggregate: ASTM C 330, [1-inch (25-mm)] [3/4-inch (19-mm)] [1/2-inch (13-mm)] [3/8-inch (10-mm)] nominal maximum aggregate size.
- E. Water: ASTM C 94/C 94M [and potable].

2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Axim Italcementi Group, Inc.; CATEXOL CN-CI.
 - b. BASF Construction Chemicals - Building Systems; Rheocrete CNI.
 - c. Euclid Chemical Company (The), an RPM company; [**ARRMATECT**] [**EUCON BCN**] [**EUCON CIA**].
 - d. Grace Construction Products, W. R. Grace & Co.; DCI.
 - e. Sika Corporation; Sika CNI.
 - f. **<Insert manufacturer's name>**
 - g. or approved equal.
- D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals - Building Systems; Rheocrete 222+.
 - b. Cortec Corporation; MCI- [**2000**] [**2005NS**].
 - c. Grace Construction Products, W. R. Grace & Co.; DCI-S.
 - d. Sika Corporation; FerroGard 901.
 - e. **<Insert manufacturer's name>**
 - f. or approved equal.
- E. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, [**free of carbon black,**] nonfading, and resistant to lime and other alkalis.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ChemMasters.
 - b. Davis Colors.
 - c. Dayton Superior Corporation.
 - d. Hoover Color Corporation.
 - e. Lambert Corporation.

- f. QC Construction Products.
- g. Rockwood Pigments NA, Inc.
- h. Scofield, L. M. Company.
- i. Solomon Colors, Inc.
- j. **<Insert manufacturer's name>**
- k. or approved equal.

2. Color: **[As indicated by manufacturer's designation] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range].**

2.6 FIBER REINFORCEMENT

- A. Carbon-Steel Fiber: ASTM A 820/A 820M, deformed, minimum of **[1.5 inches (38 mm)] [2 inches (50 mm)] [2.4 inches (60 mm)] <Insert dimension>** long, and aspect ratio of **[35 to 40] [45 to 50] [60 to 65] <Insert ratio>**.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Fiber: Type 1, Cold-Drawn Wire:

- 1) Bekaert; Dramix.
- 2) Fibercon International, Inc.; Fibercon Drawn Wire.
- 3) Nycon, Inc.; Nycon SF Type I.
- 4) Propex Concrete Systems Corp.; Novocon 1050.
- 5) Sika Corporation; Sika Fiber SH.
- 6) **<Insert manufacturer's name>**
- 7) or approved equal.

- b. Fiber: Type 2, Cut Sheet:

- 1) Bekaert; Wiremix.
- 2) Fibercon International, Inc.; Fibercon Cut Sheet.
- 3) Nycon, Inc.; Nycon SF Type II.
- 4) **<Insert manufacturer's name>**
- 5) or approved equal.

- B. Synthetic Micro-Fiber: **[Monofilament] [or] [fibrillated]** polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, **[1/2 to 1-1/2 inches (13 to 38 mm)] [1 to 2-1/4 inches (25 to 57 mm)] <Insert dimensions>** long.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Monofilament Micro-Fibers:

- 1) Axim Italcementi Group, Inc.; Fibrasol II P.
- 2) Euclid Chemical Company (The), an RPM company; Fiberstrand **[100] [150]**.
- 3) FORTA Corporation; FORTA Econo-Mono.

- 4) Grace Construction Products, W. R. Grace & Co.; Grace MicroFiber.
- 5) Metalcrete Industries; Polystrand 1000.
- 6) Nycon, Inc.; ProConM.
- 7) Propex Concrete Systems Corp.; Fibermesh 150.
- 8) Sika Corporation; Sika Fiber PPM.
- 9) **<Insert manufacturer's name>**
- 10) or approved equal.

b. Fibrillated Micro-Fibers:

- 1) Axim Italcementi Group, Inc.; Fibrasol F.
- 2) Euclid Chemical Company (The), an RPM company; Fiberstrand F.
- 3) FORTA Corporation; FORTA [**Econo-Net**] [**Ultra-Net**].
- 4) Grace Construction Products, W. R. Grace & Co.; Grace Fibers.
- 5) Nycon, Inc.; ProConF.
- 6) Propex Concrete Systems Corp.; Fibermesh 300.
- 7) Sika Corporation; Sika Fiber PPF.
- 8) **<Insert manufacturer's name>**
- 9) or approved equal.

C. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, [**1 to 2-1/4 inches (25 to 57 mm)**] **<Insert dimensions>** long.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. 3M; Scotchcast Polyolefin Fibers [**1"**] [**2"**].
- b. Euclid Chemical Company (The), an RPM company; Tuf-Strand SF.
- c. FORTA Corporation; FORTA FERRO.
- d. Grace Construction Products, W. R. Grace & Co.; Strux 90/40.
- e. Nycon, Inc.; XL.
- f. Propex Concrete Systems Corp.; Fibermesh 650.
- g. Sika Corporation; Sika Fiber [**MS**] [**MS10**].
- h. **<Insert manufacturer's name>**
- i. or approved equal.

2.7 WATERSTOPS

A. Flexible Rubber Waterstops: CE CRD-C 513, [**with factory-installed metal eyelets,**] for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Greenstreak.
- b. Williams Products, Inc.
- c. **<Insert manufacturer's name>**
- d. or approved equal.

2. Profile: **[Flat, dumbbell with center bulb] [Flat, dumbbell without center bulb] [Ribbed with center bulb] [Ribbed without center bulb] [As indicated] <Insert profile>**.
 3. Dimensions: **[4 inches by 3/16 inch thick (100 mm by 4.75 mm thick)] [6 inches by 3/8 inch thick (150 mm by 10 mm thick)] [9 inches by 3/8 inch thick (225 mm by 10 mm thick)] <Insert dimensions>**; nontapered.
- B. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstops[**with factory-installed metal eyelets**], for embedding in concrete to prevent passage of fluids through joints; resistant to oils, solvents, and chemicals. Factory fabricate corners, intersections, and directional changes.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. JP Specialties, Inc.; Earth Shield TPE-Rubber.
 - b. Vinylex Corp.; PetroStop.
 - c. WESTEC Barrier Technologies, Inc.; 600 Series TPE-R.
 - d. **<Insert manufacturer's name>**
 - e. or approved equal.
 2. Profile: **[Flat, dumbbell with center bulb] [Flat, dumbbell without center bulb] [Ribbed with center bulb] [Ribbed without center bulb] [As indicated] <Insert profile>**.
 3. Dimensions: **[4 inches by 3/16 inch thick (100 mm by 4.75 mm thick)] [6 inches by 3/16 inch thick (150 mm by 4.75 mm thick)] [6 inches by 3/8 inch thick (150 mm by 10 mm thick)] [9 inches by 3/16 inch thick (225 mm by 4.75 mm thick)] [9 inches by 3/8 inch thick (225 mm by 10 mm thick)] <Insert dimensions>**; nontapered.
- C. Flexible PVC Waterstops: CE CRD-C 572,[**with factory-installed metal eyelets**], for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BoMetals, Inc.
 - b. Greenstreak.
 - c. Paul Murphy Plastics Company.
 - d. Vinylex Corp.
 - e. **<Insert manufacturer's name>**
 - f. or approved equal.
 2. Profile: **[Flat, dumbbell with center bulb] [Flat, dumbbell without center bulb] [Ribbed with center bulb] [Ribbed without center bulb] [As indicated] <Insert profile>**.
 3. Dimensions: **[4 inches by 3/16 inch thick (100 mm by 4.75 mm thick)] [6 inches by 3/8 inch thick (150 mm by 10 mm thick)] [9 inches by 3/8 inch thick (225 mm by 10 mm thick)] <Insert dimensions>**; nontapered.

- D. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, **3/4 by 1 inch** (19 by 25 mm).
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing, Inc.; MiraSTOP.
 - b. CETCO; Volclay Waterstop-RX.
 - c. Concrete Sealants Inc.; Conseal CS-231.
 - d. Greenstreak; Swellstop.
 - e. Henry Company, Sealants Division; Hydro-Flex.
 - f. JP Specialties, Inc.; Earth Shield Type 20.
 - g. **<Insert manufacturer's name>**
 - h. or approved equal.

- E. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete, **3/8 by 3/4 inch** (10 by 19 mm).
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Adeka Ultra Seal/OCM, Inc.; Adeka Ultra Seal.
 - b. Greenstreak; Hydrotite.
 - c. Vinylex Corp.; Swellseal.
 - d. **<Insert manufacturer's name>**
 - e. or approved equal.

2.8 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A[, **except with maximum perm rating of <Insert rating>**]. Include manufacturer's recommended adhesive or pressure-sensitive tape.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing, Inc.; Blackline 400.
 - b. Fortifiber Building Systems Group; Moistop Ultra [15] [10].
 - c. Grace Construction Products, W. R. Grace & Co.; Florprufe 120.
 - d. Insulation Solutions, Inc.; Viper VaporCheck [16] [10] [6.5].
 - e. Meadows, W. R., Inc.; Perminator [15 mil] [10 mil].
 - f. Raven Industries Inc.; Vapor Block [15] [10].
 - g. Reef Industries, Inc.; Griffolyn [Type-105] [Type-65G] [15 mil Green] [10 mil Green].
 - h. Stego Industries, LLC; Stego Wrap [15 mil Class A] [10 mil Class A].
 - i. **<Insert manufacturer's name>**
 - j. or approved equal.
- B. Sheet Vapor Retarder: ASTM E 1745, Class B[, **except with maximum perm rating of <Insert rating>**]. Include manufacturer's recommended adhesive or

pressure-sensitive tape.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fortifiber Building Systems Group; Moistop Ultra 6.
 - b. Raven Industries Inc.; Griffolyn [**Type-65**] [**10 mil Green**].
 - c. Stego Industries, LLC; Stego Wrap, 10 mil Class A.
 - d. <Insert manufacturer's name>
 - e. or approved equal.

- C. Sheet Vapor Retarder: ASTM E 1745, Class C[, **except with maximum perm rating of <Insert rating>**]. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fortifiber Building Systems Group; Moistop Plus.
 - b. Raven Industries Inc.; Vapor Block 6.
 - c. Reef Industries, Inc.; Griffolyn [**Type-65**] [**Type-85**].
 - d. Stego Industries, LLC; Stego Wrap, 10 mil Class C.
 - e. <Insert manufacturer's name>
 - f. or approved equal.

- D. Bituminous Vapor Retarder: **110-mil-** (2.8-mm-) thick, semiflexible, 7-ply sheet membrane consisting of reinforced core and carrier sheet with fortified asphalt layers, protective weathercoating, and removable plastic release liner. Furnish manufacturer's accessories including bonding asphalt, pointing mastics, and self-adhering joint tape.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Meadows, W. R., Inc.; Premoulded Membrane Vapor Seal.
 - b. <Insert manufacturer's name>
 - c. or approved equal.
 2. Water-Vapor Permeance: **0.00 grains/h x sq. ft. x inches Hg** (0.00 ng/Pa x s x sq. m); ASTM E 154.
 3. Tensile Strength: **140 lbf/inch** (24.5 kN/m); ASTM E 154.
 4. Puncture Resistance: **90 lbf** (400N); ASTM E 154.

- E. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a **1-1/2-inch** (37.5-mm) sieve and 0 to 5 percent passing a **No. 8** (2.36-mm) sieve.

- F. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a **3/8-inch** (9.5-mm) sieve, 10 to 30 percent passing a **No. 100** (0.15-mm) sieve, and at least 5 percent passing **No. 200** (0.075-mm) sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

2.9 FLOOR AND SLAB TREATMENTS

- A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing [**3/8-inch (9.5-mm)**] [**No. 4 (4.75-mm)**] [**No. 8 (2.36-mm)**] **<Insert size or gradation>** sieve.
- Products: Subject to compliance with requirements, provide one of the following:
 - Anti-Hydro International, Inc.; Emery.
 - Dayton Superior Corporation; Emery Tuff Non-Slip.
 - Lambert Corporation; EMAG-20.
 - L&M Construction Chemicals, Inc.; Grip It.
 - Metalcrete Industries; Metco Anti-Skid Aggregate.
 - <Insert manufacturer's name>**
 - or approved equal.
- B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.
- Products: Subject to compliance with requirements, provide one of the following:
 - Anti-Hydro International, Inc.; A-H Alox.
 - BASF Construction Chemicals - Building Systems; Frictex NS.
 - L&M Construction Chemicals, Inc.; Grip It AO.
 - <Insert manufacturer's name>**
 - or approved equal.
- C. Emery Dry-Shake Floor Hardener: [**Pigmented**] [**Unpigmented**], factory-packaged, dry combination of Portland cement, graded emery aggregate, and plasticizing admixture; with emery aggregate consisting of no less than 60 percent of total aggregate content.
- Color: [**As indicated by manufacturer's designation**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**].
- D. Metallic Dry-Shake Floor Hardener: [**Pigmented**] [**Unpigmented**], factory-packaged, dry combination of Portland cement, graded metallic aggregate, rust inhibitors, and plasticizing admixture; with metallic aggregate consisting of no less than 65 percent of total aggregate content.
- Color: [**As indicated by manufacturer's designation**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**].
- E. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of Portland cement, graded quartz aggregate, and plasticizing admixture.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals - Building Systems; Maximent.
 - b. ChemMasters; ConColor.
 - c. Conspec by Dayton Superior; Conshake 500.
 - d. Dayton Superior Corporation; Quartz Tuff.
 - e. Edoco by Dayton Superior; Burke Non Metallic Floor Hardener 250.
 - f. Euclid Chemical Company (The), an RPM company; Surfex.
 - g. Kaufman Products, Inc.; Tycron.
 - h. Lambert Corporation; Colorhard.
 - i. L&M Construction Chemicals, Inc.; Quartzplate FF.
 - j. Metalcrete Industries; Floor Quartz.
 - k. Scofield, L. M. Company; Lithochrome Color Hardener.
 - l. Symons by Dayton Superior; Hard Top.
 - m. **<Insert manufacturer's name>**
 - n. or approved equal.

- F. Pigmented Mineral Dry-Shake Floor Hardener: Factory-packaged, dry combination of Portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals - Building Systems; Mastercron.
 - b. ChemMasters; ConColor.
 - c. Conspec by Dayton Superior; Conshake 600 Colortone.
 - d. Dayton Superior Corporation; Quartz Tuff.
 - e. Edoco by Dayton Superior; Burke Non Metallic Floor Hardener 200 - 205.
 - f. Euclid Chemical Company (The), an RPM company; Surfex.
 - g. Kaufman Products, Inc.; Tycron.
 - h. Lambert Corporation; Colorhard.
 - i. L&M Construction Chemicals, Inc.; Quartz Plate FF.
 - j. Metalcrete Industries; Floor Quartz.
 - k. Scofield, L. M. Company; Lithochrome Color Hardener.
 - l. Symons by Dayton Superior; Color Hardener.
 - m. **<Insert manufacturer's name>**
 - n. or approved equal.

2. Color: **[As indicated by manufacturer's designation] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range].**

2.10 LIQUID FLOOR TREATMENTS

- A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. ChemMasters; Chemisil Plus.
- b. ChemTec Int'l; ChemTec One.
- c. Conspec by Dayton Superior; Intraseal.
- d. Curecrete Distribution Inc.; Ashford Formula.
- e. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
- f. Edoco by Dayton Superior; Titan Hard.
- g. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
- h. Kaufman Products, Inc.; SureHard.
- i. L&M Construction Chemicals, Inc.; Seal Hard.
- j. Meadows, W. R., Inc.; LIQUI-HARD.
- k. Metalcrete Industries; Floorsaver.
- l. Nox-Crete Products Group; Duro-Nox.
- m. Symons by Dayton Superior; Buff Hard.
- n. US SPEC, Division of US Mix Products Company; US SPEC Industraseal.
- o. Vexcon Chemicals, Inc.; Vexcon StarSeal PS Clear.
- p. **<Insert manufacturer's name>**
- q. or approved equal.

C. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Advanced Floor Products; Retro-Plate 99.
- b. L&M Construction Chemicals, Inc.; FGS Hardener Plus.
- c. QuestMark, a division of CentiMark Corporation; DiamondQuest Densifying Impregnator Application.
- d. **<Insert manufacturer's name>**
- e. or approved equal.

2.11 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Axim Italcementi Group, Inc.; CATExOL CimFilm.
- b. BASF Construction Chemicals - Building Systems; Confilm.
- c. ChemMasters; SprayFilm.
- d. Conspec by Dayton Superior; Aquafilm.
- e. Dayton Superior Corporation; Sure Film (J-74).

- f. Edoco by Dayton Superior; BurkeFilm.
 - g. Euclid Chemical Company (The), an RPM company; Eucobar.
 - h. Kaufman Products, Inc.; Vapor-Aid.
 - i. Lambert Corporation; LAMBCO Skin.
 - j. L&M Construction Chemicals, Inc.; E-CON.
 - k. Meadows, W. R., Inc.; EVAPRE.
 - l. Metalcrete Industries; Waterhold.
 - m. Nox-Crete Products Group; MONOFILM.
 - n. Sika Corporation; SikaFilm.
 - o. SpecChem, LLC; Spec Film.
 - p. Symons by Dayton Superior; Finishing Aid.
 - q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
 - r. Unitex; PRO-FILM.
 - s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.
 - t. **<Insert manufacturer's name>**
 - u. or approved equal.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
 - b. BASF Construction Chemicals - Building Systems; Kure 200.
 - c. ChemMasters; Safe-Cure Clear.
 - d. Conspec by Dayton Superior; W.B. Resin Cure.
 - e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
 - f. Edoco by Dayton Superior; Res X Cure WB.
 - g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
 - h. Kaufman Products, Inc.; Thinfilm 420.
 - i. Lambert Corporation; AQUA KURE - CLEAR.
 - j. L&M Construction Chemicals, Inc.; L&M Cure R.
 - k. Meadows, W. R., Inc.; 1100-CLEAR.
 - l. Nox-Crete Products Group; Resin Cure E.
 - m. Right Pointe; Clear Water Resin.
 - n. SpecChem, LLC; Spec Rez Clear.
 - o. Symons by Dayton Superior; Resi-Chem Clear.
 - p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
 - q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.
 - r. **<Insert manufacturer's name>**
 - s. or approved equal.

- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating[, **certified by curing compound manufacturer to not interfere with bonding of floor covering**].
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Anti-Hydro International, Inc.; AH Clear Cure WB.
 - b. BASF Construction Chemicals - Building Systems; Kure-N-Seal WB.
 - c. ChemMasters; Safe-Cure & Seal 20.
 - d. Conspec by Dayton Superior; Cure and Seal WB.
 - e. Cresset Chemical Company; Crete-Trete 309-VOC Cure & Seal.
 - f. Dayton Superior Corporation; Safe Cure and Seal (J-18).
 - g. Edoco by Dayton Superior; Spartan Cote WB II.
 - h. Euclid Chemical Company (The), an RPM company; Aqua Cure VOX; Clearseal WB 150.
 - i. Kaufman Products, Inc.; Cure & Seal 309 Emulsion.
 - j. Lambert Corporation; Glazecote Sealer-20.
 - k. L&M Construction Chemicals, Inc.; Dress & Seal WB.
 - l. Meadows, W. R., Inc.; Vocomp-20.
 - m. Metalcrete Industries; Metcure.
 - n. Nox-Crete Products Group; Cure & Seal 150E.
 - o. Symons by Dayton Superior; Cure & Seal 18 Percent E.
 - p. TK Products, Division of Sierra Corporation; TK-2519 WB.
 - q. Vexcon Chemicals, Inc.; Starseal 309.
 - r. **<Insert manufacturer's name>**
 - s. or approved equal.
- G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating[, **certified by curing compound manufacturer to not interfere with bonding of floor covering**].
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals - Building Systems; Kure-N-Seal W.
 - b. ChemMasters; Safe-Cure Clear.
 - c. Conspec by Dayton Superior; High Seal.
 - d. Dayton Superior Corporation; Safe Cure and Seal (J-19).
 - e. Edoco by Dayton Superior; Spartan Cote WB II 20 Percent.
 - f. Euclid Chemical Company (The), an RPM company; Diamond Clear VOX; Clearseal WB STD.
 - g. Kaufman Products, Inc.; SureCure Emulsion.
 - h. Lambert Corporation; Glazecote Sealer-20.
 - i. L&M Construction Chemicals, Inc.; Dress & Seal WB.
 - j. Meadows, W. R., Inc.; Vocomp-20.
 - k. Metalcrete Industries; Metcure 0800.
 - l. Nox-Crete Products Group; Cure & Seal 200E.
 - m. Symons by Dayton Superior; Cure & Seal 18 Percent E.
 - n. Vexcon Chemicals, Inc.; Starseal 0800.
 - o. **<Insert manufacturer's name>**
 - p. or approved equal.

- H. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals - Building Systems; Kure-N-Seal 25 LV.
 - b. ChemMasters; Spray-Cure & Seal Plus.
 - c. Conspec by Dayton Superior; Sealcure 1315.
 - d. Dayton Superior Corporation; Day-Chem Cure and Seal (J-22UV).
 - e. Edoco by Dayton Superior; Cureseal 1315.
 - f. Euclid Chemical Company (The), an RPM company; Super Diamond Clear; LusterSeal 300.
 - g. Kaufman Products, Inc.; Sure Cure 25.
 - h. Lambert Corporation; UV Super Seal.
 - i. L&M Construction Chemicals, Inc.; Lumiseal Plus.
 - j. Meadows, W. R., Inc.; CS-309/30.
 - k. Metalcrete Industries; Seal N Kure 30.
 - l. Right Pointe; Right Sheen 30.
 - m. Vexcon Chemicals, Inc.; Certi-Vex AC 1315.
 - n. **<Insert manufacturer's name>**
 - o. or approved equal.
 2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- I. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals - Building Systems; Kure 1315.
 - b. ChemMasters; Polyseal WB.
 - c. Conspec by Dayton Superior; Sealcure 1315 WB.
 - d. Edoco by Dayton Superior; Cureseal 1315 WB.
 - e. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.
 - f. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
 - g. Lambert Corporation; UV Safe Seal.
 - h. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
 - i. Meadows, W. R., Inc.; Vocomp-30.
 - j. Metalcrete Industries; Metcure 30.
 - k. Right Pointe; Right Sheen WB30.
 - l. Symons by Dayton Superior; Cure & Seal 31 Percent E.
 - m. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.
 - n. **<Insert manufacturer's name>**
 - o. or approved equal.
 2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method

24).

2.12 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: [**ASTM D 1751, asphalt-saturated cellulosic fiber**] [or] [**ASTM D 1752, cork or self-expanding cork**].
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, [**epoxy resin with a Type A shore durometer hardness of 80**] [**aromatic polyurea with a Type A shore durometer hardness range of 90 to 95**] per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion, or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. [**Types I and II, non-load bearing**] [**Types IV and V, load bearing**], for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Reglets: Fabricate reglets of not less than **0.022-inch- (0.55-mm-)** thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than **0.034 inch (0.85 mm)** thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.13 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from **1/8 inch (3.2 mm)** and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, **1/8 to 1/4 inch (3.2 to 6 mm)** or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than [**4100 psi (29 MPa)**] **<Insert strength>** at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from **1/4 inch (6.4 mm)** and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic

- cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, **1/8 to 1/4 inch** (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than **[5000 psi (34.5 MPa)]** <Insert strength> at 28 days when tested according to ASTM C 109/C 109M.

2.14 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: **[Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, by not less than 40 percent.] [Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:]**
 1. Fly Ash: 25 percent.
 2. Combined Fly Ash and Pozzolan: 25 percent.
 3. Ground Granulated Blast-Furnace Slag: 50 percent.
 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent Portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
- C. Retain three subparagraphs below if silica fume is permitted. Limits of silica fume alone or in combination with other cementitious materials below are based on ACI 301 and ACI 318 (ACI 318M).
 1. Silica Fume: 10 percent.
 2. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
 3. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- D. Limit water-soluble, chloride-ion content in hardened concrete to **[0.06] [0.15] [0.30] [1.00]** percent by weight of cement.
- E. Admixtures: Use admixtures according to manufacturer's written instructions.
 1. Use **[water-reducing] [high-range water-reducing] [or] [plasticizing]** admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- F. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.15 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: [**5000 psi (34.5 MPa)**] [**4500 psi (31 MPa)**] [**4000 psi (27.6 MPa)**] [**3500 psi (24.1 MPa)**] [**3000 psi (20.7 MPa)**] <Insert strength> at 28 days.
2. Maximum Water-Cementitious Materials Ratio: [**0.50**] [**0.45**] [**0.40**] <Insert ratio>.
3. Slump Limit: [**4 inches (100 mm)**] [**5 inches (125 mm)**] [**8 inches (200 mm)**] for **concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture**] <Insert dimension>, plus or minus 1 inch (25 mm).
4. Air Content: [**5.5**] <Insert number> percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
5. Air Content: [**6**] <Insert number> percent, plus or minus 1.5 percent at point of delivery for [**1-inch (25-mm)**] [**3/4-inch (19-mm)**] nominal maximum aggregate size.

B. Foundation Walls: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: [**5000 psi (34.5 MPa)**] [**4500 psi (31 MPa)**] [**4000 psi (27.6 MPa)**] [**3500 psi (24.1 MPa)**] [**3000 psi (20.7 MPa)**] <Insert strength> at 28 days.
2. Maximum Water-Cementitious Materials Ratio: [**0.50**] [**0.45**] [**0.40**] <Insert ratio>.
3. Slump Limit: [**4 inches (100 mm)**] [**5 inches (125 mm)**] [**8 inches (200 mm)**] for **concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture**] <Insert dimension>, plus or minus 1 inch (25 mm).
4. Air Content: [**5.5**] <Insert number> percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
5. Air Content: [**6**] <Insert number> percent, plus or minus 1.5 percent at point of delivery for [**1-inch (25-mm)**] [**3/4-inch (19-mm)**] nominal maximum aggregate size.

C. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: [**5000 psi (34.5 MPa)**] [**4500 psi (31 MPa)**] [**4000 psi (27.6 MPa)**] [**3500 psi (24.1 MPa)**] [**3000 psi (20.7 MPa)**] <Insert strength> at 28 days.

2. Minimum Cementitious Materials Content: **[470 lb/cu. yd. (279 kg/cu. m)] [520 lb/cu. yd. (309 kg/cu. m)] [540 lb/cu. yd. (320 kg/cu. m)]**.
3. Slump Limit: **[4 inches (100 mm)] [5 inches (125 mm)]**, plus or minus **1 inch (25 mm)**.
4. Air Content: **[5.5] <Insert number>** percent, plus or minus 1.5 percent at point of delivery for **1-1/2-inch (38-mm)** nominal maximum aggregate size.
5. Air Content: **[6] <Insert number>** percent, plus or minus 1.5 percent at point of delivery for **[1-inch (25-mm)] [3/4-inch (19-mm)]** nominal maximum aggregate size.
6. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
7. Steel-Fiber Reinforcement: Add to concrete mixture, according to manufacturer's written instructions, at a rate of **[50 lb/cu. yd. (29.7 kg/cu. m)] <Insert weight>**.
8. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than **[1.0 lb/cu. yd. (0.60 kg/cu. m)] [1.5 lb/cu. yd. (0.90 kg/cu. m)] <Insert dosage>**.
9. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than **[4.0 lb/cu. yd. (2.4 kg/cu. m)] [5 lb/cu. yd. (3 kg/cu. m)] <Insert dosage>**.

D. Suspended Slabs: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: **[5000 psi (34.5 MPa)] [4500 psi (31 MPa)] [4000 psi (27.6 MPa)] [3500 psi (24.1 MPa)] [3000 psi (20.7 MPa)] <Insert strength>** at 28 days.
2. Minimum Cementitious Materials Content: **[470 lb/cu. yd. (279 kg/cu. m)] [520 lb/cu. yd. (309 kg/cu. m)] [540 lb/cu. yd. (320 kg/cu. m)]**.
3. Slump Limit: **[4 inches (100 mm)] [5 inches (125 mm)]**, plus or minus **1 inch (25 mm)**.
4. Air Content: **[5.5] <Insert number>** percent, plus or minus 1.5 percent at point of delivery for **1-1/2-inch (38-mm)** nominal maximum aggregate size.
5. Air Content: **[6] <Insert number>** percent, plus or minus 1.5 percent at point of delivery for **[1-inch (25-mm)] [3/4-inch (19-mm)]** nominal maximum aggregate size.
6. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
7. Steel-Fiber Reinforcement: Add to concrete mixture, according to manufacturer's written instructions, at a rate of **[50 lb/cu. yd. (29.7 kg/cu. m)] <Insert weight>**.
8. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than **[1.0 lb/cu. yd. (0.60 kg/cu. m)] [1.5 lb/cu. yd. (0.90 kg/cu. m)] <Insert dosage>**.
9. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than **[4.0 lb/cu. yd. (2.4 kg/cu. m)] [5 lb/cu. yd. (3 kg/cu. m)] <Insert dosage>**.

E. Suspended Slabs: Proportion structural lightweight concrete mixture as follows:

1. Minimum Compressive Strength: **[5000 psi (34.5 MPa)] [4500 psi (31 MPa)] [4000 psi (27.6 MPa)] [3500 psi (24.1 MPa)] [3000 psi (20.7 MPa)] <Insert strength>** at 28 days.

2. Calculated Equilibrium Unit Weight: [**115 lb/cu. ft. (1842 kg/cu. m)**] [**110 lb/cu. ft. (1762 kg/cu. m)**] [**105 lb/cu. ft. (1682 kg/cu. m)**], plus or minus 3 lb/cu. ft. (48.1 kg/cu. m) as determined by ASTM C 567.
3. Slump Limit: [**4 inches (100 mm)**] [**5 inches (125 mm)**], plus or minus 1 inch (25 mm).
4. Air Content: 6 percent, plus or minus 2 percent at point of delivery for nominal maximum aggregate size greater than 3/8 inch (10 mm).
5. Air Content: 7 percent, plus or minus 2 percent at point of delivery for nominal maximum aggregate size 3/8 inch (10 mm) or less.
6. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
7. Steel-Fiber Reinforcement: Add to concrete mixture, according to manufacturer's written instructions, at a rate of [**50 lb/cu. yd. (29.7 kg/cu. m)**] <Insert weight>.
8. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than [**1.0 lb/cu. yd. (0.60 kg/cu. m)**] [**1.5 lb/cu. yd. (0.90 kg/cu. m)**] <Insert dosage>.
9. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than [**4.0 lb/cu. yd. (2.4 kg/cu. m)**] [**5 lb/cu. yd. (3 kg/cu. m)**] <Insert dosage>.

F. Concrete Toppings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: [**5000 psi (34.5 MPa)**] [**4500 psi (31 MPa)**] [**4000 psi (27.6 MPa)**] [**3500 psi (24.1 MPa)**] [**3000 psi (20.7 MPa)**] <Insert strength> at 28 days.
2. Minimum Cementitious Materials Content: [**470 lb/cu. yd. (279 kg/cu. m)**] [**520 lb/cu. yd. (309 kg/cu. m)**] [**540 lb/cu. yd. (320 kg/cu. m)**].
3. Slump Limit: [**4 inches (100 mm)**] [**5 inches (125 mm)**], plus or minus 1 inch (25 mm).
4. Air Content: [**5.5**] <Insert number> percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
5. Air Content: [**6**] <Insert number> percent, plus or minus 1.5 percent at point of delivery for [**1-inch (25-mm)**] [**3/4-inch (19-mm)**] nominal maximum aggregate size.
6. Air Content: Do not allow air content of trowel-finished toppings to exceed 3 percent.
7. Steel-Fiber Reinforcement: Add to concrete mixture, according to manufacturer's written instructions, at a rate of [**50 lb/cu. yd. (29.7 kg/cu. m)**] <Insert weight>.
8. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than [**1.0 lb/cu. yd. (0.60 kg/cu. m)**] [**1.5 lb/cu. yd. (0.90 kg/cu. m)**] <Insert dosage>.
9. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than [**4.0 lb/cu. yd. (2.4 kg/cu. m)**] [**5 lb/cu. yd. (3 kg/cu. m)**] <Insert dosage>.

G. Building Frame Members: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: [**5000 psi (34.5 MPa)**] [**4500 psi (31 MPa)**] [**4000 psi (27.6 MPa)**] [**3500 psi (24.1 MPa)**] [**3000 psi (20.7 MPa)**] <Insert strength> at 28 days.
2. Maximum Water-Cementitious Materials Ratio: [**0.50**] [**0.45**] [**0.40**] <Insert ratio>.

3. Slump Limit: **[4 inches (100 mm)] [5 inches (125 mm)] [8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture]** <Insert dimension>, plus or minus 1 inch (25 mm).
4. Air Content: **[5.5]** <Insert number> percent, plus or minus 1.5 percent at point of delivery for **1-1/2-inch (38-mm)** nominal maximum aggregate size.
5. Air Content: **[6]** <Insert number> percent, plus or minus 1.5 percent at point of delivery for **[1-inch (25-mm)] [3/4-inch (19-mm)]** nominal maximum aggregate size.

H. Building Walls: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: **[5000 psi (34.5 MPa)] [4500 psi (31 MPa)] [4000 psi (27.6 MPa)] [3500 psi (24.1 MPa)] [3000 psi (20.7 MPa)]** <Insert strength> at 28 days.
2. Maximum Water-Cementitious Materials Ratio: **[0.50] [0.45] [0.40]** <Insert ratio>.
3. Slump Limit: **[4 inches (100 mm)] [5 inches (125 mm)] [8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture]** <Insert dimension>, plus or minus 1 inch (25 mm).
4. Air Content: **[5.5]** <Insert number> percent, plus or minus 1.5 percent at point of delivery for **1-1/2-inch (38-mm)** nominal maximum aggregate size.
5. Air Content: **[6]** <Insert number> percent, plus or minus 1.5 percent at point of delivery for **[1-inch (25-mm)] [3/4-inch (19-mm)]** nominal maximum aggregate size.

2.16 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.17 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M[**and ASTM C 1116/C 1116M**], and furnish batch ticket information.

1. When air temperature is between **85 and 90 deg F (30 and 32 deg C)**, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above **90 deg F (32 deg C)**, reduce mixing and delivery time to 60 minutes.

- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of **1 cu. yd. (0.76 cu. m)** or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than **1 cu. yd. (0.76 cu. m)**, increase mixing time by 15 seconds for each additional **1 cu. yd. (0.76 cu. m)**.

3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 1. **[Class A, 1/8 inch (3.2 mm)]** <Insert dimension> for smooth-formed finished surfaces.
 2. **[Class B, 1/4 inch (6 mm)] [Class C, 1/2 inch (13 mm)] [Class D, 1 inch (25 mm)]** <Insert dimension> for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 1. Install keyways, reglets, recesses, and the like, for easy removal.
 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. **[Chamfer] [Do not chamfer]** exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than **50 deg F (10 deg C)** for **[24] <Insert number>** hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved[**at least 70 percent of**] its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by DEN Project Manager.

3.4 SHORES AND RESHORES

- A. Comply with **ACI 318 (ACI 318M)** and ACI 301 for design, installation, and removal of

shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints **6 inches** (150 mm) and seal with manufacturer's recommended tape.

B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.

C. Granular Course: Cover vapor retarder with [**granular fill**] [**fine-graded granular material**], moisten, and compact with mechanical equipment to elevation tolerances of plus **0 inch** (0 mm) or minus **3/4 inch** (19 mm).

1. Place and compact a **1/2-inch-** (13-mm-) thick layer of fine-graded granular material over granular fill.

3.6 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.
- G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.

3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated, and as approved by DEN Project Manager. Coordinate locations of all construction joints with flooring materials, and review with DEN Project Manager.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least **1-1/2 inches (38 mm)** into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls [**as indicated**] **<Insert spacing>**. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated, and as approved by DEN Project Manager. Coordinate locations of all construction joints with flooring materials, and review with DEN Project Manager. Construct contraction joints for a depth equal to at least [**one-fourth**] **<Insert depth>** of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of **1/8 inch (3.2 mm)**. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

2. Sawn Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut **1/8-inch- (3.2-mm-)** wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than **1/2 inch (13 mm)** or more than **1 inch (25 mm)** below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.9 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by DEN Project Manager.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause

seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least **6 inches (150 mm)** into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below **40 deg F (4.4 deg C)** for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved by DEN Project Manager in mixture designs.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below **90 deg F (32 deg C)** at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.10 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces [**not exposed to public view**] **<Insert locations>**.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces [**exposed to public view,**] [**to receive a rubbed finish,**] [**to be covered with a coating or covering material applied directly to concrete**] **<Insert locations>**.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part Portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part Portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of **1/4 inch (6 mm)** in one direction.
1. Apply scratch finish to surfaces **[indicated] [and] [to receive concrete floor toppings] [to receive mortar setting beds for bonded cementitious floor finishes] <Insert locations>**.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces **[indicated] [to receive trowel finish] [and] [to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo] <Insert locations>**.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces **[indicated] [exposed to view] [or] [to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system] <Insert locations>**.
 2. Finish surfaces to the following tolerances, according to **ASTM E 1155 (ASTM E 1155M)**, for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
 - b. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
 - c. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.
 - d. Specified overall values of flatness, F(F) 45; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 24.
 3. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, **10-ft.- (3.05-m-)** long straightedge resting on two high spots and placed anywhere on the surface does not exceed **[1/4 inch (6 mm)] [3/16 inch (4.8 mm)] [1/8 inch (3.2 mm)]**.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces **[indicated] [where ceramic or quarry tile is to be installed by either thickset or thin-set method]**. While concrete is still plastic, slightly scarify surface with a fine broom.
1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with DEN Project Manager before application.
- G. Slip-Resistive Finish: Before final floating, apply slip-resistive [**aggregate**] [**aluminum granule**] finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:
1. Uniformly spread [**25 lb/100 sq. ft. (12 kg/10 sq. m)**] <Insert rate> of dampened slip-resistive [**aggregate**] [**aluminum granules**] over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
 2. After broadcasting and tamping, apply float finish.
 3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive [**aggregate**] [**aluminum granules**].
- H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows:
1. Uniformly apply dry-shake floor hardener at a rate of [**100 lb/100 sq. ft. (49 kg/10 sq. m)**] <Insert rate> unless greater amount is recommended by manufacturer.
 2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
 3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching $0.2 \text{ lb/sq. ft.} \times \text{h}$ ($1 \text{ kg/sq. m} \times \text{h}$) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with **12-inch** (300-mm) lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least **12 inches** (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

- c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer[**unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project**].
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 2. Do not apply to concrete that is less than **[three] [seven] [14] [28]** days' old.
 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- B. Polished Concrete Floor Treatment: Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
 1. Machine grind floor surfaces to receive polished finishes level and smooth **[and to depth required to reveal aggregate to match approved mockup]**.
 2. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
 3. Continue polishing with progressively finer grit diamond polishing pads to gloss level to match approved mockup.
 4. Control and dispose of waste products produced by grinding and polishing operations.
 5. Neutralize and clean polished floor surfaces.

- C. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least **[one] [six] <Insert number>** month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least **2 inches** (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by DEN Project Manager. Remove and replace concrete that cannot be repaired and patched to DEN Project Manager's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a **No. 16** (1.18-mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than **1/2 inch** (13 mm) in any dimension to solid concrete. Limit cut depth to **3/4 inch** (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by DEN Project Manager.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a

sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to DEN Project Manager's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to DEN Project Manager's approval.

3.17 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector [**and qualified testing and inspecting agency**] to perform field tests and inspections and prepare test reports.

B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; **[ASTM C 173/C 173M, volumetric method, for structural lightweight concrete;]**one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure one set of five (5) standard cylinder specimens for each composite sample.
 - b. Cast and field cure one set of five (5) standard cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C 39/C 39M.
 - a. Test one (1) set of two (2) field-cured specimens at 7 days and one (1) set of two (2) specimens at 28 days. One (1) specimen shall be held in reserve for additional testing as needed.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than **500 psi (3.4 MPa)**.
 10. Test results shall be reported in writing to DEN Project Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by DEN Project Manager but will not be used as sole basis for approval or rejection of concrete.
 12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by DEN Project Manager. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by DEN Project Manager.
 13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. Measure floor and slab flatness and levelness according to **ASTM E 1155 (ASTM E 1155M)** within **[24] [48] <Insert number>** hours of finishing.

3.18 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 033000

SECTION 033053 - MISCELLANEOUS CAST-IN-PLACE CONCRETE (LIMITED APPLICATIONS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including reinforcement, concrete materials, mixture design, placement procedures, and finishes.
- B. Related Sections:
 - 1. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.
 - 2. Section 321313 "Concrete Paving (CDOT)" for concrete pavement and walks.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. General: In addition to the following, comply with submittal requirements in ACI 301.
- B. Product Data: For each type of product indicated.
 - 1. Include data substantiating that materials comply with requirements.
- C. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Design Mixtures for Credit ID 1.1: For each concrete mixture containing fly ash as a replacement for Portland cement or other Portland cement replacements. For each design mixture submitted, include an equivalent concrete mixture that does not contain Portland cement replacements, to determine amount of Portland cement replaced.
- D. Other Action Submittal:

1. Design Mixtures: For each concrete mixture.

1.4 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
- C. Source Limitations: Obtain each type of cement of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.
- D. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- E. Comply with the following sections of [ACI 301](#) (ACI 301M), unless modified by requirements in the Contract Documents:
 1. "General Requirements."
 2. "Formwork and Formwork Accessories."
 3. "Reinforcement and Reinforcement Supports."
 4. "Concrete Mixtures."
 5. "Handling, Placing, and Constructing."
 6. "Lightweight Concrete."
- F. Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

1.6 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 FORMWORK

- A. Furnish formwork and formwork accessories according to [ACI 301](#) (ACI 301M).

2.2 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25] [60] <Insert number>** percent.
- B. Reinforcing Bars: ASTM A 615/A 615M, [Grade 60](#) (Grade 420), deformed.
- C. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.
- D. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.
- E. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout Project:
1. Portland Cement: ASTM C 150, **[Type I] [Type II] [Type I/II] [Type III] [Type V].**
Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class C or F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
 2. Blended Hydraulic Cement: ASTM C 595, **[Type IS, Portland blast-furnace slag] [Type IP, Portland-pozzolan] [Type I (PM), pozzolan-modified Portland] [Type I (SM), slag-modified Portland]** cement.
- B. Normal-Weight Aggregate: ASTM C 33, graded, **[1-1/2-inch (38-mm)] <Insert dimension>** nominal maximum aggregate size.
- C. Lightweight Aggregate: ASTM C 330, **[1-inch (25-mm)] <Insert dimension>** nominal maximum aggregate size.
- D. Water: ASTM C 94/C 94M.
- E. Synthetic Fiber: **[Monofilament] [or] [fibrillated]** polypropylene fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, **[1/2 to 1-1/2 inches (13 to 38 mm)] <Insert dimensions>** long.

2.4 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures.
- B. Air-Entraining Admixture: ASTM C 260.
- C. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.5 RELATED MATERIALS

- A. Vapor Retarder: Multi-ply reinforced polyethylene sheet, ASTM E 1745, Class C, not less than 7.8 mils thick; or polyethylene sheet, ASTM D 4397, not less than 10 mils thick.
- B. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.
- C. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and man-ufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a No. 4 sieve and 10 to 30 percent passing a No. 100 sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

2.6 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth or cotton mats.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.

- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
- F. Clear, **[Waterborne] [Solvent-Borne]**, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.7 CONCRETE MIXTURES

- A. Comply with **ACI 301 (ACI 301M)** requirements for concrete mixtures.
- B. Normal-Weight Concrete: Prepare design mixes, proportioned according to **ACI 301 (ACI 301M)**, as follows:
 - 1. Minimum Compressive Strength: **[4500 psi (31 MPa)] [4000 psi (27.6 MPa)] [3500 psi (24.1 MPa)] [3000 psi (20.7 MPa)] <Insert strength>** at 28 days.
 - 2. Maximum Water-Cementitious Materials Ratio: **[0.50] [0.45] <Insert ratio>**.
 - 3. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, by not less than 40 percent.
 - 4. Slump Limit: **[4 inches (100 mm)] [5 inches (125 mm)] [8 inches (200 mm)] for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture] <Insert dimension>**, plus or minus 1 inch (25 mm).
 - 5. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 2.5 to 4.5 percent.
 - 6. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 6.0 percent within a tolerance of plus 1.0 or minus 1.5 percent.
 - 7. Air Content: Maintain within range permitted by **ACI 301 (ACI 301M)**. Do not allow air content of trowel-finished floor slabs to exceed 3 percent.
- C. Structural Lightweight Concrete Mix: ASTM C 330, proportioned to produce concrete with a minimum compressive strength of **[3000 psi (20.7 MPa)] <Insert strength>** at 28 days and a calculated equilibrium unit weight of **[110 lb/cu. ft. (1762 kg/cu. m)] <Insert weight>** plus or minus 3 lb/cu. ft. (48.1 kg/cu. m), as determined by ASTM C 567. Concrete slump at point of placement shall be the minimum necessary for efficient mixing, placing, and finishing.
 - 1. Limit slump to 5 inches (125 mm) for troweled slabs and 4 inches (100 mm) for other slabs.
- D. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate but not less than a rate of **[1.0 lb/cu. yd. (0.60 kg/cu. m)] [1.5 lb/cu. yd. (0.90 kg/cu. m)] <Insert rate>**.

2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM

C 94/C 94M[**and ASTM C 1116/C 1116**], and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes.
 2. When air temperature is above **90 deg F (32 deg C)**, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For mixer capacity of **1 cu. yd. (0.76 cu. m)** or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 2. For mixer capacity larger than **1 cu. yd. (0.76 cu. m)**, increase mixing time by 15 seconds for each additional **1 cu. yd. (0.76 cu. m)**.
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, construct, erect, brace, and maintain formwork according to **ACI 301**.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR RETARDERS

- A. Install, protect, and repair vapor retarders according to ASTM E 1643; place sheets in position with longest dimension parallel with direction of pour.
1. Lap joints **6 inches (150 mm)** and seal with manufacturer's recommended adhesive or joint tape.
 2. Cover vapor retarder with fine-graded granular material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch.

3.4 STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Locate and install so strength and appearance of concrete are not impaired, at locations indicated or as approved by DEN Project Manager.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least **[one-fourth]** <Insert depth> of concrete thickness, as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool to a radius of **1/8 inch (3.2 mm)**. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut **1/8-inch- (3.2-mm-)** wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints: Install joint-filler strips at junctions with slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint fillers full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

3.6 CONCRETE PLACEMENT

- A. Comply with **ACI 301 (ACI 301M)** for placing concrete.
- B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of **ACI 301 (ACI 301M)**.
- C. Do not add water to concrete during delivery, at Project site, or during placement.
- D. Consolidate concrete with mechanical vibrating equipment.

3.7 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding $1/4$ inch (7 mm).
1. Apply to concrete surfaces [**not exposed to public view**] <Insert locations>.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Completely remove fins and other projections.
1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.
 2. Do not apply rubbed finish to smooth-formed finish.
 3. Rubbed Finish: Apply the following rubbed finish, defined in [ACI 301 \(ACI 301M\)](#), to smooth-formed finished as-cast concrete where indicated:
 - a. Smooth-rubbed finish.
 - b. Grout-cleaned finish.
 - c. Cork-floated finish.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.8 FINISHING UNFORMED SURFACES

- A. General: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on surface.
1. Do not further disturb surfaces before starting finishing operations.
- C. Scratch Finish: Apply scratch finish to surfaces indicated and surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, Portland cement terrazzo, and other bonded cementitious floor finishes, unless otherwise indicated.
- D. Float Finish: Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, fluid-applied or direct-to-deck-applied membrane roofing, or sand-bed terrazzo.

- E. Trowel Finish: Apply a hard trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system.
- F. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set methods. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.
- G. Nonslip Broom Finish: Apply a nonslip broom finish to surfaces indicated and to exterior concrete platforms, steps, and ramps. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

3.9 TOLERANCES

- A. Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

3.10 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 (ACI 301M) for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- D. Curing Methods: Cure formed and unformed concrete for at least seven days by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with

moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least **12 inches** (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Tests: Perform according to **ACI 301** (ACI 301M).
 1. Testing Frequency: One composite sample shall be obtained for each day's pour of each concrete mix exceeding **5 cu. yd.** (4 cu. m) but less than **25 cu. yd.** (19 cu. m), plus one set for each additional **50 cu. yd.** (38 cu. m) or fraction thereof.
 2. Testing Frequency: One composite sample shall be obtained for each **100 cu. yd.** (76 cu. m) or fraction thereof of each concrete mix placed each day.

3.12 REPAIRS

- A. Remove and replace concrete that does not comply with requirements in this Section.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

TECHNICAL SPECIFICATIONS
03 CONCRETE
033053
MISCELLANEOUS CAT-IN-PLACE CONCRETE (LIMITED
APPLICATIONS)

DENVER INTERNATIONAL AIRPORT
DEN TECH SPECS 2016
CONTRACT NO.00000

END OF SECTION 033053

SECTION 033300 - ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place architectural concrete including form facings, reinforcement accessories, concrete materials, concrete mixture design, placement procedures, and finishes.
- B. Comply with all requirements of Section 033000 "Cast-In-Place Concrete".
- C. Related Requirements:
 - 1. Section 033000 "Cast-In-Place Concrete" for general building and structural concrete applications, mixtures, formwork, reinforcing, finishing, and curing.
 - 2. Section 079200 "Joint Sealants" for elastomeric joint sealants in contraction and other joints in cast-in-place architectural concrete.
 - 3. Section 321313 "Concrete Paving (CDOT)" for concrete pavement and flatwork finishes.
 - 4. Section 321316 "Decorative Concrete Paving" for surface-imprinted concrete pavement and finishes.
- D. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 DEFINITIONS

- A. Cast-in-Place Architectural Concrete: Formed concrete that is exposed to view on surfaces of completed structure or building and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.
- B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.
- C. Retain "Design Reference Sample" Paragraph below if design reference sample, chosen by DEN Project Manager during Contract documentation, is proposed.

- D. Design Reference Sample: Sample designated by DEN Project Manager in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural concrete.
- E. Reveal: Projection of coarse aggregate from matrix or mortar after completion of exposure operations.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place architectural concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Cast-in-place architectural concrete subcontractor.
 - 2. Review **[concrete finishes and finishing,] [cold- and hot-weather concreting procedures,] [curing procedures,] [construction joints,] [forms and form-removal limitations,] [reinforcement accessory installation,] [concrete repair procedures,]** and protection of cast-in-place architectural concrete.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4.1[**and Credit MR 4.2**]: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Design Mixtures for Credit ID 1.1: For each concrete mixture containing fly ash as a replacement for Portland cement or other Portland cement replacements and for equivalent concrete mixtures that do not contain Portland cement replacements.
- C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.

- D. Formwork Shop Drawings: Show formwork construction including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.
- E. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints including construction joints.
- F. Samples: For each of the following materials:
 - 1. Form-facing panel.
 - 2. Form ties.
 - 3. Form liners.
 - 4. Coarse- and fine-aggregate gradations.
 - 5. Chamfers and rustications.
- G. Samples for Verification: Architectural concrete Samples, cast vertically, approximately **18 by 18 by 2 inches** (450 by 450 by 50 mm), of finishes, colors, and textures to match design reference sample. Include Sample sets showing the full range of variations expected in these characteristics. Review by DEN Project Manager will be for color and texture only.
- H. Product data: Submit product data for concrete sealer.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[manufacturer] [testing agency]**.
- B. Material Certificates: For each of the following:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Repair materials.
- C. Material Test Reports: For the following, by a qualified testing agency:
 - 1. Aggregates. **[Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity].**

1.7 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies: Comply with air pollution regulations of governing authorities.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "NRMCA Quality Control Manual - Section 3, Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 2. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. Source Limitations for Cast-in-Place Architectural Concrete: Obtain each color, size, type, and variety of concrete material and concrete mixture from single manufacturer with resources to provide cast-in-place architectural concrete of consistent quality in appearance and physical properties.
- E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specification for Structural Concrete," [**Sections 1 through 5.**] [**Sections 1 through 5 and Section 6, "Architectural Concrete."**]
 2. ACI 303.1, "Specification for Cast-in-Place Architectural Concrete."
- F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- G. Field Sample Panels: After approval of verification sample and before casting architectural concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, cast vertically, approximately **48 by 48 by 6 inches** (1200 by 1200 by 150 mm) minimum, to demonstrate the expected range of finish, color, and texture variations.
1. Locate panels as indicated or, if not indicated, as directed by DEN Project Manager.
 2. Demonstrate methods of curing, aggregate exposure, sealers, and coatings, as applicable.

3. In presence of DEN Project Manager, damage part of an exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
 4. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
 5. Demolish and remove field sample panels when directed.
- H. Mockups: Before casting architectural concrete, build mockups to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in the location and of the size indicated or, if not indicated, as directed by DEN Project Manager. Provide workmanship and procedures as required to match DEN Project Manager's finish samples.
 2. Build mockups of typical exterior wall of cast-in-place architectural concrete as shown on Drawings.
 3. Demonstrate curing, cleaning, and protecting of cast-in-place architectural concrete, finishes, and contraction joints, as applicable.
 4. In presence of DEN Project Manager, damage part of the exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
 5. Obtain DEN Project Manager's approval of mockups before casting architectural concrete.
 6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- I. Installer to submit a certificate evidencing a minimum three (3) years experience successfully providing finishes of types required.
- J. Liquid Waterproofing Manufacturer's Service:
1. Prior to commencement of liquid waterproofing work, manufacturer shall inspect all surfaces to be treated. All deficiencies or flaws in the overall construction of the substrate at issue which would ultimately effect the performance or application of the liquid waterproof coating shall be noted in writing and a copy delivered to the following parties:
 - a. Waterproofing Contractor.
 - b. General Contractor.
 - c. DEN Project Manager.
 2. Manufacturer's representative shall be present at commencement of liquid waterproofing material application to assure utilization of proper equipment, verify material quantities, supervise material application techniques, and supervise the onset application of liquid waterproofing material upon a substantial wall section which shall act as a comparative standard for the project.
 3. Manufacturer's representative will inspect all treated surfaces after application of

liquid waterproofing materials to assure complete product utilization and material performance.

- K. Liquid Waterproofing Contractor's Requirements: Contractor shall comply with recommendations and instructions set forth by manufacturer as part of manufacturer's service and the following:
1. Contractor shall certify that quantity of liquid waterproofing is sufficient to meet manufacturer's minimum surface area coverage recommendations.
 2. Contractor shall not proceed with application of liquid waterproofing material until such time that all deficiencies previously noted in the manufacturer's pre-application inspection have been properly corrected.
 3. Contractor shall notify manufacturer no less than 72 hours prior to commencement of waterproofing work. Manufacturer's representative shall be present at job commencement to verify material quantities, inspect application equipment, and supervise application start-up.
 4. Contractor shall not proceed with material application until such time that the Manufacturer has issued a Certificate of Pre-Application Inspection and written verification of specified material quantity purchase. Submit certificate to the DEN Project Manager.
- L. Provide a certificate stating that final sealer is compatible with curing sealing compound.

1.9 PROJECT CONDITIONS

- A. Perform abrasive blasting within 240 hours after casting. Coordinate with formwork construction, concrete placement schedule, and formwork removal to ensure that surfaces to be blast finished are blasted at same age for uniform results.
- B. Allow concrete to cure not less than 24 hours before commencing surface finish operations, unless otherwise acceptable to DEN Project Manager.
- C. Protect adjacent materials and finishes from dust, dirt and other surface or physical damage during finishing operations. Provide protections as required and remove from site at completion of work.
- D. Repair or replace other work damaged by finishing operations, as directed by DEN Project Manager.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. General: Comply with Section 033000 "Cast-in-Place Concrete" for formwork and other form-facing material requirements.
- B. Use materials and methods for project work as used to produce sample finishes acceptable to DEN Project Manager.
- C. Form-Facing Panels for **[As-Cast] [Exposed-Aggregate]** Finishes: Steel, glass-fiber-reinforced plastic, or other approved nonabsorptive panel materials that will provide continuous, true, and smooth architectural concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- D. Form-Facing Panels for **[As-Cast] [Exposed-Aggregate]** Finishes: Exterior-grade plywood panels, nonabsorptive, that will provide continuous, true, and smooth architectural concrete surfaces, **[high-density overlay, Class 1, or better] [medium-density overlay, Class 1, or better, mill-applied release agent and edge sealed]**, complying with DOC PS 1[, or Finnish phenolic overlaid birch plywood].
- E. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will provide surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- F. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- G. Form Liners: Units of face design, texture, arrangement, and configuration **[indicated] [to match design reference sample]**. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface treatments of concrete.
- H. Rustication Strips: Metal, rigid plastic, or dressed wood with sides beveled and back kerfed; nonstaining; in longest practicable lengths.
- I. Chamfer Strips: Metal, rigid plastic, elastomeric rubber, or dressed wood, **3/4 by 3/4 inch (19 by 19 mm)**, minimum; nonstaining; in longest practicable lengths.
- J. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800, "Specification 810.1, Expanded Cellular Glazing Tape"; minimum **1/4 inch (6 mm)** thick.
- K. Form Joint Sealant: Elastomeric sealant complying with ASTM C 920, Type M or Type S, Grade NS that adheres to form joint substrates.
- L. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood.

- M. Form-Release Agent: Commercially formulated, colorless form-release agent that will not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments of those surfaces.
1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- N. Surface Retarder: Chemical liquid set retarder, for application on form-facing materials, capable of temporarily delaying final hardening of newly placed concrete surface to depth of reveal specified.
- O. Form Ties: Factory-fabricated, **[glass-fiber-reinforced plastic]** **[internally disconnecting]** **[or]** **[removable]** ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
1. Furnish ties **[with tapered tie cone spreaders]** that, when removed, will leave holes **[3/4 inch (19 mm)]** **[1 inch (25 mm)]** **[1-1/4 inches (32 mm)]** **[1-1/2 inches (38 mm)]** **<Insert dimension>** in diameter on concrete surface.
 2. Furnish internally disconnecting ties that will leave no metal closer than **1-1/2 inches (38 mm)**, **[after exposing aggregate,]** from the architectural concrete surface.
 3. Furnish glass-fiber-reinforced plastic ties, not less than **1/2 inch (13 mm)** in diameter, of color **[to match DEN Project Manager's sample]** **[selected by DEN Project Manager]** from manufacturer's full range.
 4. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.
- P. Concrete Sealer: Siloxane, 5% to 7% solids, 100% absorption, solvent based. Subject to compliance with requirements, provide one of the following:
1. ProSoCo Siloxane, Rainguard STD with Microloc.
 2. Euclid Chemical Euco Weatherguard.
 3. Tamms Industries Baracade 6%.
 4. Okon W-1.
 5. **<Insert manufacturer's name>**
 6. or approved equal.

2.2 STEEL REINFORCEMENT AND ACCESSORIES

- A. General: Comply with Section 033000 "Cast-in-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25]** **[60]** **<Insert number>** percent.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire fabric in place; manufacture according to CRSI's "Manual of Standard Practice."
1. Where legs of wire bar supports contact forms, use **[gray, all-plastic]** **[CRSI]**

Class 1, gray, plastic-protected] [or] [CRSI Class 2, stainless-steel] bar supports.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
- Portland Cement: ASTM C 150, **[Type I] [Type II] [Type I/II] [Type III], [gray] [white]. [Supplement with the following:]**
 - Fly Ash: ASTM C 618, **[Class C] [Class F]**.
 - Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or Grade 120.
 - Silica Fume: ASTM C 1240, amorphous silica.
 - Blended Hydraulic Cement: ASTM C 595, **[Type IS, Portland blast-furnace slag] [Type IP, Portland-pozzolan] [Type I (PM), pozzolan-modified Portland] [Type I (SM), slag-modified Portland] cement.**
- B. Normal-Weight Aggregates: ASTM C 33, **[Class 5S] [Class 5M] [Class 1N] <Insert class>** coarse aggregate or better, graded. Provide aggregates from single source **[with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials]**.
- Maximum Coarse-Aggregate Size: **[1 inch (25 mm)] [3/4 inch (19 mm)] [1/2 inch (13 mm)] [3/8 inch (10 mm)]**.
 - Gradation: **[Uniformly] [Gap]** graded.
- C. Normal-Weight Fine Aggregate: **[ASTM C 33] [or] [ASTM C 144]**, manufactured or natural sand, from same source for entire Project.
- D. Water: Potable, complying with ASTM C 94/C 94M except free of wash water from mixer washout operations.

2.4 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
- Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - Retarding Admixture: ASTM C 494/C 494M, Type B.
 - Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.

5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

C. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, [**free of carbon black,**] nonfading, and resistant to lime and other alkalis.

1. Color: [**As indicated by manufacturer's designation**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager** from manufacturer's full range].

2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately **9 oz./sq. yd.** (305 g/sq. m) when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
 1. For integrally colored concrete, curing compound shall be [**pigmented type**] approved by color pigment manufacturer.
 2. For concrete indicated to be sealed, curing compound shall be compatible with sealer.

2.6 REPAIR MATERIALS

- A. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- B. Epoxy Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements.
 1. [**Types I and II, non-load bearing**] [**Types IV and V, load bearing**], for bonding hardened or freshly mixed concrete to hardened concrete.

2.7 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of cast-in-place architectural concrete proportioned on basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 1. Use a qualified independent testing agency for preparing and reporting proposed design mixtures based on laboratory trial mixtures.

- B. Proportion concrete mixtures as follows:
1. Compressive Strength (28 Days): [**5000 psi (34.5 MPa)**] [**4500 psi (31 MPa)**] [**4000 psi (27.6 MPa)**] [**3500 psi (24.1 MPa)**] [**3000 psi (20.7 MPa)**].
 2. Maximum Water-Cementitious Materials Ratio: 0.46.
 3. Slump Limit: [**3 inches (75 mm)**] [**4 inches (100 mm)**] [**8 inches (200 mm)**] **for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture** <Insert dimension(s)>, plus or minus 1 inch (25 mm).
 4. Air Content: [**5-1/2**] <Insert number> percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
 5. Air Content: [**6**] <Insert number> percent, plus or minus 1.5 percent at point of delivery for [**1-inch (25-mm)**] [**3/4-inch (19-mm)**] nominal maximum aggregate size.
- C. Cementitious Materials: For cast-in-place architectural concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than Portland cement according to ACI 301 requirements. [**Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, by not less than 40 percent.**]
- D. Limit water-soluble, chloride-ion content in hardened concrete to [**0.06**] [**0.15**] [**0.30**] [**1.00**] percent by weight of cement.
- E. Admixtures: Use admixtures according to manufacturer's written instructions.
- F. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.8 CONCRETE MIXING

- A. [**Ready-Mixed**] [or] [**Site-Mixed**] Architectural Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.
1. Clean equipment used to mix and deliver cast-in-place architectural concrete to prevent contamination from other concrete.
 2. When air temperature is between **85 and 90 deg F (30 and 32 deg C)**, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above **90 deg F (32 deg C)**, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. General: Comply with Section 033000 "Cast-in-Place Concrete" for formwork, embedded items, and shoring and reshoring.

- B. Limit deflection of form-facing panels to not exceed ACI 303.1 requirements.
- C. In addition to ACI 303.1 limits on form-facing panel deflection, limit cast-in-place architectural concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 - 1. **[Class A, 1/8 inch (3.2 mm)] [Class B, 1/4 inch (6 mm)] [Class C, 1/2 inch (13 mm)].**
- D. Fabricate forms to result in cast-in-place architectural concrete that complies with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 - 1. In addition to ACI 117, comply with the following tolerances: **<Insert tolerances>**.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-in-place surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood rustications, keyways, reglets, recesses, and the like, for easy removal.
 - 1. Seal form joints and penetrations at form ties with form joint tape or form joint sealant to prevent cement paste leakage.
 - 2. Do not use rust-stained steel form-facing material.
- F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- G. **[Chamfer] [Do not chamfer]** exterior corners and edges of cast-in-place architectural concrete.
- H. Coat contact surfaces of wood rustications and chamfer strips with sealer before placing reinforcement, anchoring devices, and embedded items.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
- M. Coat contact surfaces of forms with surface retarder, according to manufacturer's written instructions, before placing reinforcement.

- N. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and attach securely to prevent deflection and maintain stability of liners during concreting. Prevent form liners from sagging and stretching in hot weather. Seal joints of form liners and form liner accessories to prevent mortar leaks. Coat form liner with form-release agent.

3.2 REINFORCEMENT AND INSERTS

- A. General: Comply with Section 033000 "Cast-in-Place Concrete" for fabricating and installing steel reinforcement. Securely fasten steel reinforcement and wire ties against shifting during concrete placement.
- B. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.3 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than **50 deg F (10 deg C)** for 24 hours after placing concrete if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
 - 1. Schedule form removal to maintain surface appearance that matches approved **[field sample panels] [mockups]**.
 - 2. Cut off and grind glass-fiber-reinforced plastic form ties flush with surface of concrete.
- B. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved **[28-day design compressive strength] [at least 70 percent of 28-day design compressive strength]**. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- C. Clean and repair surfaces of forms to be reused in the Work. Do not use split, frayed, delaminated, or otherwise damaged form-facing material. Apply new form-release agent.
- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for cast-in-place architectural concrete surfaces.

3.4 JOINTS

- A. Construction Joints: Install construction joints true to line with faces perpendicular to surface plane of cast-in-place architectural concrete so strength and appearance of concrete are not impaired, at locations indicated or as approved by DEN Project Manager.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.
 2. Form keyed joints as indicated. [**Embed keys at least 1-1/2 inches (38 mm) into concrete.**] Align construction joint within rustications attached to form-facing material.
 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 5. Space vertical joints in walls [**as indicated**] **<Insert spacing>**. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 6. Use [**bonding agent**] [**epoxy-bonding adhesive**] at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- B. Contraction Joints: Form weakened-plane contraction joints true to line with faces perpendicular to surface plane of cast-in-place architectural concrete so strength and appearance of concrete are not impaired, at locations indicated or as approved by DEN Project Manager.

3.5 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, form-release agent, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by DEN Project Manager.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously between construction joints. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 303.1.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least **6 inches (150 mm)** into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. Do not permit vibrators to contact forms.

- E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents.
 4. Do not use chemical accelerators unless otherwise specified and approved in design mixtures.
- F. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.6 PREPARATION

- A. Remove and replace defective concrete that is not properly formed, is out of alignment or level, or displays surface defects, unless DEN Project Manager permits patching or other corrective measures. Permission to patch defective concrete is not a waiver of DEN Project Manager's right to require complete removal of defective work if patching does not, in his opinion, satisfactorily restore quality and appearance of surface.
1. Perform patching, when permitted, in compliance with applicable provisions of this Section.
- B. At exterior concrete, cold joints shall only occur at reveals, coordinate on shop drawings.

3.7 FINISHES, GENERAL

- A. Architectural Concrete Finish: Match DEN Project Manager's design reference sample, identified and described as indicated, to satisfaction of DEN Project Manager.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces.
1. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.
- C. Maintain uniformity of special finishes over construction joints unless otherwise

indicated.

3.8 AS-CAST FORMED FINISHES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections exceeding specified limits on formed-surface irregularities.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Remove fins and other projections exceeding specified limits on formed-surface irregularities. **[Repair] [Do not repair]** and patch tie holes and defects.
- C. Rubbed Finish: Apply the following to smooth-form-finished as-cast concrete where indicated:
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 - 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part Portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match surrounding concrete. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 - 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part Portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match surrounding concrete. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. Form-Liner Finish: Produce a textured surface free of pockets, streaks, and honeycombs, and of uniform appearance, color, and texture.

3.9 EXPOSED-AGGREGATE FINISHES

- A. Scrubbed Finish: After concrete has achieved a compressive strength of from **1000 to 1500 psi (6.9 to 10.3 MPa)**, apply scrubbed finish. Wet concrete surfaces thoroughly and scrub with stiff fiber or wire brushes, using water freely, until top mortar surface is removed and aggregate is uniformly exposed. Rinse scrubbed surfaces with clean water. Maintain continuity of finish on each surface or area of Work. Remove only enough concrete mortar from surfaces to match design reference sample or mockup.
- B. High-Pressure Water-Jet Finish: Perform high-pressure water jetting on concrete that has achieved a minimum compressive strength of **4500 psi (31 MPa)**. Coordinate with

formwork removal to ensure that surfaces to be high-pressure water-jet finished are treated at same age for uniform results.

1. Surface Continuity: Perform high-pressure water-jet finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work. Maintain required patterns or variances in reveal projection to match design reference sample or mockup.
- C. Abrasive-Blast Finish: Perform abrasive blasting after compressive strength of concrete exceeds 2000 psi (13.8 MPa). Coordinate with formwork removal to ensure that surfaces to be abrasive blasted are treated at same age for uniform results.
1. Surface Continuity: Perform abrasive-blast finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work, utilizing same work crew to maintain continuity of finish on each surface or area of work. Maintain required patterns or variances in depths of blast as indicated on Drawings and to match design reference sample or mockup.
 2. Abrasive Blasting: Abrasive blast corners and edges of patterns carefully, using backup boards, to maintain uniform corner or edge line. Determine type of nozzle, nozzle pressure, and blasting techniques required to match design reference sample or mockup.
 3. Depth of Cut: Use an abrasive grit of proper type and gradation to expose aggregate and surrounding matrix surfaces to match design reference sample or mockup, as follows:
 - a. Brush: Remove cement matrix to dull surface sheen and expose face of fine aggregate; with no significant reveal.
 - b. Light: Expose fine aggregate with occasional exposure of coarse aggregate and uniform color; with maximum reveal of 1/16 inch (1.5 mm).
 - c. Medium: Generally expose coarse aggregate; with slight reveal, a maximum of 1/4 inch (6 mm).
 - d. Heavy: Expose and reveal coarse aggregate to a maximum projection of one-third its diameter; with reveal range of 1/4 to 1/2 inch (6 to 13 mm).
 4. Construction Joints: Use technique acceptable to DEN Project Manager as required to achieve uniform treatment of construction joints.
 5. Power Wash Cleaning: After abrasive blasting to required depth is completed, apply a power wash to clean abrasive blasted surfaces to match DEN Project Manager's sample. Thoroughly neutralize and flush any cleaners used from surfaces with water under pressure. Protect adjacent materials/finishes from power wash.
 - a. Prior to performing power wash cleaning work, Contractor to power wash a test area to verify that concrete surfaces are not damaged by power washing. Contractor shall be responsible to replace or repair all concrete that is damaged by power washing activities, as determined by DEN Project Manager.
- D. Bushhammer Finish: Allow concrete to cure at least 14 days before starting bushhammer surface finish operations.

1. Surface Continuity: Perform bushhammer finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work. Maintain required patterns or variances of cut as shown on Drawings or to match design reference sample or mockup.
2. Surface Cut: Maintain required depth of cut and general aggregate exposure. Use power tool with hammer attachments for large, flat surfaces, and use hand hammers for small areas, at corners and edges, and for restricted locations where power tools cannot reach.
3. Remove impressions of formwork and form facings with exception of tie holes.

E. Brushed Concrete Finish:

1. Apply scrubbed finish to concrete surfaces where indicated.
2. Strip forms as soon as practicable so that scrubbed finish may be produced on green concrete surfaces.
 - a. Coordinate form removal as specified in this Section.
3. Wet concrete surface thoroughly and scrub with stiff fiber or wire brushes, using water freely, until top mortar surface is removed and aggregate uniformly exposed. Rinse scrubbed surfaces with clean water. Remove only enough concrete mortar from surfaces to match DEN Project Manager's sample.
4. Use a weak cleaning solution while scrubbing where concrete has become too hard to produce required finish with normal scrubbing procedures. Remove cleaner from finished surface by flushing with clean water. Protect adjacent surfaces and finishes from damage by cleaning.

3.10 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 for hot-weather protection during curing.
- B. Begin curing cast-in-place architectural concrete immediately after [**removing forms from**] [**applying as-cast formed finishes to**] concrete. Cure according to ACI 308.1, by one or a combination of the following methods that will not mottle, discolor, or stain concrete:
 1. Moisture Curing: Keep exposed surfaces of cast-in-place architectural concrete continuously moist for no fewer than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with **12-inch (300-mm)** lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width,

with sides and ends lapped at least **12 inches** (300 mm), and sealed by waterproof tape or adhesive. Cure for no fewer than seven days. Immediately repair any holes or tears during curing period; use cover material and waterproof tape.

3. Curing Compound: Mist concrete surfaces with water. Apply curing compound uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.11 FIELD QUALITY CONTROL

- A. General: Comply with field quality-control requirements in Section 033000 "Cast-in-Place Concrete."

3.12 REPAIRS, PROTECTION, AND CLEANING

- A. Maintain control of concrete chips, dust, and debris in each area of work. Clean up and remove such material at completion of each day of application. Prevent migration of airborne materials by use of tarpaulins, wind breaks and similar containing devices.
- B. Sealer: One coat, install per manufacturer's recommendations. Do not install over wet or damp concrete. Mask-off adjacent surfaces not to receive sealer.
- C. Cooperate with other trades for protection of completed finishes.
- D. Repair and cure damaged finished surfaces of cast-in-place architectural concrete when approved by DEN Project Manager. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved mockups.
 1. Remove and replace cast-in-place architectural concrete that cannot be repaired and cured to DEN Project Manager's approval.
- E. Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.
- F. Protect cast-in-place architectural concrete from staining, laitance, and contamination during remainder of construction period.
- G. Clean cast-in-place architectural concrete surfaces after finish treatment to remove stains, markings, dust, and debris.
- H. Wash and rinse surfaces according to concrete finish applicator's written instructions. Protect other Work from staining or damage due to cleaning operations.
 1. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement will be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the lump sum contract price.

END OF SECTION 033300

SECTION 033320 - CONCRETE TOPPING (STANDARD AGGREGATES)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Extent of concrete floor toppings is shown on drawings and includes all concrete toppings, including those shown at the Central Core portion of the project. Section Includes the following types of concrete floor toppings:
 - 1. Standard aggregate toppings.
- B. Related Sections:
 - 1. Section 03300 "Cast-In-Place Concrete" for concrete work.
 - 2. Section 093000 "Tiling" for medium-set and thickset mortar beds for tile.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include data substantiating that materials comply with requirements.
- B. Furnish data, samples, laboratory test reports, and materials certificates as specified in Section 033000 "Cast-In-Place Concrete".

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by **[manufacturer and witnessed by a qualified testing agency] [a qualified testing agency]**, for concrete floor topping.
- B. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- B. Flatness Testing: Contractor to employ an independent testing agency to determine floor flatness and floor levelness per ASTM E 1155. Test Surface: Minimum 50% of all floor areas arrange uniformly. Test as soon as possible after slab installation. Submit written report to DEN Project Manager within 48 hours of tests. Repair per requirements of Section 033000 "Cast-In-Place Concrete".
- C. Mockups: Place concrete floor topping mockups to demonstrate typical joints, surface finish, bonding, texture, tolerances, and standard of workmanship.
 - 1. Build mockups approximately 100 sq. ft. (9.3 sq. m) in the location indicated or, if not indicated, as directed by DEN Project Manager.
 - 2. If DEN Project Manager determines that mockups do not meet requirements, demolish and remove them from the site and cast others until mockups are approved.
 - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at **[location and time as determined by DEN Project Manager][Project site] <Insert location>**.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage, mixing with other components, and application.
- B. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting concrete floor topping performance.
 - 1. Place concrete floor topping only when ambient temperature and temperature of base slabs are between 50 and 86 deg F (10 and 30 deg C).

- B. Close areas to traffic during topping application and, after application, for time period recommended in writing by manufacturer.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 CEMENT AND AGGREGATES

- A. Portland Cement: ASTM C 150, Type I or Type III.
- B. Standard Aggregate: ASTM C 33, and as follows:
 - 1. Fine aggregate, consisting of sand or crushed stone screenings, clean, hard, free from deleterious matter. Grade by weight to pass sieves as follows:
 - a. 3/8": 100 percent
 - b. No. 4: 95-100 percent
 - c. No. 8: 80-100 percent
 - d. No. 16: 50-85 percent
 - e. No. 30: 25-60 percent
 - f. No. 50: 10 30 percent
 - g. No. 100: 2 10 percent
 - 2. Coarse aggregate consisting of gravel or crushed stone, clean, hard, free from deleterious matter. Grade by weight to pass sieves as follows:
 - a. 1/2": 100 percent
 - b. 3/8": 85-100 percent
 - c. No. 4: 10-30 percent
 - d. No. 8: 0-10 percent
 - e. No. 16: 0-05 percent
- C. Cast-in-aggregate Hardener:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering factory pre mixed topping mixes which may be incorporated in the work include the following:
 - a. The Euclid Chemical Co.
 - b. Master Builders.
 - c. Iron Mountain Trap Rock Co.
 - d. <Insert manufacturer>
 - e. or approved equal.

- D. Reinforcement: ASTM A 185, welded steel wire fabric.

2.2 TOPPING MIX

A. Standard Topping:

1. Design mix to produce topping material with the following characteristics:
 - a. Compressive strength; 3500 psi at 28 days.
 - b. Slump; 8" maximum at point of placement for concrete containing high range water reducing admixture (super plasticizer) and 3" maximum for other concrete.
 - c. Maximum W/C ratio; 0.51.

B. MIXING:

1. Provide batch type mechanical mixer for mixing topping material at project site. Equip batch mixer with a suitable charging hopper, water storage tank, and a water measuring device. Use only mixers that are capable of mixing aggregates, cement, and water into a uniform mix within specified time, and of discharging mix without segregation.
2. Mix each batch of 2 cu. yds. or less for at least 1-1/2 minutes after ingredients are in mixer. Increase mixing time 15 secs. for each additional cu. yd. or fraction thereof.
 - a. Ready mixed topping may be used when acceptable to DEN Resident Engineer. When acceptable, furnish ready mixed topping complying with requirements of ASTM C 94.

2.3 CURING MATERIALS

- A. Use curing materials as specified in Section 033000 "Cast-in-Place Concrete".

2.4 RELATED MATERIALS

- A. Use related materials as specified in Section 033000 "Cast-In-Place Concrete".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for conditions affecting performance of concrete floor topping.
- B. Verify that base concrete slabs comply with scratch finish requirements specified in Section 033000 "Cast-in-Place Concrete."

- C. Verify that base slabs are visibly dry and free of moisture. Test for capillary moisture by the plastic sheet method according to ASTM D 4263.
- D. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 CONDITION OF SURFACES

- A. Topping Applied to Fresh Concrete: Do not begin placement of topping until water ceases to rise to surface, and water and laitance have been removed from base slab surface.
- B. Topping Applied to Hardened Concrete: Remove dirt, loose material, oil, grease, paint, existing surface treatments and deteriorated and unsound concrete, or other contaminants, leaving a clean surface.
 - 1. When base slab surface is unacceptable for good bonding, roughen surface by chipping or scarifying before cleaning. Mechanically abrade base slabs to produce a heavily scarified surface profile with an amplitude of **1/4 inch (6 mm.)**
 - 2. Fill voids, cracks, and cavities in base slabs.
 - 3. Prior to placing topping mixture, thoroughly dampen slab surface but do not leave standing water.
 - 4. Over dampened surface, apply specified bonding compound (re-wettable or non re-wettable) or epoxy adhesive. Refer to section 033000 "Cast-In-Place Concrete".
 - 5. Place topping mix after re-wettable bonding compound has dried or while non rewettable bonding compound or epoxy adhesive is still tacky.
- C. For reinforced toppings, provide necessary chairs or supports, and maintain position of reinforcing mesh as shown on drawings.
- D. Joints: Mark locations of joints in base slab so that joints in top course will be placed directly over them.

3.3 JOINT PREPARATION

- 1. Saw cut contraction and construction joints in existing concrete to a depth of **1/2 inch (13 mm)** and fill with semirigid joint filler.
- 2. To both sides of joint edges and at perimeter of existing base slab [**mechanically remove a 4-inch- (100-mm-) wide and 0- to 1-inch (0- to 25-mm-) deep, tapered wedge of concrete and retexture surface**] [**install concrete nails in manufacturer's recommended staggered pattern**].
- B. Install joint-filler strips where topping abuts vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with topping surface, unless otherwise indicated.
 - 2. Terminate full-width, joint-filler strips **1/2 inch (13 mm)** below topping surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.

3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- C. Construction Joints: Construct joints true to line with faces perpendicular to surface plane of concrete floor topping, at locations indicated or as approved by DEN Project Manager.
1. Coat face of construction joint with epoxy adhesive at locations where concrete floor topping is placed against hardened or partially hardened concrete floor topping.
- D. Contraction Joints: Form weakened-plane contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut **1/8-inch- (3-mm-)** wide joints into concrete floor topping when cutting action will not tear, abrade, or otherwise damage surface and before random contraction cracks develop.
1. Form joints in concrete floor topping over contraction joints in base slabs, unless otherwise indicated.
 2. Construct contraction joints for a combined depth equal to topping thickness and not less than one-fourth of base-slab thickness.
 3. Construct contraction joints for a depth equal to one-half of concrete floor topping thickness, but not less than **1/2 inch (13 mm)** deep.

3.4 TOPPING APPLICATION

- A. Monolithic Floor Topping: After textured-float finish is applied to fresh concrete of base slabs specified in Section 033000 "Cast-in-Place Concrete," place concrete floor topping while concrete is still plastic.
- B. Deferred Floor Topping: Within 72 hours of placing base slabs, mix and scrub bonding slurry into dampened concrete to a thickness of **1/16 to 1/8 inch (1.6 to 3 mm)**, without puddling. Place floor topping while slurry is still tacky.
- C. Existing Concrete: Apply epoxy-bonding adhesive, mixed according to manufacturer's written instructions, and scrub into dry base slabs to a thickness of **1/16 to 1/8 inch (1.6 to 3 mm)**, without puddling. Place floor topping while adhesive is still tacky.
- D. Place concrete floor topping continuously in a single layer, tamping and consolidating to achieve tight contact with bonding surface. Do not permit cold joints or seams to develop within pour strip.
1. Screed surface with a straightedge and strike off to correct elevations.
 2. Slope surfaces uniformly where indicated.
 3. Begin initial floating using bull floats to form a uniform and open-textured surface plane free of humps or hollows.

3.5 PLACING AND COMPACTING

- A. Float Finish:

1. Spread topping mixture evenly over prepared base to the required elevation and strikeoff. Use highway straightedge, bull float, or darby to level surface.
2. After the topping has stiffened sufficiently to permit the operation, and water sheen has disappeared, float the surface at least twice to a uniform sandy texture.
3. Restraighten where necessary with highway straightedge. Check and level surface plane per ACI 117-90 to levelness and flatness tolerances of F 25 except, provide flatness only tolerance of F 25 at sloped slab areas. Cut down high spots and fill low spots.
4. Uniformly slope surfaces to drains.
5. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
6. Install cast-in floor hardener per manufacturers recommendations. Apply at a minimum of 100 pounds per 100 square feet.

3.6 TROWEL FINISH

- A. After floating, begin first trowel finish operation using power driven trowels. Continue troweling until surface is ready to receive final troweling. Begin final troweling when a ringing sound is produced as trowel is moved over surface.
- B. Continue final trowel operation to produce finished surface free of trowel marks, uniform in texture and appearance, achieving an F 25 tolerance when tested in accordance with ACI 117-90 for flatness and levelness.
- C. PROTECTING AND CURING
- D. General: Protect freshly placed concrete floor topping from premature drying and excessive cold or hot temperatures.
- E. Evaporation Retarder: Apply evaporation retarder to concrete floor topping surfaces in hot, dry, or windy conditions before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying floor topping, but before float finishing.
- F. Begin curing immediately after finishing concrete floor topping. Cure by one or a combination of the following methods, according to concrete floor topping manufacturer's written instructions:
 1. Moisture Curing: Keep surfaces continuously moist for not less than 7 days with **[water] [continuous water-fog spray] [or] [absorptive cover, water saturated and kept continuously wet. Cover topping surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers].**
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least **12 inches (300 mm)**, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in two coats in continuous operations by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.7 JOINT FILLING

- A. Prepare and clean contraction joints and install semirigid joint filler, according to manufacturer's written instructions, once topping has fully cured.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth of contraction joints. Overfill joint and trim semirigid joint filler flush with top of joint after hardening.

3.8 REPAIRS

- A. Defective Topping: Repair and patch defective concrete floor topping areas, including areas that have not bonded to concrete substrate.
- B. Failure of concrete topping to bond to substrate (as evidenced by a hollow sound when tapped), or disintegration or other failure of topping to perform as a floor finish, will be considered failure of materials and workmanship. Repair or replace toppings in areas of such failures, as directed. Does not apply to topping slab on a waterproof membrane

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: **[Owner will engage] [Engage]** a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Services: Testing and inspecting of completed applications of concrete floor toppings shall take place in successive stages, in areas of extent and using methods as follows:
 1. Sample Sets: At point of placement, a set of 3 molded-cube samples shall be taken from the topping mix for the first **1000 sq. ft. (93 sq. m)**, plus 1 set of samples for each subsequent **5000 sq. ft. (464 sq. m)** of topping, or fraction thereof, but not less than 6 samples for each day's placement. Samples shall be tested according to ASTM C 109/C 109M for compliance with compressive-strength requirements.
 2. Concrete floor topping shall be tested for delamination by dragging a steel chain over the surface.
 3. Concrete floor topping shall be tested for compliance with surface flatness and levelness tolerances.
- C. Remove and replace applications of concrete floor topping where test results indicate

that it does not comply with specified requirements.

- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement will be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the lump sum contract price.

END OF SECTION 035300

SECTION 034100 - PRECAST STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Precast structural concrete.
- 2. Precast structural concrete with **[thin-brick]** **[stone]** facings.
- 3. Precast structural concrete with commercial architectural finish.

- B. Related Sections:

- 1. Section 033000 "Cast-in-Place Concrete" for **[concrete topping and]**placing connection anchors in concrete.
- 2. Section 042000 "Unit Masonry" for inserts or anchorages required for precast concrete slab connections.
- 3. Section 044200 "Exterior Stone Cladding" for preconstruction testing of stone anchors and determination of anchor spacing.
- 4. Section 051200 "Structural Steel Framing" for furnishing and installing connections attached to structural-steel framing.
- 5. Section 055000 "Metal Fabrications" for kickers and other miscellaneous steel shapes.
- 6. Section 076200 "Sheet Metal Flashing and Trim" for flashing receivers and reglets.
- 7. Section 078413 "Penetration Firestopping" for joint-filler materials for fire-resistance-rated construction.
- 8. Section 079200 "Joint Sealants" for elastomeric joint sealants and sealant backings.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 DEFINITION

- A. Design Reference Sample: Sample of approved precast structural concrete color, finish, and texture, preapproved by DEN Project Manager.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design precast structural concrete, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Precast structural concrete units and connections shall withstand design loads indicated within limits and under conditions indicated.
- C. Structural Performance: Provide precast structural concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:
1. Dead Loads: **<Insert loads>**.
 2. Concrete Topping Load: **<Insert load>**.
 3. Live Loads: **<Insert loads>**.
 4. Roof Loads: **<Insert loads>**.
 5. Snow Loads: **<Insert loads>**.
 6. Seismic Loads: **<Insert seismic design data including seismic performance category, importance factor, use group, seismic design category, seismic zone, site classification, site coefficient, and drift criteria>**.
 7. Wind Loads: **<Insert wind loads or wind-loading criteria, positive and negative for various parts of the building as required by applicable building code or SEI/ASCE 7, including basic wind speed, importance factor, exposure category, and pressure coefficient>**.
 8. **<Insert loads or load combinations>**.
 9. Design precast structural concrete framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements. Maintain precast structural concrete deflections within limits of **ACI 318 (ACI 318M)**.
 - a. Thermal Movements: Allow for in-plane thermal movements resulting from annual ambient temperature changes of **[minus 18 to plus 120 deg F (minus 10 to plus 67 deg C)] [120 deg F (67 deg C)] <Insert temperature>**.
 10. Fire-Resistance Rating: Select material and minimum thicknesses to provide indicated fire rating.
 11. Stone to Precast Anchorages: Provide anchors, as determined through Owner's or stone supplier testing, in numbers, types, and locations as required to satisfy performance criteria specified, but not less than the following:
 - a. Minimum Anchorage Requirement: Not less than 2 anchors per unit of less than **2 sq. ft. (0.19 sq. m)** in area and 4 anchors per unit of less than **12 sq. ft. (1.1 sq. m)** in area and for units larger than **12 sq. ft. (1.1 sq. m)** in area, provide anchors spaced not more than **24 inches (600 mm)** o.c. both horizontally and vertically, all located a minimum of **6 inches (150 mm)** from stone edge.
 12. Vehicular Impact Loads: Design spandrel beams acting as vehicular barriers for

passenger cars to resist a single [6000-lbf (26.7-kN)] <Insert load> service load and [10,000-lbf (44.5-kN)] <Insert load> ultimate load applied horizontally in any direction to the spandrel beam, with anchorages or attachments capable of transferring this load to the structure. Design spandrel beams assuming the load to act at a height of 18 inches (460 mm) above the floor or ramp surface on an area not to exceed 1 sq. ft. (0.93 sq. m).

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Design Mixtures for Credit ID 1: For each concrete mixture containing fly ash as a replacement for Portland cement or other Portland cement replacements and for equivalent concrete mixtures that do not contain Portland cement replacements.
- C. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.
- D. Shop Drawings: Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement. Detail fabrication and installation of precast structural concrete units.
 - 1. Indicate joints, reveals, and extent and location of each surface finish.
 - 2. Indicate separate face and backup mixture locations and thicknesses.
 - 3. Indicate welded connections by AWS standard symbols. Show size, length, and type of each weld.
 - 4. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.
 - 5. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
 - 6. Include and locate openings larger than by 10 inches (250 mm).
 - 7. Indicate location of each precast structural concrete unit by same identification mark placed on panel.
 - 8. Indicate relationship of precast structural concrete units to adjacent materials.
 - 9. Indicate locations and details of brick units, including corner units and special shapes, and joint treatment.
 - 10. Indicate locations and details of stone facings, anchors, and joint widths.
 - 11. Indicate estimated camber for precast floor slabs with concrete toppings.
 - 12. Indicate shim sizes and grouting sequence.

13. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.

E. Samples:

1. For each type of finish indicated on exposed surfaces of precast structural concrete units with architectural finish, in sets of 3, illustrating full range of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches (300 by 300 by 50 mm).
 - a. Where other faces of precast concrete unit are exposed, include Samples illustrating workmanship, color, and texture of backup concrete as well as facing concrete.
2. Samples for each thin- or half-brick unit required, showing full range of color and texture expected. Include Samples showing color and texture of joint treatment.
 - a. Grout Samples for Initial Selection: Color charts consisting of actual sections of grout showing manufacturer's full range of colors.
 - b. Grout Samples for Verification: Showing color and texture of joint treatment.

- F. Delegated-Design Submittal: For precast structural concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For [Installer] [fabricator] [testing agency].
- B. Welding certificates.
- C. Material Certificates: For the following, from manufacturer:
 1. Cementitious materials.
 2. Reinforcing materials and prestressing tendons.
 3. Admixtures.
 4. Bearing pads.
 5. Structural-steel shapes and hollow structural sections.
 6. Brick units and accessories.
 7. Stone anchors and accessories.
- D. Material Test Reports: For aggregates.
- E. Source quality-control reports.
- F. Field quality-control[**and special inspection**] reports.

1.7 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering precast structural concrete units to comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
1. Participates in PCI's Plant Certification program[**at time of bidding**] and is designated a PCI-certified plant as follows:
 - a. Group C, [**Category C1 - Precast Concrete Products (no prestressed reinforcement)**] [**Category C2 - Prestressed Hollowcore and Repetitively Produced Products**] [**Category C3 - Prestressed Straight Strand Structural Members**] [**Category C4 - Prestressed Deflected Strand Structural Members**].
 - b. Group CA, [**Category C1A - Precast Concrete Products (no prestressed reinforcement)**] [**Category C2A - Prestressed Hollowcore and Repetitively Produced Products**] [**Category C3A - Prestressed Straight-Strand Structural Members**] [**Category C4A - Prestressed Deflected-Strand Structural Members**].
- B. Installer Qualifications: A precast concrete erector qualified[**at time of bidding**], as evidenced by PCI's Certificate of Compliance, to erect [**Category S1 - Simple Structural Systems**] [**Category S2 - Complex Structural Systems**].
- C. Installer Qualifications: An experienced precast concrete erector who, before erection of precast concrete, has retained a "PCI-Certified Field Auditor" to conduct a field audit of a project installed by erector in [**Category S1 - Simple Structural Systems**] [**Category S2 - Complex Structural Systems**] and who produces an Erectors' Post Audit Declaration, according to PCI MNL 127, "PCI Erector's Manual - Standards and Guidelines for the Erection of Precast Concrete Products."
- D. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- E. Design Standards: Comply with [ACI 318](#) (ACI 318M) and design recommendations in PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of precast structural concrete units indicated.
- F. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."

- G. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D.1.1M, "Structural Welding Code - Steel."
 2. AWS D1.4, "Structural Welding Code - Reinforcing Steel."
- H. Fire-Resistance Calculations: Where indicated, provide precast structural concrete units whose fire resistance meets the prescriptive requirements of authorities having jurisdiction or has been calculated according to **[ACI 216.1/TMS 0216.1, "Standard Method for Determining Fire Resistance of Concrete and Masonry Construction Assemblies,"]** **[PCI MNL 124, "Design for Fire Resistance of Precast Prestressed Concrete,"]** and is acceptable to authorities having jurisdiction.
- I. Sample Panels: After sample approval and before fabricating precast structural concrete units with **[architectural finish]** **[thin-brick facing]** **[stone facing]**, produce a minimum of **[2]** **<Insert number>** sample panels approximately **[16 sq. ft. (1.5 sq. m)]** **<Insert size>** in area for review by DEN Project Manager. Incorporate full-scale details of architectural features, finishes, textures, and transitions in sample panels.
1. Locate panels where indicated or, if not indicated, as directed by DEN Project Manager.
 2. Damage part of an exposed-face surface for each finish, color, and texture, and demonstrate adequacy of repair techniques proposed for repair of surface blemishes.
 3. After approval of repair technique, maintain one sample panel at fabricator's plant and one at Project site in an undisturbed condition as a standard for judging the completed Work.
 4. Demolish and remove sample panels when directed.
- J. Mockups: After sample panel approval but before production of precast structural concrete units with **[architectural finish]** **[thin-brick facing]** **[stone facing]**, construct full-sized mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockup as indicated on Drawings including **[sealants]** **<Insert construction>** and precast structural concrete units with an architectural finish complete with anchors, connections, flashings, and joint fillers.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- K. Preinstallation Conference: Conduct conference at **[Project site]** **[location and time as determined by DEN Project Manager]** **<Insert location>**.
- 1.9 DELIVERY, STORAGE, AND HANDLING
- A. Support units during shipment on nonstaining shock-absorbing material in same position as during storage.

- B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
 - 1. Store units with dunnage across full width of each bearing point unless otherwise indicated.
 - 2. Place adequate dunnage of even thickness between each unit.
 - 3. Place stored units so identification marks are clearly visible, and units can be inspected.
- C. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses that would cause cracking or damage.
- D. Lift and support units only at designated points shown on Shop Drawings.

1.10 COORDINATION

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Fabricators: Subject to compliance with requirements, provide products by one of the following:
 - 1. **<Insert fabricators' names>**.
 - 2. or approved equal.

2.2 MOLD MATERIALS

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.
 - 1. Mold-Release Agent: Commercially produced liquid-release agent that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

- B. Form Liners: Units of face design, texture, arrangement, and configuration **[indicated [to match those used for precast concrete design reference sample]]**. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
- C. Surface Retarder: Chemical set retarder, capable of temporarily delaying final hardening of newly placed concrete mixture to depth of reveal specified.

2.3 REINFORCING MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25] [60] <Insert number>** percent.
- B. Reinforcing Bars: ASTM A 615/A 615M, **Grade 60** (Grade 420), deformed.
- C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- D. Galvanized Reinforcing Bars: **[ASTM A 615/A 615M, Grade 60** (Grade 420) **][ASTM A 706/A 706M]**, deformed bars, ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized[, **and chromate wash treated after fabrication and bending]**.
- E. Epoxy-Coated Reinforcing Bars: **[ASTM A 615/A 615M, Grade 60** (Grade 420) **][ASTM A 706/A 706M]**, deformed bars, **[ASTM A 775/A 775M] [or] [ASTM A 934/A 934M]** epoxy coated, with less than 2 percent damaged coating in each **12-inch** (300-mm) bar length.
- F. Steel Bar Mats: ASTM A 184/A 184M, fabricated from **[ASTM A 615/A 615M, Grade 60** (Grade 420) **][ASTM A 706/A 706M]**, deformed bars, assembled with clips.
- G. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from **[as-drawn steel] [galvanized-steel]** wire into flat sheets.
- H. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- I. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, **[plain] [deformed]**, flat sheet, **[Type 1 bendable] [Type 2 nonbendable]** coating.
- J. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

2.4 PRESTRESSING TENDONS

- A. Pretensioning Strand: **[ASTM A 416/A 416M, Grade 250** (Grade 1720) **or Grade 270** (Grade 1860), **uncoated, 7-wire] [or] [ASTM A 886/A 886M, Grade 270** (Grade 1860), **indented, 7-wire]**, low-relaxation strand.

- B. Unbonded Post-Tensioning Strand: ASTM A 416/A 416M, **Grade 270** (Grade 1860), uncoated, 7-wire, low-relaxation strand.
 - 1. Coat unbonded post-tensioning strand with post-tensioning coating complying with ACI 423.6 and sheath with polypropylene tendon sheathing complying with ACI 423.6. Include anchorage devices and coupler assemblies.
- C. Post-Tensioning Bars: ASTM A 722, uncoated high-strength steel bar.

2.5 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.
 - 1. For surfaces exposed to view in finished structure, mix gray with white cement, of same type, brand, and mill source.
- B. Supplementary Cementitious Materials:
 - 1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
 - 2. Metakaolin Admixture: ASTM C 618, Class N.
 - 3. Silica Fume Admixture: ASTM C 1240, with optional chemical and physical requirement.
 - 4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- C. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C 33, with coarse aggregates complying with **[Class 5S] [Class 5M] [Class 4S] [Class 4M]**. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
 - 1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
 - a. Gradation: **[Uniformly graded] [Gap graded] [To match design reference sample]**.
 - 2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand of same material as coarse aggregate unless otherwise approved by DEN Project Manager.
- D. Lightweight Aggregates: Except as modified by PCI MNL 116, ASTM C 330, with absorption less than 11 percent.
- E. Coloring Admixture: ASTM C 979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.
- F. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.
- G. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

- H. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride or more than 0.15 percent chloride ions or other salts by weight of admixture.
1. Water-Reducing Admixtures: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
 5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 7. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M.
- I. Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

2.6 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.
- B. Carbon-Steel-Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 116.
- C. Carbon-Steel Plate: ASTM A 283/A 283M.
- D. Malleable-Iron Castings: ASTM A 47/A 47M.
- E. Carbon-Steel Castings: ASTM A 27/A 27M, [Grade 60-30](#) (Grade 415-205).
- F. High-Strength, Low-Alloy Structural Steel: ASTM A 572/A 572M.
- G. Carbon-Steel Structural Tubing: ASTM A 500, Grade B.
- H. Wrought Carbon-Steel Bars: ASTM A 675/A 675M, [Grade 65](#) (Grade 450).
- I. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706/A 706M.
- J. Carbon-Steel Bolts and Studs: [ASTM A 307, Grade A](#) (ASTM F 568M, Property Class 4.6); carbon-steel, hex-head bolts and studs; carbon-steel nuts, [ASTM A 563](#) (ASTM A 563M); and flat, unhardened steel washers, ASTM F 844.
- K. High-Strength Bolts and Nuts: [ASTM A 325](#) (ASTM A 325M) or [ASTM A 490](#) (ASTM A 490M), Type 1, heavy hex steel structural bolts; heavy hex carbon-steel nuts, [ASTM A 563](#) (ASTM A 563M); and hardened carbon-steel washers, [ASTM F 436](#) (ASTM F 436M).
1. Do not zinc coat [ASTM A 490](#) (ASTM A 490M) bolts.
- L. Zinc-Coated Finish: For exterior steel items[, **steel in exterior walls,**] and items

indicated for galvanizing, apply zinc coating by [**hot-dip process according to ASTM A 123/A 123M or ASTM A 153/A 153M**] [**electrodeposition according to ASTM B 633, SC 3, Types 1 and 2**].

1. For steel shapes, plates, and tubing to be galvanized, limit silicon content of steel to less than 0.03 percent or to between 0.15 and 0.25 percent or limit sum of silicon and 2.5 times phosphorous content to 0.09 percent.
 2. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035B or SSPC-Paint 20.
- M. Shop-Primed Finish: Prepare surfaces of nongalvanized-steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3, and shop apply [**lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79**] [**SSPC-Paint 25**] according to SSPC-PA 1.
- N. Welding Electrodes: Comply with AWS standards.
- O. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install precast structural concrete units.

2.7 STAINLESS-STEEL CONNECTION MATERIALS

- A. Stainless-Steel Plate: ASTM A 666, Type 304, of grade suitable for application.
- B. Stainless-Steel Bolts and Studs: ASTM F 593, Alloy 304 or 316, hex-head bolts and studs; stainless-steel nuts; and flat, stainless-steel washers. Lubricate threaded parts of stainless-steel bolts with an antiseize thread lubricant during assembly.
- C. Stainless-Steel-Headed Studs: ASTM A 276, with minimum mechanical properties of PCI MNL 116.

2.8 BEARING PADS

- A. Provide one of the following bearing pads for precast structural concrete units[**as recommended by precast fabricator for application**]:
 1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore, Type A durometer hardness, ASTM D 2240; minimum tensile strength **2250 psi (15.5 MPa)**, ASTM D 412.
 2. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. 70 to 90 Shore, Type A durometer hardness, ASTM D 2240; capable of supporting a compressive stress of **3000 psi (20.7 MPa)** with no cracking, splitting, or delaminating in the internal portions of pad. Test 1 specimen for every 200 pads used in Project.
 3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer; 80 to 100 Shore, Type A durometer hardness, ASTM D 2240; complying with AASHTO's "AASHTO Load

and Resistance Factor Design (LRFD) Bridge Specifications," Division II, Section 18.10.2; or with MIL-C-882E.

4. Frictionless Pads: Tetrafluoroethylene, glass-fiber reinforced, bonded to stainless- or mild-steel plate, of type required for in-service stress.
5. High-Density Plastic: Multimonomer, nonleaching, plastic strip.

2.9 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, Portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time.
- C. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C 881/C 881M, of type, grade, and class to suit requirements.

2.10 THIN-BRICK UNITS AND ACCESSORIES

- A. Thin-Brick Units: ASTM C 216, Type FBX or ASTM C 1088, Grade Exterior, Type TBX, **[not less than 1/2 inch (13 mm)] [3/4 inch (19 mm)] [1 inch (25 mm)]** thick with a tolerance of plus or minus **1/16 inch (1.6 mm)**, and as follows:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.
 2. Face Color and Texture: **[Match DEN Project Manager's samples] [Medium brown, wire cut] [Full-range red, sand molded] [Gray, velour]**.
 3. Face Size: **2-1/4 inches (57 mm)** high by **8 inches (203 mm)** long.
 4. Face Size: **2-1/4 inches (57 mm)** high by **7-1/2 to 7-5/8 inches (190 to 194 mm)** long.
 5. Face Size: **2-3/4 to 2-13/16 inches (70 to 71 mm)** high by **7-1/2 to 7-5/8 inches (190 to 194 mm)** long.
 6. Face Size: **3-1/2 to 3-5/8 inches (89 to 92 mm)** high by **7-1/2 to 7-5/8 inches (190 to 194 mm)** long.
 7. Face Size: **3-1/2 to 3-5/8 inches (89 to 92 mm)** high by **11-1/2 to 11-5/8 inches (292 to 295 mm)** long.
 8. Face Size: **<Insert dimensions>**.
 9. **[Where indicated to "match existing,"]**provide thin brick matching color, texture, and face size of existing adjacent brick work.

a. <Insert information on existing brick if known>.

10. Face Size: 57 mm high by 190 mm long.
11. Face Size: 70 mm high by 190 mm long.
12. Face Size: 90 mm high by 190 mm long.
13. Face Size: 90 mm high by 290 mm long.
14. Face Size: <Insert dimensions>.
15. Special Shapes: Include corners, edge corners, and end edge corners.
16. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute; ASTM C 67.
17. Efflorescence: Tested according to ASTM C 67 and rated "not effloresced."
18. Surface Coating: Thin brick with colors or textures applied as coatings shall withstand 50 cycles of freezing and thawing; ASTM C 67 with no observable difference in applied finish when viewed from 10 feet (3 m).
19. Back Surface Texture: Scored, combed, wire roughened, ribbed, keybacked, or dovetailed.

B. Sand-Cement Mortar: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144. Mix at ratio of 1 part cement to 4 parts sand, by volume, with minimum water required for placement.

C. Latex-Portland Cement Pointing Grout: ANSI A118.6 and as follows:

1. Dry-grout mixture, factory prepared, of Portland cement, graded aggregate, and dry, redispersible, ethylene-vinyl-acetate additive for mixing with water; uniformly colored.
2. Commercial Portland cement grout, factory prepared, with liquid styrene-butadiene rubber or acrylic-resin latex additive; uniformly colored.
3. Colors: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range].**

2.11 STONE MATERIALS AND ACCESSORIES

A. Stone facing for precast structural concrete is specified in Section 044200 "Exterior Stone Cladding."

B. Anchors are generally supplied by stone fabricator or, in some cases, by precaster. Specify supplier. Anchors may be toe in, toe out, or dowels.

C. Anchors: Stainless steel, ASTM A 666, Type 304, of temper and diameter required to support loads without exceeding allowable design stresses.

1. Fit each anchor leg with neoprene grommet collar of width at least twice the diameter and of length at least five times the diameter of anchor.

D. Sealant Filler: ASTM C 920, low-modulus, multicomponent, nonsag urethane sealant complying with requirements in Section 079200 "Joint Sealants" and that is nonstaining to stone substrate.

- E. Epoxy Filler: ASTM C 881/C 881M, 100 percent solids, sand-filled nonshrinking, nonstaining of type, class, and grade to suit application.
 - 1. Elastomeric Anchor Sleeve: 1/2 inch (13 mm) long; 60 Shore, Type A durometer hardness; ASTM D 2240.
- F. Bond Breaker: [**Preformed, compressible, resilient, nonstaining, nonwaxing, closed-cell polyethylene foam pad, nonabsorbent to liquid and gas, 1/8 inch (3.2 mm) thick**] [**Polyethylene sheet, ASTM D 4397, 6 to 10 mils (0.15 to 0.25 mm) thick**].

2.12 INSULATED FLAT WALL PANEL ACCESSORIES

- A. Molded-Polystyrene Board Insulation: ASTM C 578, [**Type I, 0.90 lb/cu. ft. (15 kg/cu. m)**] [**Type VIII, 1.15 lb/cu. ft. (18 kg/cu. m)**] [**Type II, 1.35 lb/cu. ft. (22 kg/cu. m)**]; [**square**] [**ship-lap**] edges; with R-value of <Insert value> and thickness of <Insert dimension>.
- B. Extruded-Polystyrene Board Insulation: ASTM C 578, [**Type IV, 1.60 lb/cu. ft. (26 kg/cu. m)**] [**Type X, 1.30 lb/cu. ft. (21 kg/cu. m)**] [**Type VI, 1.80 lb/cu. ft. (29 kg/cu. m)**]; [**square**] [**ship-lap**] edges; with R-value of <Insert value> and thickness of <Insert dimension>.
- C. Polyisocyanurate Board Insulation: ASTM C 591, [**Type I, 1.8 lb/cu. ft. (29 kg/cu. m)**] [**Type IV, 2 lb/cu. ft. (32 kg/cu. m)**] [**Type II, 2.5 lb/cu. ft. (40 kg/cu. m)**] unfaced, with R-value of <Insert value> and thickness of <Insert dimension>.
- D. Wythe Connectors: [**Glass-fiber connectors**] [**Vinyl-ester polymer connectors**] [**Polypropylene pin connectors**] [**Stainless-steel pin connectors**] [**Bent galvanized reinforcing bars**] [**Galvanized welded wire trusses**] [**Galvanized bent wire connectors**] [**Cylindrical metal sleeve anchors**] manufactured to connect wythes of precast concrete panels.

2.13 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
 - 1. Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, by not less than 40 percent.
 - 2. Limit use of fly ash to 25 percent replacement of Portland cement by weight and granulated blast-furnace slag to 40 percent of Portland cement by weight; metakaolin and silica fume to 10 percent of Portland cement by weight.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by **ACI 318 (ACI 318M)** or **PCI MNL 116** when tested according to **ASTM C 1218/C 1218M**.

- D. Normal-Weight Concrete Mixtures: Proportion **[face mixtures] [face and backup mixtures] [full-depth mixture] [face and backup mixtures or full-depth mixtures, at fabricator's option]** by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
1. Compressive Strength (28 Days): **5000 psi (34.5 MPa)**.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
- E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 116.
- F. Lightweight Concrete Backup Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.2, with materials to be used on Project, to provide lightweight concrete with the following properties:
1. Compressive Strength (28 Days): **5000 psi (34.5 MPa)**.
 2. Unit Weight: Calculated equilibrium unit weight of **115 lb/cu. ft. (1842 kg/cu. m)**, plus or minus **3 lb/cu. ft. (48 kg/cu. m)**, according to ASTM C 567.
- G. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116.
- H. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.
- I. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.14 MOLD FABRICATION

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.
- B. Maintain molds to provide completed precast structural concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
1. Form joints are not permitted on faces exposed to view in the finished work.
 2. Edge and Corner Treatment: Uniformly **[chamfered] [radiused]**.

2.15 THIN-BRICK FACINGS

- A. Place form-liner templates accurately to provide grid for thin-brick facings. Provide solid backing and supports to maintain stability of liners while placing thin bricks and during concrete placement.
- B. Securely place thin-brick units face down into form-liner pockets and place concrete backing mixture.
- C. Completely fill joint cavities between thin-brick units with sand-cement mortar, and place precast concrete backing mixture while sand-cement mortar is still fluid enough to ensure bond.
- D. Mix and install pointing grout according to ANSI A108.10. Completely fill joint cavities between thin-brick units with pointing grout, and compress into place without spreading pointing grout onto faces of thin-brick units. Remove excess pointing grout immediately to prevent staining of brick.
 - 1. Tool joints to a **[slightly concave] [grapevine] [V-]**shape when pointing grout is thumbprint hard.
- E. Clean faces and joints of brick facing.

2.16 STONE FACINGS

- A. Clean stone surfaces before placing in molds to remove soil, stains, and foreign materials. Use cleaning methods and materials recommended by stone supplier.
- B. Accurately position stone facings to comply with requirements and in locations indicated on Shop Drawings. Install anchors, supports, and other attachments indicated or necessary to secure stone in place. Keep concrete reinforcement a minimum of **3/4 inch (19 mm)** from the back surface of stone. Use continuous spacers to obtain uniform joints of widths indicated and with edges and faces aligned according to established relationships and indicated tolerances.
 - 1. Stone to Precast Anchorages: Provide anchors in numbers, types and locations required to satisfy specified performance criteria, but not less than 2 anchors per stone unit of less than **2 sq. ft. (0.19 sq. m)** in area and 4 anchors per unit of less than **12 sq. ft. (1.1 sq. m)** in area; for units larger than **12 sq. ft. (1.1 sq. m)** in area, provide anchors spaced not more than **24 inches (600 mm)** o.c. horizontally and vertically. Locate anchors a minimum of **6 inches (150 mm)** from stone edge.
- C. Fill anchor holes with **[sealant filler and install anchors] [epoxy filler and install anchors with elastomeric anchor sleeve at back surface of stone]**.
 - 1. Install polyethylene sheet to prevent bond between back of stone facing and concrete substrate and to ensure no passage of precast matrix to stone surface.
 - 2. Install **1/8-inch (3-mm)** polyethylene-foam bond breaker to prevent bond between back of stone facing and concrete substrate and to ensure no passage of precast

matrix to stone surface. Maintain minimum projection requirements of stone anchors into concrete substrate.

2.17 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast structural concrete units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in precast structural concrete units as indicated on the Contract Drawings.
- D. Cast-in openings larger than **10 inches (250 mm)** in any dimension. Do not drill or cut openings or prestressing strand without DEN Project Manager's approval.
- E. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.
1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcement exceeds limits specified, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
 2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
 3. Place reinforcement to maintain at least **3/4-inch (19-mm)** minimum coverage. Increase cover requirements according to **ACI 318 (ACI 318M)** when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
 4. Place reinforcing steel and prestressing strand to maintain at least **3/4-inch (19-mm)** minimum concrete cover. Increase cover requirements for reinforcing steel to **1-1/2 inches (38 mm)** when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
 5. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.

- F. Reinforce precast structural concrete units to resist handling, transportation, and erection stresses.
- G. Prestress tendons for precast structural concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 116.
 - 1. Delay detensioning or post-tensioning of precast, prestressed structural concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under same conditions as concrete.
 - 2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
 - 3. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
 - 4. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and possible rust spots.
 - 5. Protect strand ends and anchorages with a minimum of 1-inch- (25-mm-) thick, nonmetallic, nonshrink, grout mortar and sack rub surface. Coat or spray the inside surfaces of pocket with bonding agent before installing grout.
- H. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- I. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch (25 mm) or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.
- J. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.
 - 1. Place backup concrete mixture to ensure bond with face-mixture concrete.
- K. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 116.
 - 1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."
- L. Comply with ACI 306.1 procedures for cold-weather concrete placement.
- M. Comply with PCI MNL 116 procedures for hot-weather concrete placement.
- N. Identify pickup points of precast structural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings.

Imprint or permanently mark casting date on each precast structural concrete unit on a surface that will not show in finished structure.

- O. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- P. Discard and replace precast structural concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 116 and meet DEN Project Manager's approval.

2.18 CASTING INSULATED WALL PANELS

- A. Cast and screed wythe supported by mold.
- B. Place insulation boards abutting edges and ends of adjacent boards. Insert wythe connectors through insulation, and consolidate concrete around connectors according to connector manufacturer's written instructions.
- C. Cast and screed top wythe to meet required finish.

2.19 FABRICATION TOLERANCES

- A. Fabricate precast structural concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with PCI MNL 116 product dimension tolerances.
- B. Brick-Faced Precast Structural Concrete Units: Restrict the following misalignments to 2 percent of number of bricks in a unit:
 - 1. Alignment of Mortar Joints:
 - a. Jog in Alignment: **1/8 inch (3 mm)**.
 - b. Alignment with Panel Centerline: Plus or minus **1/8 inch (3 mm)**.
 - 2. Variation in Width of Exposed Mortar Joints: Plus or minus **1/8 inch (3 mm)**.
 - 3. Tipping of Individual Bricks from the Panel Plane of Exposed Brick Surface: Plus **1/16 inch (1.6 mm)**; minus **1/4 inch (6 mm)** less than or equal to depth of form-liner joint.
 - 4. Exposed Brick Surface Parallel to Primary Control Surface of Panel: Plus **1/4 inch (6 mm)**; minus **1/8 inch (3 mm)**.
 - 5. Individual Brick Step in Face from Panel Plane of Exposed Brick Surface: Plus **1/16 inch (1.6 mm)**; minus **1/4 inch (6 mm)** less than or equal to depth of form-liner joint.
- C. Stone Veneer-Faced Precast Structural Concrete Units:

1. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated: Plus or minus **1/4 inch (6 mm)**.
2. Variation in Joint Width: **1/8 inch in 36 inches (3 mm in 900 mm)** or a quarter of nominal joint width, whichever is less.
3. Variation in Plane between Adjacent Stone Units (Lipping): **1/16-inch (1.6-mm)** difference between planes of adjacent units.

2.20 COMMERCIAL FINISHES

- A. Commercial Grade: Remove fins and large protrusions and fill large holes. Rub or grind ragged edges. Faces must have true, well-defined surfaces. Air holes, water marks, and color variations are permitted. Limit form joint offsets to **3/16 inch (5 mm)**.
- B. Standard Grade: Normal plant-run finish produced in molds that impart a smooth finish to concrete. Surface holes smaller than **1/2 inch (13 mm)** caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls are permitted. Fill air holes greater than **1/4 inch (6 mm)** in width that occur more than once per **2 sq. in (1300 sq. mm)**. Major or unsightly imperfections, honeycombs, or structural defects are not permitted. Limit joint offsets to **1/8 inch (3 mm)**.
- C. Grade B Finish: Fill air pockets and holes larger than **1/4 inch (6 mm)** in diameter with sand-cement paste matching color of adjacent surfaces. Fill air holes greater than **1/8 inch (3 mm)** in width that occur more than once per **2 sq. in. (1300 sq. mm)**. Grind smooth form offsets or fins larger than **1/8 inch (3 mm)**. Repair surface blemishes due to holes or dents in molds. Discoloration at form joints is permitted.
- D. Grade A Finish: Fill surface blemishes with the exception of air holes **1/16 inch (1.6 mm)** in width or smaller, and form marks where the surface deviation is less than **1/16 inch (1.6 mm)**. Float apply a neat cement-paste coating to exposed surfaces. Rub dried paste coat with burlap to remove loose particles. Discoloration at form joints is permitted. Grind smooth all form joints.
- E. Screed or float finish unformed surfaces. Strike off and consolidate concrete with vibrating screeds to a uniform finish. Hand screed at projections. Normal color variations, minor indentations, minor chips, and spalls are permitted. Major imperfections, honeycombing, or defects are not permitted.
- F. Smooth, steel trowel finish unformed surfaces. Consolidate concrete, bring to proper level with straightedge, float, and trowel to a smooth, uniform finish.
- G. Apply roughened surface finish according to **ACI 318 (ACI 318M)** to precast concrete units that will receive concrete topping after installation.

2.21 COMMERCIAL ARCHITECTURAL FINISHES

- A. Manufacture member faces free of joint marks, grain, and other obvious defects with corners, including false joints, uniform, straight, and sharp. Finish exposed-face surfaces of precast concrete units to match approved [**design reference sample**]

[sample panels] [mockups] and as follows:

1. Design Reference Sample: <Insert description and identify fabricator and code number of sample>.
2. PCI's "Architectural Precast Concrete - Color and Texture Selection Guide," of plate numbers indicated.
3. Smooth-Surface Finish: Provide surfaces free of excessive air voids, sand streaks, and honeycombs, with uniform color and texture.
4. Textured-Surface Finish: Impart by form liners or inserts to provide surfaces free of pockets, streaks, and honeycombs, with uniform color and texture.
5. Bushhammer Finish: Use power or hand tools to remove matrix and fracture coarse aggregates.
6. Exposed-Aggregate Finish: Use chemical-retarding agents applied to concrete molds and washing and brushing procedures to expose aggregate and surrounding matrix surfaces after form removal.
7. Abrasive-Blast Finish: Use abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces.
8. Acid-Etched Finish: Use acid and hot-water solution, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces. Protect hardware, connections, and insulation from acid attack.
9. Honed Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.
10. Polished Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.
11. Sand-Embedment Finish: Use selected stones placed in a sand bed in bottom of mold, with sand removed after curing.

2.22 SOURCE QUALITY CONTROL

- A. Testing Agency: [Owner will engage] [Engage] a qualified testing agency to evaluate precast structural concrete fabricator's quality-control and testing methods.
 1. Allow testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.
- B. Testing: Test and inspect precast structural concrete according to PCI MNL 116 requirements.
 1. Test and inspect self-consolidating concrete according to PCI TR-6.
- C. Strength of precast structural concrete units will be considered deficient if units fail to comply with [ACI 318](#) ([ACI 318M](#)) requirements for concrete strength.
- D. If there is evidence that strength of precast concrete units may be deficient or may not comply with [ACI 318](#) ([ACI 318M](#)) requirements, employ a qualified testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M.

1. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by DEN Project Manager.
 2. Cores will be tested in an air-dry condition or, if units will be wet under service conditions, test cores after immersion in water in a wet condition.
 3. Strength of concrete for each series of 3 cores will be considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.
 4. Test results will be made in writing on same day that tests are performed, with copies to DEN Project Manager, Contractor, and precast concrete fabricator. Test reports will include the following:
 - a. Project identification name and number.
 - b. Date when tests were performed.
 - c. Name of precast concrete fabricator.
 - d. Name of concrete testing agency.
 - e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
- E. Patching: If core test results are satisfactory and precast structural concrete units comply with requirements, clean and dampen core holes and solidly fill with same precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.
- F. Defective Units: Discard and replace precast structural concrete units that do not comply with requirements, including strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to DEN Project Manager's approval. DEN Project Manager reserves the right to reject precast units that do not match approved samples, sample panels, and mockups.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not install precast concrete units until supporting, cast-in-place, building structural framing has attained minimum allowable design compressive strength or until supporting steel or other structure is complete.

3.2 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting precast structural concrete units to supporting members and backup materials.
- B. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, supports, and bracing as required to maintain position, stability, and alignment of units until permanent connection.
 - 1. Install temporary steel or plastic spacing shims or bearing pads as precast structural concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
 - 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 - 3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
 - 4. For hollow-core slab voids used as electrical raceways or mechanical ducts, align voids between units and tape butt joint at end of slabs.
- C. Connect precast structural concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
 - 1. Do not permit connections to disrupt continuity of roof flashing.
- D. Field cutting of precast units is not permitted without approval of the DEN Project Manager.
- E. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units.
- F. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
 - 1. Protect precast structural concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
 - 2. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil- (0.1-mm-) thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780.
 - 3. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and reprime damaged painted surfaces.
 - 4. Remove, reweld, or repair incomplete and defective welds.
- G. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
 - 1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot. For friction connections, apply specified bolt torque and check 25 percent of bolts

at random by calibrated torque wrench.

- H. Grouting: Grout connections and joints and open spaces at keyways, connections, and joints where required or indicated on Shop Drawings. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled.
1. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces.
 2. Fill joints completely without seepage to other surfaces.
 3. Trowel top of grout joints on roofs smooth and uniform. Finish transitions between different surface levels not steeper than 1 to 12.
 4. Place grout end cap or dam in voids at ends of hollow-core slabs.
 5. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
 6. Keep grouted joints damp for not less than 24 hours after initial set.

3.3 ERECTION TOLERANCES

- A. Erect precast structural concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.
- B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by DEN Project Manager.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: **[Owner will engage] [Engage]** a qualified special inspector to perform the following special inspections:
1. Erection of precast structural concrete members.
 2. **<Insert special inspections>**.
- B. Testing Agency: **[Owner will engage] [Engage]** a qualified testing agency to perform tests and inspections.
- C. Field welds will be visually inspected and nondestructive tested according to ASTM E 165 or ASTM E 709. High-strength bolted connections will be subject to inspections.
- D. Testing agency will report test results promptly and in writing to Contractor and DEN Project Manager.
- E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- G. Prepare test and inspection reports.

3.5 REPAIRS

- A. Repair precast structural concrete units if permitted by DEN Project Manager.
 - 1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units has not been impaired.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet (6 m).
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.
- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with requirements as determined by DEN Project Manager.

3.6 CLEANING

- A. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 034100

SECTION 034500 - PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Architectural precast concrete cladding[**and load-bearing**] units.
2. Insulated, architectural precast concrete units.
3. Brick-faced, architectural precast concrete units.
4. Stone-faced, architectural precast concrete units.

- B. Related Sections include the following:

1. Section 033000 "Cast-In-Place Concrete" for installing connection anchors in concrete.
2. Section 034900 "Glass-Fiber-Reinforced Concrete (GFRC)."
3. Section 047200 "Cast Stone Masonry" for wet or dry cast stone facings, trim, and accessories.
4. Section 042000 "Unit Masonry" for thin brick setting materials and installation after precast concrete panel production.
5. Section 051200 "Structural Steel Framing" for furnishing and installing connections attached to structural-steel framing.
6. Section 055000 "Metal Fabrications" for kickers and other miscellaneous steel shapes.
7. Section 071900 "Water Repellents" for water-repellent finish treatments.
8. Section 085113 "Aluminum Windows" for windows set into architectural precast concrete units.
9. Section 093000 "Tiling" for ceramic tile setting materials and installation.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 DEFINITION

- A. Design Reference Sample: Sample of approved architectural precast concrete color, finish, and texture, preapproved by DEN Project Manager.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:
1. Loads: As indicated.
 2. Dead Loads: **<Insert applicable dead loads.>**
 3. Live Loads: **<Insert applicable live loads.>**
 4. Wind Loads: **<Insert applicable wind loads or wind-load criteria, positive and negative for various parts of building as required by applicable building code or ASCE 7, including basic wind speed, importance factor, exposure category, and pressure coefficient.>**
 5. Seismic Loads: **<Insert applicable seismic design data including seismic performance category, importance factor, use group, seismic design category, seismic zone, site classification, site coefficient, and drift criteria.>**
 6. Project Specific Loads: **<Insert applicable loads.>**
 7. Design framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements as follows:
 - a. Upward and downward movement of **[1/2 inch (13 mm)] [3/4 inch (19 mm)] [1 inch (25 mm)]**.
 8. Thermal Movements: Provide for in-plane thermal movements resulting from annual ambient temperature changes of **[80 deg F (26 deg C)] [120 deg F (67 deg C)] <Insert temperature range>**.
 9. Fire-Resistance Rating: Select material and minimum thicknesses to provide **[1] [2] <Insert number>**-hour fire rating.
 10. Window Washing System: Design precast units supporting window washing system indicated to resist pull-out and horizontal shear forces transmitted from window washing equipment.
 11. Vehicular Impact Loads: Design spandrel beams acting as vehicular barriers for passenger cars to resist a single **[6000-lb (26.7-kN)] <Insert load>** service load and **[10,000-lb (44.5-kN)] <Insert load>** ultimate load applied horizontally in any direction to the spandrel beam, with anchorages or attachments capable of transferring this load to the structure. Design spandrel beams assuming the load to act at a height of **18 inches (460 mm)** above the floor or ramp surface on an area not to exceed **1 sq. ft. (0.93 sq. m)**.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
- C. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.
- D. Shop Drawings: Detail fabrication and installation of architectural precast concrete units. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit. Indicate joints, reveals, and extent and location of each surface finish. Indicate details at building corners.
1. Indicate separate face and backup mixture locations and thicknesses.
 2. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware and connections.
 3. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
 4. Indicate locations, extent, and treatment of dry joints if two-stage casting is proposed.
 5. Include plans and elevations showing unit location and sequence of erection for special conditions.
 6. Indicate location of each architectural precast concrete unit by same identification mark placed on panel.
 7. Indicate relationship of architectural precast concrete units to adjacent materials.
 8. Indicate locations and details of brick units, including corner units and special shapes, and joint treatment.
 9. Indicate locations and details of stone facings, anchors, and joint widths.
 10. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
 11. Comprehensive engineering analysis [**signed and sealed**] [**certified**] by the qualified professional engineer responsible for its preparation. Show governing panel types, connections, and types of reinforcement, including special reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from architectural precast concrete.
- E. Samples: For each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of 3, illustrating full range of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches (300 by 300 by 50 mm).
1. When other faces of precast concrete unit are exposed, include Samples illustrating workmanship, color, and texture of backup concrete as well as facing concrete.
 2. Samples for each brick unit required, showing full range of color and texture expected. Include Sample showing color and texture of joint treatment.
 - a. Grout Samples for Initial Selection: Color charts consisting of actual sections of grout showing manufacturer's full range of colors.

- b. Grout Samples for Verification: Showing color and texture of joint treatment.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[Installer]** **[fabricator]** **[testing agency]**.
- B. Welding certificates.
- C. Material Certificates: For the following items, signed by manufacturers:
1. Cementitious materials.
 2. Reinforcing materials and prestressing tendons.
 3. Admixtures.
 4. Bearing pads.
 5. Structural-steel shapes and hollow structural sections.
 6. Brick units and accessories.
 7. Stone anchors.
- D. Material Test Reports: For aggregates.
- E. Source quality-control test reports.
- F. Field quality-control test[**and special inspection**] reports.

1.7 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: A precast concrete erector qualified and designated by PCI's Certificate of Compliance to erect Category **[A (Architectural Systems) for non-load]** **[S2 (Complex Structural Systems) for load]**-bearing members.
- B. Installer Qualifications: A precast concrete erector who has retained a "PCI-Certified Field Auditor" to conduct a field audit of a project in same category as this Project before erection of precast concrete and who can produce an Erectors' Post-Audit Declaration.
- C. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
1. Participates in PCI's plant certification program[**at time of bidding**] and is designated a PCI-certified plant for Group A, Category A1 - Architectural

Cladding and Load Bearing Units[**or participates in APA's "Plant Certification Program for Production of Architectural Precast Concrete Products" and is designated an APA-certified plant**].

- D. Testing Agency Qualifications: An independent testing agency[, **acceptable to authorities having jurisdiction,**] qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- E. Design Standards: Comply with **ACI 318** (ACI 318M) and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.
- F. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."
- G. Welding: Qualify procedures and personnel according to AWS D1.1/D.1.1M, "Structural Welding Code - Steel"; and AWS D1.4, "Structural Welding Code - Reinforcing Steel."
- H. Calculated Fire-Test-Response Characteristics: Where indicated, provide architectural precast concrete units whose fire resistance has been calculated according to **[ACI 216.1/TMS 0216.1, "Standard Method for Determining Fire Resistance of Concrete and Masonry Construction Assemblies,"]** **[PCI MNL 124, "Design for Fire Resistance of Precast Prestressed Concrete,"]** and is acceptable to authorities having jurisdiction.
- I. Sample Panels: After sample approval and before fabricating architectural precast concrete units, produce a minimum of **[2]** **<Insert number>** sample panels approximately **[16 sq. ft. (1.5 sq. m)]** **<Insert size>** in area for review by DEN Project Manager. Incorporate full-scale details of architectural features, finishes, textures, and transitions in sample panels.
1. Locate panels where indicated or, if not indicated, as directed by DEN Project Manager.
 2. Damage part of an exposed-face surface for each finish, color, and texture, and demonstrate adequacy of repair techniques proposed for repair of surface blemishes.
 3. After acceptance of repair technique, maintain one sample panel at manufacturer's plant and one at Project site in an undisturbed condition as a standard for judging the completed Work.
 4. Demolish and remove sample panels when directed.
- J. Range Samples: After sample panel approval and before fabricating architectural precast concrete units, produce a minimum of **[3]** **[5]** **<Insert number>** sets of samples, approximately **[16 sq. ft. (1.5 sq. m)]** **<Insert number>** in area, representing anticipated range of each color and texture on Project's units. Following range sample, maintain one set of samples at Project site and remaining sample sets at manufacturer's plant as color and texture approval reference.

- K. Mockups: After sample panel[**and range sample**] approval but before production of architectural precast concrete units, construct full-sized mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockup as indicated on Drawings including [**aluminum framing, glass, sealants,**] **<Insert construction>** and architectural precast concrete complete with anchors, connections, flashings, and joint fillers.
 2. Approved mockups may become part of the completed Work if undamaged at time of Substantial Completion.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents unless such deviations are specifically approved by DEN Project Manager in writing.
- L. Preconstruction Testing Mockup: Provide a full-size mockup of architectural precast concrete indicated on Drawings for preconstruction testing. Refer to Division **[01] [08]** **<Insert Division number>** Section "**<Insert Section title>**" for preconstruction testing requirements.
1. Build preconstruction testing mockup as indicated on Drawings including [**aluminum framing, glass, sealants,**] **<Insert construction>** and architectural precast concrete complete with anchors, connections, flashings, and joint fillers.
 2. Build preconstruction testing mockup at testing agency facility.
- M. Preinstallation Conference: Conduct conference at **[Project site]** **[location and time as determined by DEN Project Manager]** to comply with requirements in Section 013100 "Project Management And Coordination."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver architectural precast concrete units in such quantities and at such times to limit unloading units temporarily on the ground.
- B. Support units during shipment on nonstaining shock-absorbing material.
- C. Store units with adequate dunnage and bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
- D. Place stored units so identification marks are clearly visible, and units can be inspected.
- E. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses which would cause cracking or damage.
- F. Lift and support units only at designated points shown on Shop Drawings.

1.10 SEQUENCING

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Fabricators: Subject to compliance with requirements, fabricators offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Fabricators: Subject to compliance with requirements, provide products by one of the following:
 - 1. **<Insert, in separate subparagraphs, fabricator's name; product name or designation.>**
 - 2. or approved equal.

2.2 MOLD MATERIALS

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.
 - 1. Mold-Release Agent: Commercially produced liquid-release agent that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
- B. Form Liners: Units of face design, texture, arrangement, and configuration **[indicated] [to match those used for precast concrete design reference sample]**. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
- C. Surface Retarder: Chemical set retarder, capable of temporarily delaying final hardening of newly placed concrete mixture to depth of reveal specified.

2.3 REINFORCING MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25] [60] <Insert number> percent.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- D. Galvanized Reinforcing Bars: [ASTM A 615/A 615M, Grade 60 (Grade 420)] [ASTM A 706/A 706M], deformed bars, ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized[, and chromate wash treated after fabrication and bending].
- E. Epoxy-Coated Reinforcing Bars: [ASTM A 615/A 615M, Grade 60 (Grade 420)] [ASTM A 706/A 706M], deformed bars, [ASTM A 775/A 775M] [or] [ASTM A 934/A 934M] epoxy coated.
- F. Steel Bar Mats: ASTM A 184/A 184M, fabricated from [ASTM A 615/A 615M, Grade 60 (Grade 420)] [ASTM A 706/A 706M], deformed bars, assembled with clips.
- G. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from [as-drawn] [galvanized] steel wire into flat sheets.
- H. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- I. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, [plain] [deformed], flat sheet, Type [1 bendable] [2 nonbendable] coating.
- J. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

2.4 PRESTRESSING TENDONS

- A. Prestressing Strand: ASTM A 416/A 416M, Grade 270 (Grade 1860), uncoated, 7-wire, low-relaxation strand.
 - 1. Coat unbonded post-tensioning strand with corrosion inhibitor passing ASTM D 1743 and sheath with polypropylene tendon sheathing. Include anchorage devices and coupler assemblies.

2.5 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.
 - 1. For surfaces exposed to view in finished structure, mix gray with white cement, of same type, brand, and mill source.
- B. Supplementary Cementitious Materials:

1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
 2. Metakaolin Admixture: ASTM C 618, Class N.
 3. Silica Fume Admixture: ASTM C 1240, with optional chemical and physical requirement.
 4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
 - a. Gradation: [**Uniformly graded**] [**Gap graded**] [**To match design reference sample**].
 2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand of same material as coarse aggregate, unless otherwise approved by DEN Project Manager.
- D. Lightweight Aggregates: Except as modified by PCI MNL 117, ASTM C 330, with absorption less than 11 percent.
- E. Coloring Admixture: ASTM C 979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.
- F. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.
- G. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- H. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.
1. Water-Reducing Admixtures: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
 5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 7. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017 M.

2.6 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.

- B. Carbon-Steel-Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 117, Table 3.2.3.
 - C. Carbon-Steel Plate: ASTM A 283/A 283M.
 - D. Malleable Iron Castings: ASTM A 47/A 47M.
 - E. Carbon-Steel Castings: ASTM A 27/A 27M, [Grade 60-30](#) (Grade 415-205).
 - F. High-Strength, Low-Alloy Structural Steel: ASTM A 572/A 572M.
 - G. Carbon-Steel Structural Tubing: ASTM A 500, Grade B.
 - H. Wrought Carbon-Steel Bars: ASTM A 675/A 675M, [Grade 65](#) (Grade 450).
 - I. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706/A 706M.
 - J. Carbon-Steel Bolts and Studs: [ASTM A 307, Grade A](#) (ASTM F 568M, Property Class 4.6); carbon-steel, hex-head bolts and studs; carbon-steel nuts, [ASTM A 563](#) (ASTM A 563M); and flat, unhardened steel washers, ASTM F 844.
 - K. High-Strength Bolts and Nuts: [ASTM A 325](#) (ASTM A 325M), Type 1, heavy hex steel structural bolts; heavy hex carbon-steel nuts, [ASTM A 563](#) (ASTM A 563M); and hardened carbon-steel washers, [ASTM F 436](#) (ASTM F 436M).
 - L. Zinc-Coated Finish: For exterior steel items[, **steel in exterior walls,**] and items indicated for galvanizing, apply zinc coating by [**hot-dip process according to ASTM A 123/A 123M or ASTM A 153/A 153M**] [**electrodeposition according to ASTM B 633, SC 3, Types 1 and 2**].
 - 1. For steel shapes, plates, and tubing to be galvanized, limit silicon content of steel to less than 0.03 percent or to between 0.15 and 0.25 percent or limit sum of silicon and 2.5 times phosphorous content to 0.09 percent.
 - 2. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.
 - M. Shop-Primed Finish: Prepare surfaces of nongalvanized steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3 and shop-apply [**lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79**] [**SSPC-Paint 25**] according to SSPC-PA 1.
 - N. Welding Electrodes: Comply with AWS standards.
- 2.7 STAINLESS-STEEL CONNECTION MATERIALS
- A. Stainless-Steel Plate: ASTM A 666, Type 304, of grade suitable for application.

- B. Stainless-Steel Bolts and Studs: ASTM F 593, Alloy 304 or 316, hex-head bolts and studs; stainless-steel nuts; and flat, stainless-steel washers.
 - 1. Lubricate threaded parts of stainless-steel bolts with an antiseize thread lubricant during assembly.
- C. Stainless-Steel-Headed Studs: ASTM A 276, with minimum mechanical properties of PCI MNL 117, Table 3.2.3.

2.8 BEARING PADS

- A. Provide one of the following bearing pads for architectural precast concrete units[**as recommended by precast fabricator for application**]:
 - 1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, Type A durometer hardness of 50 to 70, ASTM D 2240, minimum tensile strength **2250 psi (15.5 MPa)**, ASTM D 412.
 - 2. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Type A durometer hardness of 70 to 90, ASTM D 2240; capable of supporting a compressive stress of **3000 psi (20.7 MPa)** with no cracking, splitting, or delaminating in the internal portions of pad. Test one specimen for every 200 pads used in Project.
 - 3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer; Type A durometer hardness of 80 to 100, ASTM D 2240; complying with AASHTO's "AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications, Division II, Section 18.10.2, or with MIL-C-882E.
 - 4. Frictionless Pads: Tetrafluoroethylene (Teflon), glass-fiber reinforced, bonded to stainless or mild-steel plate, of type required for in-service stress.
 - 5. High-Density Plastic: Multimer, nonleaching, plastic strip.

2.9 ACCESSORIES

- A. Reglets: Specified in Section 076200 "Sheet Metal Flashing And Trim."
- B. Reglets: [**PVC extrusions,**] [**Stainless steel, Type 302 or 304,**] [**Copper,**] felt or fiber filled, or with face opening of slots covered.
- C. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install architectural precast concrete units.

2.10 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

- B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, Portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time.
- C. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C 881/C 881M, of type, grade, and class to suit requirements.

2.11 THIN BRICK UNITS AND ACCESSORIES

- A. Thin Brick Units: ASTM C 216, Type FBX or ASTM C 1088, Grade Exterior, Type TBX, [not less than 1/2 inch (13 mm)] [3/4 inch (19 mm)] [1 inch (25 mm)] thick with a tolerance of plus or minus 1/16 inch (1.6 mm), and as follows:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. <Insert, in separate subparagraphs, manufacturer's name; product name or designation.>
 - b. or approved equal.
 - 2. Face Size: 2-1/4 inches (57 mm) high by 8 inches (203 mm) long.
 - 3. Face Size: 2-1/4 inches (57 mm) high by 7-1/2 to 7-5/8 inches (190 to 194 mm) long.
 - 4. Face Size: 2-3/4 to 2-13/16 inches (70 to 71 mm) high by 7-1/2 to 7-5/8 inches (190 to 194 mm) long.
 - 5. Face Size: 3-1/2 to 3-5/8 inches (89 to 92 mm) high by 7-1/2 to 7-5/8 inches (190 to 194 mm) long.
 - 6. Face Size: 3-1/2 to 3-5/8 inches (89 to 92 mm) high by 11-1/2 to 11-5/8 inches (292 to 295 mm) long.
 - 7. Face Size: <Insert dimensions.>
 - 8. [Where indicated to "match existing,"]provide thin brick matching color, texture, and face size of existing adjacent brick work.
 - a. <Insert information on existing brick if known.>
 - 9. Face Size: 57 mm high by 190 mm long.
 - 10. Face Size: 70 mm high by 190 mm long.
 - 11. Face Size: 90 mm high by 190 mm long.
 - 12. Face Size: 90 mm high by 290 mm long.
 - 13. Face Size: <Insert dimensions.>
 - 14. Special Shapes: Include corners, edge corners, and end edge corners.
 - 15. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute; ASTM C 67.
 - 16. Efflorescence: Tested according to ASTM C 67 and rated "not effloresced."
 - 17. Surface Coating: Thin brick with colors or textures applied as coatings shall withstand 50 cycles of freezing and thawing; ASTM C 67 with no observable difference in applied finish when viewed from 10 feet (3 m).
 - 18. Face Color and Texture: [Match DEN Project Manager's samples] [Medium brown, wire cut] [Full-range red, sand molded] [Gray, velour].

19. Back Surface Texture: Scored, combed, wire roughened, ribbed, keybacked, or dovetailed.
- B. Sand-Cement Mortar: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144. Mix at ratio of 1 part cement to 4 parts sand, by volume, with minimum water required for placement.
- C. Latex-Portland Cement Pointing Grout: ANSI A118.6 and as follows:
 1. Dry-grout mixture, factory prepared, of Portland cement, graded aggregate, and dry, redispersible, ethylene-vinyl-acetate additive for mixing with water; uniformly colored.
 2. Commercial Portland cement grout, factory prepared, with liquid styrene-butadiene rubber or acrylic-resin latex additive; uniformly colored.
 3. Colors: **[As indicated by manufacturer's designations] [Match Project Manager's samples] [As selected by Project Manager from manufacturer's full range].**

2.12 STONE MATERIALS AND ACCESSORIES

- A. Stone facing for architectural precast concrete is specified in Section 044200 "Exterior Stone Cladding."
- B. Anchors are generally supplied by stone fabricator or, in some cases, by precaster. Specify supplier. Anchors may be toe in, toe out, or dowels.
- C. Anchors: Stainless steel, ASTM A 666, Type 304, of temper and diameter required to support loads without exceeding allowable design stresses.
 1. Fit each anchor leg with neoprene grommet collar of width at least twice the diameter and of length at least five times the diameter of anchor.
- D. Sealant Filler: ASTM C 920, low-modulus, multicomponent, nonsag urethane sealant complying with requirements in Section 079200 "Joint Sealants" and that is nonstaining to stone substrate.
- E. Epoxy Filler: ASTM C 881/C 881M, 100 percent solids, sand-filled nonshrinking, nonstaining of type, class, and grade to suit application.
 1. Elastomeric Anchor Sleeve: **1/2 inch (13 mm)** long, Type A durometer hardness of 60, ASTM D 2240.
- F. Bond Breaker: **[Preformed, compressible, resilient, nonstaining, nonwaxing, closed-cell polyethylene foam pad, nonabsorbent to liquid and gas, 1/8 inch (3.2 mm) thick] [Polyethylene sheet, ASTM D 4397, 6 to 10 mils (0.15 to 0.25 mm) thick].**

2.13 INSULATED PANEL ACCESSORIES

- A. Molded-Polystyrene Board Insulation: ASTM C 578, Type [I, 0.90 lb/cu. ft. (15 kg/cu. m)] [VIII, 1.15 lb/cu. ft. (18 kg/cu. m)] [II, 1.35 lb/cu. ft. (22 kg/cu. m)]; [square] [ship-lap] edges; with R-value of <Insert value> and thickness of <Insert dimension>.
- B. Extruded-Polystyrene Board Insulation: ASTM C 578, Type [IV, 1.60 lb/cu. ft. (26 kg/cu. m)] [X, 1.30 lb/cu. ft. (21 kg/cu. m)] [VI, 1.80 lb/cu. ft. (29 kg/cu. m)]; [square] [ship-lap] edges; with R-value of <Insert value> and thickness of <Insert dimension>.
- C. Polyisocyanurate Board Insulation: ASTM C 591, Type [I, 1.8 lb/cu. ft. (29 kg/cu. m)] [IV, 2 lb/cu. ft. (32 kg/cu. m)] [II, 2.5 lb/cu. ft. (40 kg/cu. m)] unfaced, with R-value of <Insert value> and thickness of <Insert dimension>.
- D. Wythe Connectors: [Glass-fiber and vinyl-ester polymer connectors] [Polypropylene pin connectors] [Stainless-steel pin connectors] [Bent galvanized reinforcing bars or galvanized welded wire trusses] [Cylindrical metal sleeve anchors] manufactured to connect wythes of precast concrete panels.

2.14 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
 - 1. Limit use of fly ash and silica fume to 20 percent of Portland cement by weight; limit metakaolin and silica fume to 10 percent of Portland cement by weight.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.
- D. Normal-Weight Concrete Mixtures: Proportion [face mixtures] [face and backup mixtures] [full-depth mixture] [face and backup mixtures or full-depth mixtures, at fabricator's option] by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi (34.5 MPa) minimum.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
- E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 117.
- F. Lightweight Concrete Backup Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.2, with materials to be used on Project, to provide lightweight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi (34.5 MPa).

2. Unit Weight: Calculated equilibrium unit weight of **115 lb/cu. ft.** (1842 kg/cu. m), plus or minus **3 lb/cu. ft.** (48 kg/cu. m), according to ASTM C 567.

- G. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.
- H. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

2.15 MOLD FABRICATION

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
 - 1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.
- B. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
 - 1. Form joints are not permitted on faces exposed to view in the finished work.
 - 2. Edge and Corner Treatment: Uniformly [**chamfered**] [**radiused**].

2.16 THIN BRICK FACINGS

- A. Place form liner templates accurately to provide grid for thin brick facings. Provide solid backing and supports to maintain stability of liners while placing thin bricks and during concrete placement.
- B. Securely place thin brick units face down into form liner pockets and place concrete backing mixture.
- C. Completely fill joint cavities between thin brick units with sand-cement mortar, and place precast concrete backing mixture while sand-cement mortar is still fluid enough to ensure bond.
- D. Mix and install grout according to ANSI A108.10. Completely fill joint cavities between thin brick units with grout, and compress into place without spreading grout onto faces of thin brick units. Remove excess grout immediately to prevent staining of brick.
 - 1. Tool joints to a [**slightly concave**] [**grapevine**] [**V-**]shape when pointing grout is thumbprint hard.
- E. Clean faces and joints of brick facing.

2.17 STONE FACINGS

- A. Accurately position stone facings to comply with requirements and in locations indicated on Shop Drawings. Install anchors, supports, and other attachments indicated or necessary to secure stone in place. Keep concrete reinforcement a minimum of **3/4 inch (19 mm)** from the back surface of stone. Use continuous spacers to obtain uniform joints of widths indicated and with edges and faces aligned according to established relationships and indicated tolerances.
1. Stone to Precast Anchorages: Provide anchors in numbers, types and locations required to satisfy specified performance criteria, but not less than 2 anchors per stone unit of less than **2 sq. ft. (0.19 sq. m)** in area and 4 anchors per unit of less than **12 sq. ft. (1.1 sq. m)** in area; for units larger than **12 sq. ft. (1.1 sq. m)** in area, provide anchors spaced not more than **24 inches (600 mm)** o.c. horizontally and vertically. Locate anchors a minimum of **6 inches (150 mm)** from stone edge.
- B. Fill anchor holes with **[sealant filler and install anchors] [epoxy filler and install anchors with elastomeric anchor sleeve at back surface of stone]**.
1. Install polyethylene sheet to prevent bond between back of stone facing and concrete substrate and to ensure no passage of precast matrix to stone surface.
 2. Install **1/8-inch (3-mm)** polyethylene-foam bond breaker to prevent bond between back of stone facing and concrete substrate and to ensure no passage of precast matrix to stone surface. Maintain minimum projection requirements of stone anchors into concrete substrate.

2.18 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on the Contract Drawings.
- D. Cast-in openings larger than **10 inches (250 mm)** in any dimension. Do not drill or cut openings or prestressing strand without DEN Project Manager's approval.
- E. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A 775/A 775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
 2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
 3. Place reinforcement to maintain at least **3/4-inch (19-mm)** minimum coverage. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
 4. Place reinforcing steel and prestressing strand to maintain at least **3/4-inch (19-mm)** minimum concrete cover. Increase cover requirements for reinforcing steel to **1-1/2 inches (38 mm)** when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
 5. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.
- F. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses.
- G. Prestress tendons for architectural precast concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 117.
1. Delay detensioning or post-tensioning of precast, prestressed architectural concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under same conditions as concrete.
 2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat-cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
 3. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
 4. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and possible rust spots.
- H. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- I. Place face mixture to a minimum thickness after consolidation of the greater of **1 inch (25 mm)** or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.
- J. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.

1. Place backup concrete mixture to ensure bond with face-mixture concrete.
 - K. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 117.
 1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."
 - L. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.
 - M. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that will not show in finished structure.
 - N. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
 - O. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and DEN Project Manager's approval.
- 2.19 INSULATED PANEL CASTING
- A. Cast and screed supported wythe over mold.
 - B. Place insulation boards abutting edges and ends of adjacent boards. Insert wythe connectors through insulation, and consolidate concrete around connectors according to connector manufacturer's written instructions.
 - C. Cast and screed top wythe to meet required finish.
- 2.20 FABRICATION TOLERANCES
- A. Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.
 - B. Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with the following product tolerances:
 1. Overall Height and Width of Units, Measured at the Face Exposed to View: As follows:

- a. 10 feet (3 m) or under, plus or minus 1/8 inch (3 mm).
 - b. 10 to 20 feet (3 to 6 m), plus 1/8 inch (3 mm), minus 3/16 inch (5 mm).
 - c. 20 to 40 feet (6 to 12 m), plus or minus 1/4 inch (6 mm).
 - d. Each additional 10 feet (3 m), plus or minus 1/16 inch (1.5 mm).
2. Overall Height and Width of Units, Measured at the Face Not Exposed to View:
As follows:
- a. 10 feet (3 m) or under, plus or minus 1/4 inch (6 mm).
 - b. 10 to 20 feet (3 to 6 m), plus 1/4 inch (6 mm), minus 3/8 inch (10 mm).
 - c. 20 to 40 feet (6 to 12 m), plus or minus 3/8 inch (10 mm).
 - d. Each additional 10 feet (3 m), plus or minus 1/8 inch (3 mm).
3. Total Thickness or Flange Thickness: Plus 1/4 inch (6 mm), minus 1/8 inch (3 mm).
4. Rib Thickness: Plus or minus 1/8 inch (3 mm).
5. Rib to Edge of Flange: Plus or minus 1/8 inch (3 mm).
6. Distance between Ribs: Plus or minus 1/8 inch (3 mm).
7. Variation from Square or Designated Skew (Difference in Length of the Two Diagonal Measurements): Plus or minus 1/8 inch per 72 inches (3 mm per 1830 mm) or 1/2 inch (13 mm) total, whichever is greater.
8. Length and Width of Block-outs and Openings within One Unit: Plus or minus 1/4 inch (6 mm).
9. Location and Dimension of Block-outs Hidden from View and Used for HVAC and Utility Penetrations: Plus or minus 3/4 inch (19 mm).
10. Dimensions of Haunches: Plus or minus 1/4 inch (6 mm).
11. Haunch Bearing Surface Deviation from Specified Plane: Plus or minus 1/8 inch (3 mm).
12. Difference in Relative Position of Adjacent Haunch Bearing Surfaces from Specified Relative Position: Plus or minus 1/4 inch (6 mm).
13. Bowing: Plus or minus L/360, maximum 1 inch (25 mm).
14. Local Smoothness: 1/4 inch per 10 feet (6 mm per 3 m).
15. Warping: 1/16 inch per 12 inches (1.5 mm per 300 mm) of distance from nearest adjacent corner.
16. Tipping and Flushness of Plates: Plus or minus 1/4 inch (6 mm).
17. Dimensions of Architectural Features and Rustications: Plus or minus 1/8 inch (3 mm).
- C. Position Tolerances: For cast-in items measured from datum line location, as indicated on Shop Drawings.
1. Weld Plates: Plus or minus 1 inch (25 mm).
 2. Inserts: Plus or minus 1/2 inch (13 mm).
 3. Handling Devices: Plus or minus 3 inches (75 mm).
 4. Reinforcing Steel and Welded Wire Fabric: Plus or minus 1/4 inch (6 mm) where position has structural implications or affects concrete cover; otherwise, plus or minus 1/2 inch (13 mm).
 5. Reinforcing Steel Extending out of Member: Plus or minus 1/2 inch (13 mm) of plan dimensions.

6. Tendons: Plus or minus **1/4 inch (6 mm)**, vertical; plus or minus **1 inch (25 mm)**, horizontal.
 7. Location of Rustication Joints: Plus or minus **1/8 inch (3 mm)**.
 8. Location of Opening within Panel: Plus or minus **1/4 inch (6 mm)**.
 9. Location of Flashing Reglets: Plus or minus **1/4 inch (6 mm)**.
 10. Location of Flashing Reglets at Edge of Panel: Plus or minus **1/8 inch (3 mm)**.
 11. Reglets for Glazing Gaskets: Plus or minus **1/8 inch (3 mm)**.
 12. Electrical Outlets, Hose Bibs: Plus or minus **1/2 inch (13 mm)**.
 13. Location of Bearing Surface from End of Member: Plus or minus **1/4 inch (6 mm)**.
 14. Allowable Rotation of Plate, Channel Inserts, and Electrical Boxes: 2-degree rotation or **1/4 inch (6 mm)** maximum over the full dimension of unit.
 15. Position of Sleeve: Plus or minus **1/2 inch (13 mm)**.
 16. Location of Window Washer Track or Buttons: Plus or minus **1/8 inch (3 mm)**.
- D. Brick-Faced Architectural Precast Concrete Units: Restrict the following misalignments to 2 percent of number of bricks in a unit.
1. Alignment of Mortar Joints:
 - a. Jog in Alignment: **1/8 inch (3 mm)**.
 - b. Alignment with Panel Centerline: Plus or minus **1/8 inch (3 mm)**.
 2. Variation in Width of Exposed Mortar Joints: Plus or minus **1/8 inch (3 mm)**.
 3. Tipping of Individual Bricks from the Panel Plane of Exposed Brick Surface: Plus **1/16 inch (1.5 mm)**; minus **1/4 inch (6 mm)** less than or equal to depth of form liner joint.
 4. Exposed Brick Surface Parallel to Primary Control Surface of Panel: Plus **1/4 inch (6 mm)**; minus **1/8 inch (3 mm)**.
 5. Individual Brick Step in Face from Panel Plane of Exposed Brick Surface: Plus **1/16 inch (1.5 mm)**; minus **1/4 inch (6 mm)** less than or equal to depth of form liner joint.
- E. Stone Veneer-Faced Architectural Precast Concrete Units:
1. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated: Plus or minus **1/4 inch (6 mm)**.
 2. Variation in Joint Width: **1/8 inch in 36 inches (3 mm in 900 mm)** or a quarter of nominal joint width, whichever is less.
 3. Variation in Plane between Adjacent Stone Units (Lipping): **1/16 inch (1.5 mm)** difference between planes of adjacent units.

2.21 FINISHES

- A. Panel faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved [**design reference sample**] [**sample panels**] [**mockups**] and as follows:

1. Design Reference Sample: **<Insert description and identify fabricator and code number of sample.>**
2. PCI's "Architectural Precast Concrete - Color and Texture Selection Guide," of plate numbers indicated.
3. As-Cast Surface Finish: Provide surfaces free of pockets, sand streaks, and honeycombs.
4. Textured-Surface Finish: Impart by form liners or inserts to provide surfaces free of pockets, streaks, and honeycombs, with uniform color and texture.
5. Bushhammer Finish: Use power or hand tools to remove matrix and fracture coarse aggregates.
6. Exposed-Aggregate Finish: Use chemical retarding agents applied to concrete forms and washing and brushing procedures to expose aggregate and surrounding matrix surfaces after form removal.
7. Abrasive-Blast Finish: Use abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces.
8. Acid-Etched Finish: Use acid and hot-water solution, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces. Protect hardware, connections, and insulation from acid attack.
9. Honed Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.
10. Polished Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.
11. Sand-Embedment Finish: Use selected stones placed in a sand bed in bottom of mold, with sand removed after curing.

B. Finish exposed **[top] [bottom] [and back]** surfaces of architectural precast concrete units to match face-surface finish.

C. Finish exposed **[top] [bottom] [and back]** surfaces of architectural precast concrete units by smooth, steel-trowel finish.

D. Finish unexposed surfaces of architectural precast concrete units by float finish.

2.22 SOURCE QUALITY CONTROL

A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."

B. Owner will employ an independent testing agency to evaluate architectural precast concrete fabricator's quality-control and testing methods.

1. Allow Owner's testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with Owner's testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.

- C. Strength of precast concrete units will be considered deficient if units fail to comply with **ACI 318 (ACI 318M)** requirements for concrete strength.
- D. Testing: If there is evidence that strength of precast concrete units may be deficient or may not comply with **ACI 318 (ACI 318M)** requirements, precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M.
1. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by DEN Project Manager.
 2. Cores will be tested in an air-dry condition.
 3. Strength of concrete for each series of 3 cores will be considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.
 4. Test results will be made in writing on same day that tests are performed, with copies to DEN Project Manager, Contractor, and precast concrete fabricator. Test reports will include the following:
 - a. Project identification name and number.
 - b. Date when tests were performed.
 - c. Name of precast concrete fabricator.
 - d. Name of concrete testing agency.
 - e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
- E. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not install precast concrete units until supporting cast-in-place building structural framing has attained minimum allowable design compressive strength or supporting steel or other structure is complete.

3.2 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.
- B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.
1. Install temporary steel or plastic spacing shims or bearing pads as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
 4. Unless otherwise indicated, maintain uniform joint widths of **3/4 inch (19 mm)**.
- C. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
1. Do not permit connections to disrupt continuity of roof flashing.
- D. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
1. Protect architectural precast concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
 2. Welds not specified shall be continuous fillet welds, using no less than the minimum fillet as specified by AWS.
 3. Clean weld-affected metal surfaces with chipping hammer followed by brushing, and apply a minimum **4.0-mil- (0.1-mm-)** thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780.
 4. Clean weld-affected metal surfaces with chipping hammer followed by brushing, and reprime damaged painted surfaces.
 5. Remove, reweld, or repair incomplete and defective welds.
- E. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot. For friction connections, apply specified bolt torque and check 25 percent of bolts at random by calibrated torque wrench.
- F. Grouting Connections: Grout connections where required or indicated. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping

until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.

3.3 ERECTION TOLERANCES

- A. Erect architectural precast concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.
- B. Erect architectural precast concrete units level, plumb, square, and true, without exceeding the following noncumulative erection tolerances:
1. Plan Location from Building Grid Datum: Plus or minus **1/2 inch (13 mm)**.
 2. Plan Location from Centerline of Steel: Plus or minus **1/2 inch (13 mm)**.
 3. Top Elevation from Nominal Top Elevation: As follows:
 - a. Exposed Individual Panel: Plus or minus **1/4 inch (6 mm)**.
 - b. Non-Exposed Individual Panel: Plus or minus **1/2 inch (13 mm)**.
 - c. Exposed Panel Relative to Adjacent Panel: **1/4 inch (6 mm)**.
 - d. Non-Exposed Panel Relative to Adjacent Panel: **1/2 inch (13 mm)**.
 4. Support Elevation from Nominal Support Elevation: As follows:
 - a. Maximum Low: **1/2 inch (13 mm)**.
 - b. Maximum High: **1/4 inch (6 mm)**.
 5. Maximum Plumb Variation over the Lesser of Height of Structure or **100 Feet (30 m)**: **1 inch (25 mm)**.
 6. Plumb in Any **10 Feet (3 m)** of Element Height: **1/4 inch (6 mm)**.
 7. Maximum Jog in Alignment of Matching Edges: **1/4 inch (6 mm)**.
 8. Joint Width (Governs over Joint Taper): Plus or minus **1/4 inch (6 mm)**.
 9. Maximum Joint Taper: **3/8 inch (10 mm)**.
 10. Joint Taper in **10 Feet (3 m)**: **1/4 inch (6 mm)**.
 11. Maximum Jog in Alignment of Matching Faces: **1/4 inch (6 mm)**.
 12. Differential Bowing or Camber, as Erected, between Adjacent Members of Same Design: **1/4 inch (6 mm)**.
 13. Opening Height between Spandrels: Plus or minus **1/4 inch (6 mm)**.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: **[Owner will engage] [Engage]** a qualified special inspector to perform the following special inspections and prepare reports:
1. Erection of precast concrete members.
 2. **<Insert special inspections.>**
- B. Testing Agency: **[Owner will engage] [Engage]** a qualified testing agency to perform tests and inspections and prepare test reports.

- C. Field welds will be subject to visual inspections and nondestructive testing according to ASTM E 165 or ASTM E 709. High-strength bolted connections will be subject to inspections.
- D. Testing agency will report test results promptly and in writing to Contractor and DEN Project Manager.
- E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 REPAIRS

- A. Repair architectural precast concrete units if permitted by DEN Project Manager. The DEN Project Manager reserves the right to reject repaired units that do not comply with requirements.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of **20 feet (6 m)**.
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.
- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.6 CLEANING

- A. Clean surfaces of precast concrete units exposed to view.
- B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 034500

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Concrete masonry units.
2. Concrete building brick.
3. Decorative concrete masonry units.
4. Pre-faced concrete masonry units.
5. Concrete facing brick.
6. Face brick.
7. Building (common) brick.
8. Hollow brick.
9. Glazed brick.
10. Structural-clay facing tile.
11. Stone trim units.
12. Mortar and grout.
13. Steel reinforcing bars.
14. Masonry joint reinforcement.
15. Ties and anchors.
16. Embedded flashing.
17. Miscellaneous masonry accessories.
18. Masonry-cell insulation.
19. Cavity-wall insulation.

- B. Related Sections:

1. Section 033000 "Cast-in-Place Concrete" for [**installing**] dovetail slots for masonry anchors.
2. Section 042300 "Glass Unit Masonry" for glass block.
3. Section 047200 "Cast Stone Masonry" for furnishing cast stone trim.
4. Section 051200 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
5. Section 055000 "Metal Fabrications" for furnishing steel [**lintels**] [**and**] [**shelf angles**] for unit masonry.
6. Section 071900 "Water Repellents" for water repellents applied to unit masonry.

7. Section 076200 "Sheet Metal Flashing and Trim" for [**exposed**] sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.
8. Section 079200 "Joint Sealants" for sealants and related products.
9. Section 089000 "Louvers and Vents" for wall vents (brick vents).
10. Section 096313 "Brick Flooring" for interior brick flooring.
11. Section 096313.35 "Chemical-Resistant Brick Flooring" for chemical-resistant, interior brick flooring.
12. Section 097500 "Stone Facing" for stone window stools.
13. Section 321400 "Unit Paving" for exterior unit masonry paving.
14. Section 323223 "Segmental Retaining Walls" for dry-laid, concrete unit retaining walls.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide[**structural**] unit masonry that develops indicated net-area compressive strengths at 28 days.
 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
 2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: [**Owner will**] Engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
 1. Clay Masonry Unit Test: For each type of unit required, according to ASTM C 67 for compressive strength.
 2. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
 3. Mortar Test (Property Specification): For each mix required, according to ASTM C 109/C 109M for compressive strength[, **ASTM C 1506 for water retention, and ASTM C 91 for air content**].
 4. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.

5. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.
6. Prism Test: For each type of construction required, according to ASTM C 1314.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated or required, including certifications that each type complies with specified requirements.
 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
- C. Shop Drawings: For the following:
 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 2. Stone Trim Units: Show sizes, profiles, and locations of each stone trim unit required.
 3. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." [**Show elevations of reinforced walls.**]
 4. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- D. Samples for Initial Selection:
 1. Decorative CMUs, in the form of small-scale units.
 2. Pre-faced CMUs.
 3. Concrete facing brick, in the form of small-scale units.
 4. **[Face] [Hollow] brick[, in the form of straps of five or more bricks].**
 5. Glazed brick.
 6. Glazed structural-clay tile.
 7. Stone trim.
 8. Colored mortar.
 9. Weep holes/vents.
- E. Samples for Verification: For each type and color of the following:
 1. **[Exposed] [Decorative] CMUs.**
 2. Pre-faced CMUs.
 3. Concrete facing brick.
 4. **[Face] [Hollow] brick[, in the form of straps of five or more bricks].**
 5. Special brick shapes.

6. Glazed brick.
7. Glazed structural-clay tile.
8. Unglazed structural-clay tile.
9. Stone trim.
10. **[Pigmented] [and] [colored-aggregate]** mortar. Make Samples using same sand and mortar ingredients to be used on Project.
11. Weep holes **[and vents]**.
12. Accessories embedded in masonry.

1.7 INFORMATIONAL SUBMITTALS

- A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
 1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of DEN Project Manager and approved in writing.
- B. Qualification Data: For testing agency.
- C. Certificate from the manufacturer stating that all materials are per contract requirements and proof of minimum five (5) years experience manufacturing same.
- D. Certificate from installer evidencing minimum three (3) years experience successfully installing this type of work.
- E. Material Certificates: For each type and size of the following:
 1. Masonry units.
 - a. Include **[data on material properties] [material test reports substantiating compliance with requirements]**.
 - b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
 - c. For exposed brick, include test report for efflorescence according to ASTM C 67.
 - d. For surface-coated brick, include test report for durability of surface appearance after 50 cycles of freezing and thawing per ASTM C 67 **[or a list of addresses of buildings in Project's area where proposed brick has been used successfully and with a history of durability]**.
 - e. For masonry units **[used in structural masonry]**, include data and calculations establishing average net-area compressive strength of units.
 2. Cementitious materials. Include brand, type, and name of manufacturer.
 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.

4. Grout mixes. Include description of type and proportions of ingredients.
 5. Reinforcing bars.
 6. Joint reinforcement.
 7. Anchors, ties, and metal accessories.
- F. Mix Designs: For each type of mortar[**and grout**]. Include description of type and proportions of ingredients.
1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- G. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
- H. Cold-Weather[**and Hot-Weather**] Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.
- 1.8 CLOSEOUT SUBMITTALS
- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".
- 1.9 QUALITY ASSURANCE
- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- E. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.
1. Build sample panels for [**each type of exposed unit masonry construction**]

- [**typical exterior wall**] [**typical interior wall**] [**typical exterior and interior walls**] in sizes approximately [48 inches (1200 mm)] [60 inches (1500 mm)] <Insert size> long by [36 inches (900 mm)] [48 inches (1200 mm)] <Insert size> high[**by full thickness**].
2. Where masonry is to match existing, erect panels adjacent and parallel to existing surface.
 3. Clean[**one-half of**] exposed faces of panels with masonry cleaner indicated.
 4. Protect approved sample panels from the elements with weather-resistant membrane.
 5. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by DEN Project Manager in writing.
 - a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by DEN Project Manager in writing.
- F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution. Build mockups in locations as directed by DEN Project Manager.
1. Build mockup of typical wall area as shown on Drawings.
 2. Build mockups for [**each type of exposed unit masonry construction**] [**typical exterior wall**] [**typical interior wall**] [**typical exterior and interior walls**] in sizes approximately [48 inches (1200 mm)] [60 inches (1500 mm)] [72 inches (1800 mm)] [96 inches (2400 mm)] <Insert size> long by [36 inches (900 mm)] [48 inches (1200 mm)] [60 inches (1500 mm)] [72 inches (1800 mm)] <Insert size> high by full thickness, including face and backup wythes and accessories.
 - a. Include a sealant-filled joint at least 16 inches (400 mm) long in [**each**] [**exterior wall**] mockup.
 - b. Include lower corner of window opening[**framed with stone trim**] at upper corner of exterior wall mockup. Make opening approximately 12 inches (300 mm) wide by 16 inches (400 mm) high.
 - c. Include through-wall flashing installed for a 24-inch (600-mm) length in corner of exterior wall mockup approximately 16 inches (400 mm) down from top of mockup, with a 12-inch (300-mm) length of flashing left exposed to view (omit masonry above half of flashing).
 - d. Include [**metal**] [**wood**] studs, sheathing, [**building paper**] [**building wrap**] [**sheathing joint-and-penetration treatment**] [**air barrier**], veneer anchors, flashing[, **cavity drainage material**], and weep holes in exterior masonry-veneer wall mockup.
 - e. Include [**glazed structural-clay tile**] [**pre-faced CMUs**] on one face of interior unit masonry wall mockup.
 3. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
 4. Clean[**one-half of**] exposed faces of mockups with masonry cleaner as indicated.

5. Protect accepted mockups from the elements with weather-resistant membrane.
6. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
 - a. Approval of mockups is also for other material and construction qualities specifically approved by DEN Project Manager in writing.
 - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by DEN Project Manager in writing.
- G. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]** to comply with requirements in Section 013100 "Project Management and Coordination."
- H. Manufacturer of sealer shall:
 1. Pre-approve CMU substrate condition. Submit letter to DEN Project Manager accepting substrate.
 2. Be present at job-site when sealer is initially installed.
 3. Certify that sealer has been applied per manufacturers recommendations.
- I. Warranty: Installer to warrant installation, masonry units, grout and accessories for minimum **[two (2)] <Insert number>** years.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store and handle masonry units to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion or other causes.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- E. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- F. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.11 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
1. Extend cover a minimum of **24 inches (600 mm)** down both sides of walls and hold cover securely in place.
 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of **24 inches (600 mm)** down face next to unconstructed wythe and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three (3) days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 2. Protect sills, ledges, and projections from mortar droppings.
 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is **40 deg F (4 deg C)** and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Cold Weather Protection:
1. Do not lay masonry units which are wet or frozen.
 2. Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.
 3. Remove masonry damaged by freezing conditions.
 4. Perform the following construction procedures while masonry work is progressing. Temperature ranges indicated below apply to air temperatures existing at time of installation except for grout. The contractor is to keep a thermometer at each site for use by the field crew and the inspectors.
 - a. For grout, temperature ranges apply to anticipated minimum night temperatures. In heating mortar and grout materials, maintain mixing temperature selected within **10 deg. F (6 deg. C)**.

- 1) 40 deg. F (4 deg. C) to 32 deg. F (0 deg. C):
 - a) Mortar: Heat mixing water to produce mortar temperature between 40 deg. F (4 deg. C) and 120 deg. F (49 deg. C).
 - b) Grout: Follow normal masonry procedures.
- 2) 32 deg. F (0 deg. C) to 25 deg. F (4 deg. C):
 - a) Mortar: Heat mixing water and sand to produce mortar temperatures between 40 deg. F (4 deg. C) and 120 deg. F (49 deg. C); maintain temperature of mortar on boards above freezing.
 - b) Grout: Heat grout materials to 90 deg. F (32 deg. C) to produce in place grout temperature of 70 deg. F (21 deg. C) at end of work day.
- 3) 25 deg. F (4 deg. C) to 20 deg. F (7 deg. C):
 - a) Mortar: Heat mixing water and sand to produce mortar temperatures between 40 deg. F (4 deg. C) and 120 deg. F (49 deg. C); maintain temperature of mortar on boards above freezing.
 - b) Grout: Heat grout materials to 90 deg. F (32 deg. C) to produce in place grout temperature of 70 deg. F (21 deg. C) at end of work day.
 - c) Heat both sides of walls under construction using salamanders or other heat sources.
 - d) Use windbreaks or enclosures when wind is in excess of 15 mph.
- 4) 20 deg. F (7 deg. C) and below:
 - a) Mortar: Heat mixing water and sand to produce mortar temperatures between 40 deg. F (4 deg. C) and 120 deg. F (49 deg. C).
 - b) Grout: Heat grout materials to 90 deg. F (32 deg. C) to produce in place grout temperature of 70 deg. F (21 deg. C) at end of work day.
 - c) Masonry Units: Heat masonry units so that they are above 20 deg. F (7 deg. C) at time of laying.
 - d) Provide enclosure and auxiliary heat to maintain an air temperature of at least 40 deg. F (4 deg. C) for 24 hours after laying units.
 - e) Do not heat water for mortar and grout to above 160 deg. F (71 deg. C).
5. Protect completed masonry and masonry not being worked on in the following manner. Temperature ranges indicated apply to mean daily air temperatures except for grouted masonry. For grouted masonry, temperature ranges apply to anticipated minimum night temperatures.

- a. 40 deg. F (4 deg. C) to 32 deg. F (0 deg. C):
 - 1) Protect masonry from rain or snow for at least 24 hours by covering with weather resistive membrane.
 - b. 32 deg. F (0 deg. C) to 25 deg. F (4 deg. C):
 - 1) Completely cover masonry with weather resistive membrane for at least 24 hours.
 - c. 25 deg. F (4 deg. C) to 20 deg. F (7 deg. C):
 - 1) Completely cover masonry with weather resistive insulating blankets or similar protection for at least 24 hours, 48 hours for grouted masonry.
 - d. 20 deg. F (7 deg. C) and below:
 - 1) Except as otherwise indicated, maintain masonry temperature above 32 deg. F (0 deg. C) for 24 hours using enclosures and supplementary heat, electric heating blankets, infrared lamps or other methods proven to be satisfactory. For grouted masonry maintain heated enclosure to 40 deg. F (4 deg. C) for 48 hours.
- F. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
- G. CONSTRUCTION WASTE MANAGEMENT
1. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

- A. Regional Materials: CMUs shall be manufactured within **500 miles (800 km)** of Project site from aggregates[**and cement**] that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles (800 km)** of Project site.
- B. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 2. Provide [**square-edged**] [**bullnose**] units for outside corners unless otherwise indicated.
- C. Integral Water Repellent: Provide units made with integral water repellent [**for exposed units**] [**and**] [**where indicated**].
1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514 as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.
 - a. Products: Subject to compliance with requirements, provide products by one of the following:
 - 1) ACM Chemistries; RainBloc.
 - 2) BASF Aktiengesellschaft; Rheapel Plus.
 - 3) Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block.
 - 4) **<Insert manufacturer>**
 - 5) or approved equal.
- D. CMUs: ASTM C 90.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of [**2150 psi (14.8 MPa)**] [**2800 psi (19.3 MPa)**] [**3050 psi (21.0 MPa)**] **<Insert value>**.
 2. Density Classification: [**Lightweight**] [**Medium weight**] [**Normal weight**][**unless otherwise indicated**].
 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
 4. Size (Width): Manufactured to the following dimensions:
 - a. 100 mm nominal; [**90**] [**92**] mm actual.
 - b. 150 mm nominal; [**140**] [**143**] mm actual.
 - c. 200 mm nominal; [**190**] [**194**] mm actual.
 - d. 250 mm nominal; [**240**] [**244**] mm actual.
 - e. 300 mm nominal; [**290**] [**295**] mm actual.
 - f. 400 mm nominal; [**390**] [**396**] mm actual.

5. Exposed Faces: Provide color and texture matching the range represented by DEN Project Manager's sample.
 6. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.
- E. Concrete Building Brick: ASTM C 55.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of [2800 psi (19.31 MPa)] [3050 psi (21.03 MPa)] [3750 psi (25.86 MPa)] [4050 psi (27.92 MPa)] <Insert value>.
 2. Density Classification: [Lightweight] [Medium weight] [Normal weight].
 3. Size (Actual Dimensions): 3-5/8 inches (92 mm) wide by [2-1/4 inches (57 mm)] [2-3/4 inches (70 mm)] [3-5/8 inches (92 mm)] high by 7-5/8 inches (194 mm) long.
 4. Size (Actual Dimensions): 90 mm wide by [57] [70] [90] mm high by 190 mm long.
- F. Decorative CMU's: ASTM C 90.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. <Insert, in separate subparagraphs, manufacturer's name; product name or designation>.
 - b. or approved equal.
 2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of [2150 psi (14.8 MPa)] [2800 psi (19.3 MPa)] [3050 psi (21.0 MPa)] <Insert value>.
 3. Density Classification: [Lightweight] [Medium weight] [Normal weight].
 4. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph.
 5. Pattern and Texture:
 - a. Standard pattern, ground-face finish.[Match DEN Project Manager's samples.]
 - b. Standard pattern, split-face finish.[Match DEN Project Manager's samples.]
 - c. Standard pattern, split-ribbed finish.[Match DEN Project Manager's samples.]
 - d. Scored vertically so units laid in running bond appear as square units laid in stacked bond, standard finish.[Match DEN Project Manager's samples.]
 - e. Triple scored vertically so units laid in running bond appear as vertical units laid in stacked bond (soldier courses), standard finish.[Match DEN Project Manager's samples.]
 6. Colors: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range].
 7. Special Aggregate: Provide units made with aggregate matching aggregate in DEN Project Manager's sample.

- G. Pre-faced CMUs: Lightweight [**hollow**] [**solid**] concrete units complying with ASTM C 90, with manufacturer's standard smooth resinous facing complying with ASTM C 744.
1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. <Insert, in separate subparagraphs, manufacturer's name; product name or designation>.
 - b. or approved equal.
 2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of [2150 psi (14.8 MPa)] [2800 psi (19.3 MPa)] [3050 psi (21.0 MPa)] <Insert value>.
 3. Size: Manufactured to dimensions specified in "CMUs" Paragraph but with pre-faced surfaces having 1/16-inch- (1.5-mm-) wide returns of facing to create 1/4-inch- (6.5-mm-) wide mortar joints with modular coursing.
 4. Colors and Patterns: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range].

H. Concrete Facing Brick: ASTM C 1634.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of [3750 psi (25.86 MPa)] [4050 psi (27.92 MPa)] <Insert value>.
2. Density Classification: [Lightweight] [Medium weight] [Normal weight].
3. Size (Actual Dimensions): 3-5/8 inches (92 mm) wide by [2-1/4 inches (57 mm)] [2-3/4 inches (70 mm)] [3-5/8 inches (92 mm)] high by [7-5/8 inches (194 mm)] [11-5/8 inches (295 mm)] [15-5/8 inches (397 mm)] long.
4. Size (Actual Dimensions): 90 mm wide by [57] [70] [90] mm high by [190] [290] [390] mm long.
5. Texture: [Split-face finish] [Ground-face finish] <Insert description>.
 - a. Match DEN Project Manager's samples.
6. Colors: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range].
7. Special Aggregate: Provide units made with aggregate matching aggregate in DEN Project Manager's sample.

2.3 [CONCRETE] [AND] [MASONRY] LINTELS

- A. General: Provide one of the following:
- B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. [Provide lintels with net-area compressive strength not less than CMUs.]

- C. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Section 033000 "Cast-in-Place Concrete," and with reinforcing bars indicated.
- D. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.4 BRICK

- A. Regional Materials: Brick shall be manufactured within **500 miles (800 km)** of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles (800 km)** of Project site.
- B. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
 - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
 - 2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
 - 3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
 - 4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- C. Face Brick: Facing brick complying with ASTM C 216[**or hollow brick complying with ASTM C 652, Class H40V (void areas between 25 and 40 percent of gross cross-sectional area)**].
 - 1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation for acceptable face brick>**.
 - b. or approved equal.
 - 2. Grade: **[SW] [MW or SW]**.
 - 3. Type: **[FBX] [FBS] [FBA] [FBX or HBX] [FBS or HBS] [FBA or HBA]**.
 - 4. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of **[3350 psi (23.10 MPa)] [4150 psi (28.61 MPa)] [4950 psi (34.13 MPa)] [6200 psi (42.75 MPa)] [6600 psi (45.51 MPa)] [8250 psi (56.88 MPa)] <Insert value>**.
 - 5. Initial Rate of Absorption: Less than **30 g/30 sq. in. (30 g/194 sq. cm)** per minute when tested per ASTM C 67.

6. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
7. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet (3 m) [or shall have a history of successful use in Project's area].
8. Size (Actual Dimensions): [3-1/2 inches (89 mm) wide by 2-1/4 inches (57 mm) high by 7-1/2 inches (190 mm) long] [or] [3-5/8 inches (92 mm) wide by 2-1/4 inches (57 mm) high by 7-5/8 inches (194 mm) long].
9. Size (Actual Dimensions): [3-1/2 inches (89 mm)] [or] [3-5/8 inches (92 mm)] wide by 2-1/4 inches (57 mm) high by 8 inches (203 mm) long.
10. Size (Actual Dimensions): [3-1/2 inches (89 mm) wide by 2-1/4 inches (57 mm) high by 11-1/2 inches (292 mm) long] [or] [3-5/8 inches (92 mm) wide by 2-1/4 inches (57 mm) high by 11-5/8 inches (295 mm) long].
11. Size (Actual Dimensions): [2-3/4 inches (70 mm) wide by 2-3/4 inches (70 mm) high by 8 inches (203 mm) long] [or] [3 inches (76 mm) wide by 2-3/4 inches (70 mm) high by 8 inches (203 mm) long].
12. Size (Actual Dimensions): [2-3/4 inches (70 mm) wide by 2-5/8 inches (67 mm) high by 9-5/8 inches (244 mm) long] [or] [3 inches (76 mm) wide by 2-3/4 inches (70 mm) high by 9-5/8 inches (244 mm) long].
13. Size (Actual Dimensions): [3-1/2 inches (89 mm) wide by 2-3/4 inches (70 mm) high by 7-1/2 inches (190 mm) long] [or] [3-5/8 inches (92 mm) wide by 2-13/16 inches (71 mm) high by 7-5/8 inches (194 mm) long].
14. Size (Actual Dimensions): [3-1/2 inches (89 mm) wide by 2-3/4 inches (70 mm) high by 8 inches (203 mm) long] [or] [3-5/8 inches (92 mm) wide by 2-13/16 inches (71 mm) high by 8 inches (203 mm) long].
15. Size (Actual Dimensions): 3-5/8 inches (92 mm) wide by 2-5/8 inches (67 mm) high by 9-5/8 inches (244 mm) long.
16. Size (Actual Dimensions): [3-1/2 inches (89 mm) wide by 2-3/4 inches (70 mm) high by 11-1/2 inches (292 mm) long] [or] [3-5/8 inches (92 mm) wide by 2-13/16 inches (71 mm) high by 11-5/8 inches (295 mm) long].
17. Size (Actual Dimensions): [2-3/4 inches (70 mm) wide by 3-5/8 inches (92 mm) high by 11-5/8 inches (295 mm) long] [or] [3 inches (76 mm) wide by 3-5/8 inches (92 mm) high by 11-5/8 inches (295 mm) long].
18. Size (Actual Dimensions): [3-1/2 inches (89 mm) wide by 3-1/2 inches (89 mm) high by 7-1/2 inches (190 mm) long] [or] [3-5/8 inches (92 mm) wide by 3-5/8 inches (92 mm) high by 7-5/8 inches (194 mm) long].
19. Size (Actual Dimensions): [3-1/2 inches (89 mm) wide by 3-1/2 inches (89 mm) high by 11-1/2 inches (292 mm) long] [or] [3-5/8 inches (92 mm) wide by 3-5/8 inches (92 mm) high by 11-5/8 inches (295 mm) long].
20. Size (Actual Dimensions): [3-1/2 inches (89 mm) wide by 7-1/2 inches (190 mm) high by 7-1/2 inches (190 mm) long] [or] [3-5/8 inches (92 mm) wide by 7-5/8 inches (194 mm) high by 7-5/8 inches (194 mm) long].
21. Size (Actual Dimensions): 90 mm wide by [57] [70] [90] [190] mm high by [190] [290] mm long.
22. Application: Use where brick is exposed unless otherwise indicated.
23. [Where shown to "match existing,"]provide face brick matching color range, texture, and size of existing adjacent brickwork.
 - a. <Insert information on existing brick if known>.

24. Color and Texture: **[Medium brown, wire-cut] [Full-range red, sand molded] [Buff, velour] [Match DEN Project Manager's samples] [As selected by DEN Project Manager].**
- D. Building (Common) Brick: ASTM C 62, **[Grade SW] [Grade MW or SW] [Grade NW, MW, or SW].**
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of **[1700 psi (11.72 MPa)] [2100 psi (14.48 MPa)] [3350 psi (23.10 MPa)] [4150 psi (28.61 MPa)] [4950 psi (34.13 MPa)] [6200 psi (42.75 MPa)] [6600 psi (45.51 MPa)] [8250 psi (56.88 MPa)] <Insert value>.**
 2. Size: Match size of face brick.
 3. Size (Actual Dimensions): **[3-1/2 inches (89 mm) wide by 2-1/4 inches (57 mm) high by 7-1/2 inches (190 mm) long] [or] [3-5/8 inches (92 mm) wide by 2-1/4 inches (57 mm) high by 7-5/8 inches (194 mm) long].**
 4. Size (Actual Dimensions): 90 mm wide by 57 mm high by 190 mm long.
 5. Application: Use where brick is indicated for concealed locations.**[Face brick complying with requirements for grade, compressive strength, and size indicated for building brick may be substituted for building brick.]**
- E. Hollow Brick: ASTM C 652, **[Grade SW] [Grade MW or SW], [Class H40V (void areas between 25 and 40 percent of gross cross-sectional area)] [Class H60V (void areas between 40 and 60 percent of gross cross-sectional area)], [Type HBX] [Type HBS] [Type HBA] [Type HBB].**
1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation for acceptable hollow brick>.**
 - b. or approved equal.
 2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of **[3350 psi (23.10 MPa)] [4150 psi (28.61 MPa)] [4950 psi (34.13 MPa)] [6200 psi (42.75 MPa)] [6600 psi (45.51 MPa)] [8250 psi (56.88 MPa)] <Insert value>.**
 3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
 4. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from **10 feet (3 m)****[or shall have a history of successful use in Project's area].**
 5. Size (Actual Dimensions): **[5-1/2 inches (140 mm) wide by 3-1/2 inches (89 mm) high by 11-1/2 inches (292 mm) long] [or] [5-5/8 inches (143 mm) wide by 3-5/8 inches (92 mm) high by 11-5/8 inches (295 mm) long].**
 6. Size (Actual Dimensions): **[7-1/2 inches (190 mm) wide by 3-1/2 inches (89 mm) high by 11-1/2 inches (292 mm) long] [or] [7-5/8 inches (194 mm) wide by 3-5/8 inches (92 mm) high by 11-5/8 inches (295 mm) long].**

7. Size (Actual Dimensions): [5-1/2 inches (140 mm) wide by 3-1/2 inches (89 mm) high by 15-1/2 inches (394 mm) long] [or] [5-5/8 inches (143 mm) wide by 3-5/8 inches (92 mm) high by 15-5/8 inches (397 mm) long].
 8. Size (Actual Dimensions): [7-1/2 inches (190 mm) wide by 3-1/2 inches (89 mm) high by 15-1/2 inches (394 mm) long] [or] [7-5/8 inches (194 mm) wide by 3-5/8 inches (92 mm) high by 15-5/8 inches (397 mm) long].
 9. Size (Actual Dimensions): 4-5/8 inches (117 mm) wide by 2-3/4 inches (70 mm) high by 9-5/8 inches (244 mm) long.
 10. Size (Actual Dimensions): 90 mm wide by [57] [70] [90] [190] mm high by [190] [290] mm long.
 11. Size (Actual Dimensions): [140] [190] mm wide by 90 mm high by 290 mm long.
 12. Application: Use where brick is exposed unless otherwise indicated.
 13. [Where shown to "match existing,"]provide hollow brick matching color range, texture, and size of existing adjacent brickwork.
 - a. <Insert information on existing brick if known>.
 14. Color and Texture: [Medium brown, wire-cut] [Full-range red, smooth texture] [Buff, velour] [Match DEN Project Manager's samples] [As selected by DEN Project Manager].
- F. Glazed Face Brick: [Facing brick complying with ASTM C 216, with glaze complying with ASTM C 126;] [single-fired glazed brick complying with ASTM C 1405, Division Solid;] [hollow brick complying with ASTM C 652, Class H40V (void areas between 25 and 40 percent of gross cross-sectional area), with glaze complying with ASTM C 126;] [or] [single-fired glazed brick complying with ASTM C 1405, Division H40V (void areas between 25 and 40 percent of gross cross-sectional area)].
1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. <Insert, in separate subparagraphs, manufacturer's name; product name or designation for acceptable glazed face brick>.
 - b. or approved equal.
 2. ASTM C 216 Grade: [SW] [MW or SW].
 3. ASTM C 216 Type: [FBX] [FBS] [FBA].
 4. ASTM C 652 Grade: [SW] [MW or SW].
 5. ASTM C 652 Type: [HBX] [HBS] [HBA].
 6. ASTM C 1405 Class: [Exterior] [Interior].
 7. ASTM C 1405 Grade: [S (Select)] [SS (Select Sized)].
 8. Size (Actual Dimensions): [3-1/2 inches (89 mm) wide by 2-1/4 inches (57 mm) high by 7-1/2 inches (190 mm) long] [or] [3-5/8 inches (92 mm) wide by 2-1/4 inches (57 mm) high by 7-5/8 inches (194 mm) long].
 9. Size (Actual Dimensions): [3-1/2 inches (89 mm)] [or] [3-5/8 inches (92 mm)] wide by 2-1/4 inches (57 mm) high by 8 inches (203 mm) long.
 10. Size (Actual Dimensions): [3-1/2 inches (89 mm) wide by 2-3/4 inches (70 mm) high by 7-1/2 inches (190 mm) long] [or] [3-5/8 inches (92 mm) wide by 2-13/16 inches (71 mm) high by 7-5/8 inches (194 mm) long].

11. Size (Actual Dimensions): [3-1/2 inches (89 mm) wide by 2-3/4 inches (70 mm) high by 8 inches (203 mm) long] [or] [3-5/8 inches (92 mm) wide by 2-13/16 inches (71 mm) high by 8 inches (203 mm) long].
 12. Size (Actual Dimensions): [3-1/2 inches (89 mm) wide by 2-3/4 inches (70 mm) high by 11-1/2 inches (292 mm) long] [or] [3-5/8 inches (92 mm) wide by 2-13/16 inches (71 mm) high by 11-5/8 inches (295 mm) long].
 13. Size (Actual Dimensions): [3-1/2 inches (89 mm) wide by 7-1/2 inches (190 mm) high by 7-1/2 inches (190 mm) long] [or] [3-5/8 inches (92 mm) wide by 7-5/8 inches (194 mm) high by 7-5/8 inches (194 mm) long].
 14. Size (Actual Dimensions): 90 mm wide by [57] [70] [90] [190] mm high by [190] [290] mm long.
 15. Provide Type I (single-faced units) where only one finished face is exposed when units are installed, and Type II (double-faced units) where two opposite finished faces are exposed when units are installed.
 16. Application: Use where [brick is exposed unless otherwise indicated] [indicated].
 17. Colors: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range].
 18. [Where shown to "match existing,"]provide glazed brick matching color range, texture, and size of existing adjacent brickwork.
 - a. <Insert information on existing brick if known>.
- G. Glazed Hollow Brick: [Hollow brick complying with ASTM C 652, with glaze complying with ASTM C 126] [or] [single-fired glazed brick complying with ASTM C 1405].
1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. <Insert, in separate subparagraphs, manufacturer's name; product name or designation for acceptable glazed hollow brick>.
 - b. or approved equal.
 2. ASTM C 652 Grade: [SW] [MW or SW].
 3. ASTM C 652 Type: [HBX] [HBS] [HBA].
 4. ASTM C 652 Class: [H40V (void areas between 25 and 40 percent of gross cross-sectional area)] [H60V (void areas between 40 and 60 percent of gross cross-sectional area)].
 5. ASTM C 1405 Class: [Exterior] [Interior].
 6. ASTM C 1405 Grade: [S (Select)] [SS (Select Sized)].
 7. ASTM C 1405 Division: [H40V (void areas between 25 and 40 percent of gross cross-sectional area)] [H60V (void areas between 40 and 60 percent of gross cross-sectional area)].
 8. Size (Actual Dimensions): 5-5/8 inches (143 mm) wide by 3-5/8 inches (92 mm) high by 11-5/8 inches (295 mm) long.
 9. Size (Actual Dimensions): 7-5/8 inches (194 mm) wide by 3-5/8 inches (92 mm) high by 11-5/8 inches (295 mm) long.
 10. Size (Actual Dimensions): [140] [190] mm wide by 90 mm high by 290 mm long.

11. Provide Type I (single-faced units) where only one finished face is exposed when units are installed, and Type II (double-faced units) where two opposite finished faces are exposed when units are installed.
12. Application: Use where **[brick is exposed unless otherwise indicated]** **[indicated]**.
13. Colors: **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's samples]** **[As selected by DEN Project Manager from manufacturer's full range]**.
14. **[Where shown to "match existing,"]**provide glazed brick matching color range, texture, and size of existing adjacent brickwork.
 - a. **<Insert information on existing brick if known>**.

2.5 STRUCTURAL-CLAY FACING TILE

A. General:

1. Provide solid, multicored, or hollow units, with shape and direction of cores optional unless otherwise indicated.
2. Where reinforced masonry is indicated, provide multicored units designed for use in reinforced, grouted masonry; either with vertical cores and with webs notched to receive horizontal reinforcement, or with horizontal cores and with holes in bed shells for placement of grout and to receive vertical reinforcement.
3. Where indicated for exterior applications, provide units recommended by manufacturer for exterior use in Project's location.
4. Provide special shapes where required for corners, jambs, coved bases, sills, and other special conditions indicated, including applications that cannot be produced by sawing standard units.
 - a. Provide **[bullnose]** **[square-edged]** units for outside corners unless otherwise indicated.
 - b. Provide coved internal corners.
 - c. Provide recessed, coved base units.
5. Where direct application of plaster is indicated or where bonded to backup masonry, provide units with rough, combed, or scored faces.

B. Glazed Structural-Clay Facing Tile: ASTM C 126, **[Grade S (select)]** **[Grade SS (select sized or ground edge)]**.

1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.
2. Sizes: 6T Series with actual face dimensions of **5-1/6 inches** (128.6 mm) high by **11-3/4 inches** (298.5 mm) long by widths indicated.

3. Sizes: 8W Series with actual face dimensions of **7-3/4 inches** (196.9 mm) high by **15-3/4 inches** (400.1 mm) long by widths indicated.
 4. Width: Manufactured to dimensions **1/4 inch** (6.4 mm) less than nominal dimensions.
 5. Provide Type I (single-faced units) where only one finished face is exposed when units are installed, and Type II (double-faced units) where two opposite finished faces are exposed when units are installed.
 6. Provide special units glazed on ends and tops, as well as faces for corners, jambs, sills, pilasters, columns, and other applications indicated, where glazed units are exposed on other surfaces and faces.
 7. Colors and Patterns: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range]**.
- C. Unglazed Structural-Clay Facing Tile: ASTM C 212, **[Type FTX] [Type FTS], [Standard] [Special-Duty]** class.
1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.
 2. Number of Faces: Single faced **[where only one finished face is exposed when units are installed. Double faced where both finished faces are exposed when units are installed]**.
 3. Size: **[As indicated] [Match existing] <Insert size>**.

2.6 STONE TRIM UNITS

- A. Granite: ASTM C 615.
1. Description: **[Fine] [Medium]-grained, [white] [pink] [gray] [black] stone.[Uniform pattern, without veining]**.
- B. Limestone: ASTM C 568, **[Classification I Low] [Classification II Medium] [Classification III High]** Density.
1. Variety and Sources: Indiana oolitic limestone quarried in Lawrence, Monroe, or Owen Counties, Indiana.
 - a. Grade and Color: **[Select, buff] [Select, gray] [Standard, buff] [Standard, gray] [Rustic, buff] [Rustic, gray] [Variegated]**, according to grade and color classification established by ILI.
- C. Marble: ASTM C 503, **[Classification I Calcite] [Classification II Dolomite]**.
1. Description: Uniform, fine- to medium-grained, white stone with only slight veining.

- D. Quartz-Based Stone: ASTM C 616, [**Classification I Sandstone**] [**Classification II Quartzitic Sandstone**] [**III Quartzite**].
- E. Varieties and Sources: Subject to compliance with requirements, provide[**one of**] the following:
1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
 2. or approved equal.
- F. Finish: [**Polished**] [**Honed**] [**Smooth**] [**Machine tooled, 4 bats per 1 inch (25 mm)**] [**Machine tooled, 6 bats per 1 inch (25 mm)**] [**Machine tooled, 8 bats per 1 inch (25 mm)**] [**Chat sawed**] [**Split face**] [**Rock face (pitched face)**] <Insert finish>.
1. Finish for [**Tops of Sills**] [**Jamb Returns**] [**and**] [**Soffits of Lintels**]: [**Sand rubbed**] [**Split face**] <Insert finish>.
- G. Provide stone units accurately shaped, with exposed faces dressed true, and with beds and joints at right angles to faces.
1. For limestone, comply with recommendations in ILI's "Indiana Limestone Handbook."
 2. For marble, comply with recommendations in MIA's "Dimensional Stone--Design Manual VI."

2.7 MORTAR AND GROUT MATERIALS

- A. Regional Materials: Aggregate for mortar and grout[, **cement, and lime**] shall be extracted, harvested, or recovered, as well as manufactured, within **500 miles (800 km)** of Project site.
- B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- E. Masonry Cement: ASTM C 91.
1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Capital Materials Corporation; Flamingo Color Masonry Cement.
 - b. Cemex S.A.B. de C.V.; [**Brikset Type N**] [**Citadel Type S**] [**Dixie Type S**] [**Kosmortar Type N**] [**Richmortar**] [**Victor Plastic Cement**].
 - c. Essroc, Italcementi Group; [**Brixment**] [**or**] [**Velvet**].

- d. Holcim (US) Inc.; [**Mortamix Masonry Cement**] [**Rainbow Mortamix Custom Buff Masonry Cement**] [**White Mortamix Masonry Cement**].
 - e. Lafarge North America Inc.; [**Magnolia Masonry Cement**] [**Lafarge Masonry Cement**] [**Trinity White Masonry Cement**].
 - f. Lehigh Cement Company; [**Lehigh Masonry Cement**] [**Lehigh White Masonry Cement**].
 - g. National Cement Company, Inc.; Coosa Masonry Cement.
 - h. or approved equal.
- F. Mortar Cement: ASTM C 1329.
1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Lafarge North America Inc.; [**Lafarge Mortar Cement**] [or] [**Magnolia Superbond Mortar Cement**].
 - b. or approved equal.
- G. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Davis Colors; True Tone Mortar Colors.
 - b. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
 - c. Solomon Colors, Inc.; SGS Mortar Colors.
 - d. <Insert manufacturer>
 - e. or approved equal.
- H. Colored Cement Product: Packaged blend made from [**portland cement and hydrated lime**] [**masonry cement**] and mortar pigments, all complying with specified requirements, and containing no other ingredients.
1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Colored Portland Cement-Lime Mix:
 - 1) Capital Materials Corporation; Riverton Portland Cement Lime Custom Color.
 - 2) Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
 - 3) Lafarge North America Inc.; Eaglebond Portland & Lime.
 - 4) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.
 - 5) <Insert manufacturer>
 - 6) or approved equal.
 - b. Colored Masonry Cement:

- 1) Capital Materials Corporation; Flamingo Color Masonry Cement.
 - 2) Cemex S.A.B. de C.V.; Richcolor Masonry Cement.
 - 3) Essroc, Italcementi Group; Brixment-in-Color.
 - 4) Holcim (US) Inc.; Rainbow Mortamix Custom Color Masonry Cement.
 - 5) Lafarge North America Inc.; U.S. Cement Custom Color Masonry Cement.
 - 6) Lehigh Cement Company; Lehigh Custom Color Masonry Cement.
 - 7) National Cement Company, Inc.; Coosa Masonry Cement.
 - 8) **<Insert manufacturer>**
 - 9) or approved equal.
2. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
 3. Pigments shall not exceed 10 percent of portland cement by weight.
 4. Pigments shall not exceed 5 percent of **[masonry cement]** **[or]** **[mortar cement]** by weight.
- I. Aggregate for Mortar: ASTM C 144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 2. For joints less than **1/4 inch (6 mm)** thick, use aggregate graded with 100 percent passing the **No. 16 (1.18-mm)** sieve.
 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- J. Aggregate for Grout: ASTM C 404.
- K. Epoxy Pointing Mortar: ASTM C 395, epoxy-resin-based material formulated for use as pointing mortar for structural-clay tile facing units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by DEN Project Manager from manufacturer's colors.
- L. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Euclid Chemical Company (The); Accelguard 80.
 - b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.
 - c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.
 - d. **<Insert manufacturer>**
 - e. or approved equal.
- M. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent by same manufacturer.

1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. ACM Chemistries; RainBloc for Mortar.
 - b. BASF Aktiengesellschaft; Rheopel Mortar Admixture.
 - c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
 - d. **<Insert manufacturer>**
 - e. or approved equal.

N. Water: Potable.

2.8 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, **Grade 60** (Grade 420).

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size for Side Rods: [0.187-inch (4.76-mm)] diameter.
4. Wire Size for Cross Rods: [0.187-inch (4.76-mm)] diameter.
5. Wire Size for Veneer Ties: [0.187-inch (4.76-mm)] diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than **16 inches** (407 mm) o.c.
7. Provide in lengths of not less than **10 feet** (3 m)[, **with prefabricated corner and tee units**].

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.

D. Masonry Joint Reinforcement for Multiwythe Masonry:

1. Ladder type with 1 side rod at each face shell of hollow masonry units more than **4 inches** (100 mm) wide, plus [**1 side rod**] [**2 side rods**] at each wythe of masonry **4 inches** (100 mm) wide or less.
2. Tab type, ladder design, with 1 side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe but with at least **5/8-inch** (16-mm) cover on outside face.
3. Adjustable (two-piece) type, ladder design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum adjustment of **1-1/4 inches** (32 mm). Size ties to extend at least halfway through facing wythe but with at least **5/8-inch** (16-mm) cover on outside face.[**Ties have hooks or clips to engage a continuous horizontal wire in the facing wythe.**]

E. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single **0.187-inch-** (4.76-mm-) diameter, hot-dip galvanized, carbon -steel

continuous wire.

2.9 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
 2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
 3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least **5/8-inch (16-mm)** cover on outside face. Outer ends of wires are bent 90 degrees and extend **2 inches (50 mm)** parallel to face of veneer.
- C. Individual Wire Ties: Rectangular units with closed ends and not less than **4 inches (100 mm)** wide.
1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than **2 inches (50 mm)** long may be used for masonry constructed from solid units.
 2. Where wythes **[do not align] [are of different materials]**, use adjustable ties with pintle-and-eye connections having a maximum adjustment of **1-1/4 inches (32 mm)**.
 3. Wire: Fabricate from **[3/16-inch- (4.76-mm-)] [1/4-inch- (6.35-mm-)]** diameter, **[hot-dip galvanized steel]** wire.
- D. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Anchor Section for Welding to Steel Frame: Crimped **1/4-inch- (6.35-mm-)** diameter, **[hot-dip galvanized steel]** wire.
 2. Tie Section: Triangular-shaped wire tie, sized to extend within **1 inch (25 mm)** of masonry face, made from **[0.187-inch- (4.76-mm-)] [0.25-inch- (6.35-mm-)]** diameter, **[hot-dip galvanized steel]** wire.
- E. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from **[0.105-inch- (2.66-mm-)] thick, steel sheet, galvanized after fabrication]**
 - a. **[0.108-inch- (2.74-mm-)]** thick, galvanized sheet may be used at interior walls unless otherwise indicated.

2. Tie Section: Triangular-shaped wire tie, sized to extend within **1 inch (25 mm)** of masonry face, made from **[0.187-inch- (4.76-mm-)]** diameter, hot-dip galvanized steel wire.
- F. Partition Top anchors: **0.105-inch- (2.66-mm-)** thick metal plate with **3/8-inch- (9.5-mm-)** diameter metal rod **6 inches (152 mm)** long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
- G. Rigid Anchors: Fabricate from steel bars **[1-1/2 inches (38 mm) wide by 1/4 inch (6.35 mm) thick by 24 inches (610 mm) long, with ends turned up 2 inches (51 mm) or with cross pins unless otherwise indicated] [bent to configuration indicated]**.
1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.
- H. Adjustable Masonry-Veneer Anchors:
1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
 - a. Structural Performance Characteristics: Capable of withstanding a **100-lbf (445-N)** load in both tension and compression without deforming or developing play in excess of **0.05 inch (1.3 mm)**.
 2. Contractor's Option: Unless otherwise indicated, provide any of the following types of anchors:
 3. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.
 - a. Products: Subject to compliance with requirements, provide products by one of the following:
 - 1) Dayton Superior Corporation, Dur-O-Wal Division; **[D/A 213] [or] [D/A 210 with D/A 700-708]**.
 - 2) Heckmann Building Products Inc.; **[315-D with 316] [or] [Pos-I-Tie]**.
 - 3) Hohmann & Barnard, Inc.; **[DW-10] [DW-10HS] [or] [DW-10-X]**.
 - 4) Wire-Bond; **[1004, Type III] [RJ-711] [or] [SureTie]**.
 - 5) or approved equal.
 - b. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, **2-3/4 inches (70 mm)** wide by **3 inches (76 mm)** high; with projecting tabs having slotted holes for inserting vertical legs of wire tie specially formed to fit anchor section.
 - c. Anchor Section: Sheet metal plate, **1-1/4 inches (32 mm)** wide by **[6 inches (152 mm)] [9 inches (229 mm)]** long, with screw holes top and bottom and with raised rib-stiffened strap, **5/8 inch (16 mm)** wide by **[3-5/8 inches (92 mm)] [5-1/2 inches (140 mm)]** long, stamped into center to provide a slot between strap and plate for inserting wire tie.

- d. Anchor Section: Gasketed sheet metal plate, **1-1/4 inches (32 mm)** wide by **6 inches (152 mm)** long, with screw holes top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation or sheathing; and raised rib-stiffened strap, **5/8 inch (16 mm)** wide by **6 inches (152 mm)** long, stamped into center to provide a slot between strap and plate for inserting wire tie. Provide anchor manufacturer's standard, self-adhering, modified bituminous gaskets manufactured to fit behind anchor plate and extend beyond pronged legs.
 - e. Anchor Section: Corrosion-resistant, self-drilling, eye-screw designed to receive wire tie. Eye-screw has spacer that seats directly against framing and is same thickness as sheathing and has gasketed, washer head that covers hole in sheathing.
 - f. Fabricate sheet metal anchor sections and other sheet metal parts from **[0.105-inch- (2.66-mm-) thick, steel sheet, galvanized after fabrication]** .
 - g. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from **[0.187-inch- (4.76-mm-)] [0.25-inch- (6.35-mm-)]** diameter, **[hot-dip galvanized steel] [stainless-steel]** wire.
4. Slip-in, Masonry-Veneer Anchors: Units consisting of a wire tie section and an anchor section designed to interlock with metal studs and be slipped into place as sheathing is installed.
- a. Products: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hohmann & Barnard, Inc.; AA308.
 - 2) **<Insert manufacturer>**
 - 3) or approved equal.
 - b. Wire-Type Anchor: Bent wire anchor section with an eye to receive the wire tie. Wire tie has a vertical leg that slips into the eye of anchor section and allows vertical adjustment. Both sections are made from **3/16-inch (4.76-mm)**, hot-dip galvanized wire.
5. Seismic Masonry-Veneer Anchors: Units consisting of a metal anchor section and a connector section designed to engage a continuous wire embedded in the veneer mortar joint.
- a. Products: Subject to compliance with requirements, provide products by one of the following:
 - 1) Dayton Superior Corporation, Dur-O-Wal Division; D/A 213S.
 - 2) Hohmann & Barnard, Inc.; DW-10-X-Seismicclip.
 - 3) Wire-Bond; RJ-711 with Wire-Bond clip.
 - 4) **<Insert manufacturer>**
 - 5) or approved equal.
 - b. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, **2-3/4 inches (70 mm)** wide by **3 inches (76 mm)** high; with projecting tabs having slotted holes for inserting vertical leg of connector section.

- c. Connector Section: Rib-stiffened, sheet metal bent plate with down-turned leg designed to fit in anchor section slot and with integral tabs designed to engage continuous wire. Size connector to extend at least halfway through veneer but with at least **5/8-inch (16-mm)** cover on outside face.
 - d. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, **2-3/4 inches (70 mm)** wide by **3 inches (76 mm)** high; with projecting tabs having slotted holes for inserting vertical legs of wire tie specially formed to fit anchor section. Size wire tie to extend at least **1-1/2 inches (38 mm)** into veneer but with at least **5/8-inch (16-mm)** cover on outside face.
 - e. Connector Section: Sheet metal clip welded to wire tie with integral tabs designed to engage continuous wire.
 - f. Anchor Section: Gasketed sheet metal plate, **1-1/4 inches (32 mm)** wide by **6 inches (152 mm)** long, with screw holes top and bottom; top and bottom ends bent to form pronged legs to bridge insulation or sheathing and contact studs; and raised rib-stiffened strap, **5/8 inch (16 mm)** wide by **6 inches (152 mm)** long, stamped into center to provide a slot between strap and plate for inserting wire tie. Provide anchor manufacturer's standard, self-adhering, modified bituminous gaskets manufactured to fit behind anchor plate and extend beyond pronged legs.
 - g. Connector Section: Triangular wire tie and rigid PVC extrusion with snap-in grooves for inserting continuous wire. Size wire tie to extend at least halfway through veneer but with at least **5/8-inch (16-mm)** cover on outside face.
 - h. Fabricate sheet metal anchor sections and other sheet metal parts from **[0.105-inch- (2.66-mm-) thick, steel sheet, galvanized after fabrication]** .
 - i. Fabricate wire connector sections from **[0.187-inch- (4.76-mm-)] [0.25-inch- (6.35-mm-)]** diameter, hot-dip galvanized, carbon -steel wire.
6. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and neoprene or EPDM washer, **No. 10 (4.83-mm)** diameter by length required to penetrate steel stud flange with not less than three exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours per ASTM B 117.
- a. Products: Subject to compliance with requirements, provide products by one of the following:
 - 1) ITW Buildex; Teks Maxiseal with Climaseal finish.
 - 2) Textron Inc., Textron Fastening Systems; Elco Dril-Flex with Stalgard finish.
 - 3) **<Insert manufacturer>**
 - 4) or approved equal.
7. Stainless-Steel Drill Screws for Steel Studs: Proprietary fastener consisting of carbon-steel drill point and 300 Series stainless-steel shank, complying with ASTM C 954 except manufactured with hex washer head and neoprene or EPDM washer, **No. 10 (4.83-mm)** diameter by length required to penetrate steel stud flange with not less than three exposed threads.
- a. Products: Subject to compliance with requirements, provide products by

one of the following:

- 1) Dayton Superior Corporation, Dur-O-Wal Division; Stainless Steel SX Fastener.
- 2) ITW Buildex; Scots long life Tekes.
- 3) **<Insert manufacturer>**
- 4) or approved equal.

2.10 MISCELLANEOUS ANCHORS

- A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.
- B. Dovetail Slots in Concrete: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from **0.034-inch** (0.86-mm), galvanized steel sheet.
- C. Anchor Bolts: **[Headed] [or] [L-shaped]** steel bolts complying with **ASTM A 307, Grade A** (ASTM F 568M, Property Class 4.6); with **ASTM A 563** (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.
- D. Postinstalled Anchors: **[Torque-controlled expansion anchors] [or] [chemical anchors]**.
 1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or **ASTM F 1941** (ASTM F 1941M), Class Fe/Zn 5 unless otherwise indicated.
 3. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy **[Group 1 (A1)] [Group 2 (A4)]** stainless-steel bolts, **ASTM F 593** (ASTM F 738M), and nuts, **ASTM F 594** (ASTM F 836M).

2.11 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with **[SMACNA's "Architectural Sheet Metal Manual"] [Section 076200 "Sheet Metal Flashing and Trim"]** and as follows:
 1. Stainless Steel: ASTM A 240/A 240M, Type 304, **0.016 inch** (0.40 mm) thick.
 2. Copper: ASTM B 370, Temper H00, cold-rolled copper sheet, **16-oz./sq. ft.** (4.9-kg/sq. m) weight or **0.0216 inch** (0.55 mm) thick or ASTM B 370, Temper H01, high-yield copper sheet, **12-oz./sq. ft.** (3.7-kg/sq. m) weight or **0.0162 inch** (0.41 mm) thick.
 3. Fabricate continuous flashings in sections **96 inches** (2400 mm) long minimum, but not exceeding **12 feet** (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.

4. Fabricate through-wall metal flashing embedded in masonry from [**stainless steel**] [**copper**], with ribs at 3-inch (76-mm) intervals along length of flashing to provide an integral mortar bond.
 - a. Products: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cheney Flashing Company; [**Cheney Flashing (Dovetail)**] [or] [**Cheney 3-Way Flashing (Sawtooth)**].
 - 2) Keystone Flashing Company, Inc.; Keystone 3-Way Interlocking Thruwall Flashing.
 - 3) Sandell Manufacturing Co., Inc.; Mechanically Keyed Flashing.
 - 4) <Insert manufacturer>
 - 5) or approved equal.
5. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
6. Fabricate through-wall flashing with drip edge [**where**] [**unless otherwise**] indicated. Fabricate by extending flashing 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees[**and hemmed**].
7. Fabricate through-wall flashing with sealant stop [**where**] [**unless otherwise**] indicated. Fabricate by bending metal back on itself 3/4 inch (19 mm) at exterior face of wall and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.
8. Fabricate metal [**drip edges**] [**and**] [**sealant stops**] for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches (76 mm) into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam will shed water.
9. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches (76 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees[**and hemmed**].
10. Metal Sealant Stop: Fabricate from stainless steel. Extend at least 3 inches (76 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.
11. Metal Expansion-Joint Strips: Fabricate from [**stainless steel**] [**copper**] to shapes indicated.

B. Flexible Flashing: Use[**one of**] the following unless otherwise indicated:

1. Copper-Laminated Flashing: [7-oz./sq. ft. (2-kg/sq. m)] copper sheet bonded between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.
 - a. Products: Subject to compliance with requirements, provide products by one of the following:
 - 1) Advanced Building Products Inc.; [**Copper Fabric Flashing**] [**Copper Sealtite 2000**].

- 2) Dayton Superior Corporation, Dur-O-Wal Division; Copper Fabric Thru-Wall Flashing.
 - 3) Hohmann & Barnard, Inc.; H & B C-Fab Flashing.
 - 4) Phoenix Building Products; Type FCC-Fabric Covered Copper.
 - 5) Sandell Manufacturing Co., Inc.; Copper Fabric Flashing.
 - 6) York Manufacturing, Inc.; Multi-Flash 500.
 - 7) **<Insert manufacturer>**
 - 8) or approved equal.
2. Asphalt-Coated Copper Flashing: [7-oz./sq. ft. (2-kg/sq. m)] copper sheet coated with flexible asphalt. Use only where flashing is fully concealed in masonry.
- a. Products: Subject to compliance with requirements, provide one of the following:
- 1) Advanced Building Products Inc.; Cop-R-Cote.
 - 2) Dayton Superior Corporation, Dur-O-Wal Division; Copper Coated Thru-Wall Flashing.
 - 3) Hohmann & Barnard, Inc.; H & B C-Coat Flashing.
 - 4) Phoenix Building Products; Type ACC-Asphalt Bituminous Coated.
 - 5) Sandell Manufacturing Co., Inc.; Coated Copper Flashing.
 - 6) **<Insert manufacturer>**
 - 7) or approved equal.
3. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than [0.040 inch (1.02 mm)].
- a. Products: Subject to compliance with requirements, provide products by one of the following:
- 1) Advanced Building Products Inc.; Peel-N-Seal.
 - 2) Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
 - 3) Dayton Superior Corporation, Dur-O-Wal Division; Dur-O-Barrier Thru-Wall Flashing.
 - 4) Fiberweb, Clark Hammerbeam Corp.; Aquaflash 500.
 - 5) Grace Construction Products, W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing.
 - 6) Heckmann Building Products Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.
 - 7) Hohmann & Barnard, Inc.; Textroflash.
 - 8) W. R. Meadows, Inc.; Air-Shield Thru-Wall Flashing.
 - 9) Polyguard Products, Inc.; **[Polyguard 300] [Polyguard 400]**.
 - 10) Sandell Manufacturing Co., Inc.; Sando-Seal.
 - 11) Williams Products, Inc.; Everlastic MF-40.
 - 12) **<Insert manufacturer>**
 - 13) or approved equal.

- b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
 4. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.
 - a. Products: Subject to compliance with requirements, provide products by one of the following:
 - 1) DuPont; Thru-Wall Flashing.
 - 2) Hohmann & Barnard, Inc.; Flex-Flash.
 - 3) Hyload, Inc.; Hyload Cloaked Flashing System.
 - 4) Mortar Net USA, Ltd.; Total Flash.
 - 5) **<Insert manufacturer>**
 - 6) or approved equal.
 - b. Monolithic Sheet: Elastomeric thermoplastic flashing, **0.040 inch** (1.0 mm) thick.
 - c. Self-Adhesive Sheet: Elastomeric thermoplastic flashing, **0.025 inch** (0.64 mm) thick, with a **0.015-inch-** (0.38-mm-) thick coating of adhesive.
 - d. Self-Adhesive Sheet with Drip Edge: Elastomeric thermoplastic flashing, **0.025 inch** (0.64 mm) thick, with a **0.015-inch-** (0.38-mm-) thick coating of rubberized-asphalt adhesive. Where flashing extends to face of masonry, rubberized-asphalt coating is held back approximately **1-1/2 inches** (38 mm) from edge.
 - 1) Color: **[Gray] [White] [Tan/buff] [Black]**.
 - e. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
 5. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D 4637, **0.040 inch** (1.0 mm) thick.
 - a. Products: Subject to compliance with requirements, provide products by one of the following:
 - 1) Carlisle Coatings & Waterproofing; Pre-Kleened EPDM Thru-Wall Flashing.
 - 2) Firestone Specialty Products; FlashGuard.Heckmann Building Products Inc.; No. 81 EPDM Thru-Wall Flashing.
 - 3) Hohmann & Barnard, Inc.; Epra-Max EPDM Thru-Wall Flashing.
 - 4) Sandell Manufacturing Co., Inc.; EPDM Flashing.
 - 5) **<Insert manufacturer>**
 - 6) or approved equal.
- C. Application: Unless otherwise indicated, use the following:
1. Where flashing is indicated to receive counterflashing, use metal flashing.

2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
 3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing [**with a drip edge**] [**with a sealant stop**] [**or flexible flashing with a metal drip edge**] [**or elastomeric thermoplastic flashing with drip edge**] [**or flexible flashing with a metal sealant stop**].
 4. Where flashing is fully concealed, use [**metal flashing**] [**or**] [**flexible flashing**].
- D. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from high-density polyethylene incorporating chemical stabilizers that prevent UV degradation. Cell flashing pans have integral weep spouts that are designed to be built into mortar bed joints and weep collected moisture to the exterior of CMU walls and that extend into the cell to prevent clogging with mortar.
1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Mortar Net USA, Ltd.; Blok-Flash.
 - b. **<Insert manufacturer>**
 - c. or approved equal.
- E. Solder and Sealants for Sheet Metal Flashings:[**As specified in Section 076200 "Sheet Metal Flashing and Trim."**]
1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
 2. Solder for Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.
 3. Elastomeric Sealant: ASTM C 920, chemically curing [**urethane**] [**polysulfide**] [**silicone**] sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.
- 2.12 MISCELLANEOUS MASONRY ACCESSORIES
- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from [**neoprene**] [**urethane**] [**or**] [**PVC**].
 - B. Preformed Control-Joint Gaskets: Made from [**styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805**] [**or**] [**PVC, complying with ASTM D 2287, Type PVC-65406**] and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
 - C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

- D. Weep/Vent Products: Use[**one of**] the following unless otherwise indicated:
1. Vinyl Weep Hole/Vent: One-piece, offset, T-shaped units made from flexible PVC, designed to fit into a head joint and consisting of a louvered vertical leg, flexible wings to seal against ends of masonry units, and a top flap to keep mortar out of the head joint; in color selected by DEN Project Manager.
 - a. Products: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hohmann & Barnard, Inc.; #343 Louvered Weep Hole.
 - 2) Williams Products, Inc.; Williams-Goodco Brick Vent.
 - 3) Wire-Bond; Louvered Weepholes.
 - 4) **<Insert manufacturer>**
 - 5) or approved equal.
- E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Advanced Building Products Inc.; **[Mortar Break] [Mortar Break II]**.
 - b. Archovations, Inc.; CavClear Masonry Mat.
 - c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
 - d. Mortar Net USA, Ltd.; Mortar Net.
 - e. **<Insert manufacturer>**
 - f. or approved equal.
 2. Provide one of the following configurations:
 - a. Strips, full-depth of cavity and **10 inches (250 mm)** high, with dovetail shaped notches **7 inches (175 mm)** deep that prevent clogging with mortar droppings.
 - b. Strips, not less than **[3/4 inch (19 mm)] [1-1/2 inches (38 mm)]** thick and **10 inches (250 mm)** high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.
 - c. Sheets or strips full depth of cavity and installed to full height of cavity.
 - d. Sheets or strips not less than **[3/4 inch (19 mm)] [1 inch (25 mm)]** **<Insert thickness>** thick and installed to full height of cavity with additional strips **4 inches (100 mm)** high at weep holes and thick enough to fill entire depth of cavity and prevent weep holes from clogging with mortar.
- F. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from **0.148-inch (3.77-mm)** steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
1. Products: Subject to compliance with requirements, provide products by one of the following:

- a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
- b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
- c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
- d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.
- e. <Insert manufacturer>
- f. or approved equal.

2.13 MASONRY-CELL INSULATION

- A. Loose-Granular Fill Insulation: Perlite complying with ASTM C 549, Type II (surface treated for water repellency and limited moisture absorption) or Type IV (surface treated for water repellency and to limit dust generation).
- B. Molded-Polystyrene Insulation Units: Rigid, cellular thermal insulation formed by the expansion of polystyrene-resin beads or granules in a closed mold to comply with ASTM C 578, Type I. Provide specially shaped units designed for installing in cores of masonry units.
 1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Concrete Block Insulating Systems; Korfil.
 - b. Shelter Enterprises Inc.; Omni Core.
 - c. <Insert manufacturer>
 - d. or approved equal.

2.14 CAVITY-WALL INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, [Type IV] [Type X], closed-cell product extruded with an integral skin.
- B. Extruded-Polystyrene Board Insulation with Increased R-Value: ASTM C 578, Type IV, but with an aged thermal resistance (R-value) for 1-inch (25-mm) thickness of 5.6 deg F x h x sq. ft./Btu at 75 deg F (1.0 K x sq. m/W at 24 deg C) at 5 years; closed-cell product with a carbon-black filler and extruded with an integral skin.
- C. Molded-Polystyrene Board Insulation: ASTM C 578, Type I.
- D. Polyisocyanurate Board Insulation: ASTM C 1289, Type I (aluminum-foil-faced), Class 2 (glass-fiber-reinforced).
- E. Adhesive: Type recommended by insulation board manufacturer for application indicated.

2.15 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for

removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Diedrich Technologies, Inc.
- b. EaCo Chem, Inc.
- c. ProSoCo, Inc.
- d. **<Insert manufacturer>**
- e. or approved equal.

B. Exercise caution when cleaning masonry to protect all other adjacent materials from damage. Protect all adjacent materials prior to and during all masonry cleaning operations. Contractor shall replace any damaged materials.

2.16 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use [**portland cement-lime**] mortar unless otherwise indicated.
3. For exterior masonry, use [**portland cement-lime**] mortar.
4. For reinforced masonry, use [**portland cement-lime**] mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, [**Proportion**] [**Property**] Specification. Provide the following types of mortar for applications stated unless another type is indicated[**or needed to provide required compressive strength of masonry**].

1. For masonry below grade or in contact with earth, use [**Type S**].
2. For reinforced masonry, use [**Type S**] [**Type N**].
3. For mortar parge coats, use [**Type N**].
4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

D. Pigmented Mortar: Use colored cement product[**or select and proportion pigments**

with other ingredients to produce color required. Do not add pigments to colored cement products].

1. Pigments shall not exceed 10 percent of portland cement by weight.
 2. Mix to match DEN Project Manager's sample.
 3. Application: Use pigmented mortar for exposed mortar joints with the following units:
 - a. Decorative CMUs.
 - b. Pre-faced CMUs.
 - c. Concrete facing brick.
 - d. Face brick.
 - e. Hollow brick.
 - f. Glazed brick.
 - g. Glazed structural-clay facing tile.
 - h. Stone trim units.
 - i. Cast stone trim units.
- E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
1. Mix to match DEN Project Manager's sample.
 2. Application: Use colored aggregate mortar for exposed mortar joints with the following units:
 - a. Decorative CMUs.
 - b. Pre-faced CMUs.
 - c. Concrete facing brick.
 - d. Face brick.
 - e. Hollow brick.
 - f. Glazed brick.
 - g. Glazed structural-clay facing tile.
 - h. Stone trim units.
 - i. Cast stone trim units.
- F. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 2. Proportion grout in accordance with ASTM C 476, **[Table 1] [or] [paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa)]**.
 3. Provide grout with a slump of **[8 to 11 inches (203 to 279 mm)] [10 to 11 inches (254 to 279 mm)]** as measured according to ASTM C 143/C 143M.
- G. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.
1. Application: Use epoxy pointing mortar for exposed mortar joints with the

following units:

- a. Pre-faced CMUs.
- b. Glazed brick.
- c. Glazed structural-clay facing tile.

2.17 MASONRY SEALER

- A. Apply masonry sealer in strict compliance with manufacturer's recommendations and under required project and weather conditions.
 1. Criteria:
 - a. Minimal darkening and color change of masonry surfaces.
 - b. Minimum 10% chemical solids consisting of a siloxane/acrylic emulsion solution.
 2. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Okon W-2
 - b. <Insert manufacturer>
 - c. or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 2. Verify that foundations are within tolerances specified.
 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Do not wet concrete masonry units.
- E. Cleaning Reinforcing: Before placing, remove loose rust, ice and other coatings from reinforcing.

- F. Thickness: Build cavity and composite walls, floors and other masonry construction to the full thickness shown. Build single wythe walls (if any) to the actual thickness of the masonry units, using units of nominal thickness indicated.
- G. Build chases and recesses as shown or required for the work of other trades. Provide not less than 8" of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.
- H. Leave openings for equipment to be installed before completion of masonry work. After installation of equipment, complete masonry work to match work immediately adjacent to the opening.
- I. Cut masonry units using motor driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining work. Use full size units without cutting where possible. Cut masonry as required to allow passage of utilities, but maintain integrity of masonry and fire rating of wall.
- J. Use dry or wet cutting saws to cut concrete masonry units.
- K. At Split-Faced CMU: Provide color matching non-split face units where indicated and at light fixtures attached directly to the CMU. Provide special shapes or sizes where indicated or required to achieve design intent.

3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
 - 1. Mix units from several pallets or cubes as they are placed.
- F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

- G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). [Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).]

5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than **1/16 inch (1.5 mm)** from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in **[running bond] [stack bond] [one-third running bond] [Flemish bond] [English bond] [bond pattern indicated on Drawings]**; do not use units with less than nominal **4-inch (100-mm)** horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than **[2 inches (50 mm)] [4-inches (100-mm)]**. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal **4-inch (100-mm)** horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout **24 inches (600 mm)** under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 1. Install compressible filler in joint between top of partition and underside of structure above.
 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide **1/2-inch (13-mm)** clearance between end of anchor rod and end of tube. Space anchors **[48 inches (1200 mm)] <Insert spacing>** o.c. unless otherwise indicated.

3. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078446 "Fire-Resistive Joint Systems."

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow **[brick]** **[and]** **[CMUs]** as follows:
 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings and in all courses of piers, columns and pilasters, and where adjacent to cells or cavities to be reinforced or filled with concrete or grout. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.
- D. Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not shown, lay walls with 3/8" joints.
- E. Cut joints flush for masonry walls which are to be concealed or to be covered by other materials, unless otherwise indicated.
- F. Tool exposed joints slightly concave using a jointer larger than joint thickness, unless otherwise indicated tool unexposed joints concave, where possible.
- G. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners or jambs to shift adjacent stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.
- H. Collar Joints: After each course is laid, fill the vertical longitudinal joint between wythes solidly and with mortar for the following masonry work:
 1. Exterior walls, except cavity walls.
 2. Non loadbearing interior walls or partitions where metal ties or horizontal reinforcing are indicated for structural bonding and nominal thickness of wall or partition is required to meet code requirements for height to thickness ratio.
- I. Lay structural-clay tile as follows:
 1. Lay vertical-cell units with full head joints unless otherwise indicated. Provide bed

- joints with full mortar coverage on face shells and webs.
2. Lay horizontal-cell units with full bed joints unless otherwise indicated. Keep drainage channels, if any, free of mortar. Form head joints with sufficient mortar so excess will be squeezed out as units are placed in position. Butter both sides of units to be placed, or butter one side of unit already in place and one side of unit to be placed.
 3. Maintain joint thicknesses indicated except for minor variations required to maintain bond alignment. If not indicated, lay walls with **1/4- to 3/8-inch-** (6- to 10-mm-) thick joints.
 4. Where epoxy-mortar pointed joints are indicated, rake out setting mortar to a uniform depth of **1/4 inch (6 mm)** and point with epoxy mortar to comply with epoxy-mortar manufacturer's written instructions.
- J. Set **[stone]** **[cast-stone]** trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
 2. Allow cleaned surfaces to dry before setting.
 3. Wet joint surfaces thoroughly before applying mortar.
- K. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
1. For glazed masonry units, use a nonmetallic jointer **3/4 inch (19 mm)** or more in width.
- L. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 COMPOSITE MASONRY

- A. Bond wythes of composite masonry together using one of the following methods:
1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for **[4.5 sq. ft. (0.42 sq. m)] [2.67 sq. ft. (0.25 sq. m)] [1.77 sq. ft. (0.16 sq. m)]** of wall area spaced not to exceed **[36 inches (914 mm)] [24 inches (610 mm)] [16 inches (406 mm)]** o.c. horizontally and **16 inches (406 mm)** o.c. vertically. Stagger ties in alternate courses. Provide additional ties within **12 inches (305 mm)** of openings and space not more than **36 inches (914 mm)** apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than **24 inches (610 mm)** o.c. vertically.
 - a. Where bed joints of wythes do not align, use adjustable (two-piece) type ties.
 2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
 - a. Where bed joints of both wythes align, use **[ladder-type reinforcement**

- extending across both wythes] [tab-type reinforcement].**
- b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement[**with continuous horizontal wire in facing wythe attached to ties**].
3. Header Bonding: Provide masonry unit headers extending not less than **3 inches (76 mm)** into each wythe. Space headers not over **[8 inches (203 mm)] [12 inches (305 mm)]** clear horizontally and **16 inches (406 mm)** clear vertically.
- B. Bond wythes of composite masonry together using bonding system indicated on Drawings.
- C. Collar Joints: Solidly fill collar joints by parging face of first wythe that is laid and shoving units of other wythe into place.
- D. Collar Joints in Clay Tile Masonry: After each course is laid, fill the vertical, longitudinal joint between wythes solidly with mortar at **[exterior walls, except cavity walls] [, and] [interior walls and partitions]**.
- E. Corners: Provide interlocking masonry unit bond in each wythe and course at corners unless otherwise indicated.
1. Provide continuity with masonry joint reinforcement at corners by using prefabricated L-shaped units as well as masonry bonding.
- F. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, bond walls together as follows:
1. Provide individual metal ties not more than **[8 inches (203 mm)] o.c.**
2. Provide continuity with masonry joint reinforcement by using prefabricated T-shaped units.
3. Provide rigid metal anchors not more than **[24 inches (610 mm)] o.c.** If used with hollow masonry units, embed ends in mortar-filled cores.

3.7 CAVITY WALLS

- A. Bond wythes of cavity walls together using one of the following methods:
1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for **[4.5 sq. ft. (0.42 sq. m)] [2.67 sq. ft. (0.25 sq. m)] [1.77 sq. ft. (0.16 sq. m)]** of wall area spaced not to exceed **[36 inches (914 mm)] [24 inches (610 mm)] [16 inches (406 mm)] o.c.** horizontally and **16 inches (406 mm) o.c.** vertically. Stagger ties in alternate courses. Provide additional ties within **12 inches (305 mm)** of openings and space not more than **36 inches (915 mm)** apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than **24 inches (610 mm) o.c.** vertically.
- a. Where bed joints of wythes do not align, use adjustable (two-piece) type ties.

- b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type ties to allow for differential movement regardless of whether bed joints align.
 2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
 - a. Where bed joints of both wythes align, use [**ladder-type reinforcement extending across both wythes**] [**tab-type reinforcement**].
 - b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement[**with continuous horizontal wire in facing wythe attached to ties**].
 - c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement[**with continuous horizontal wire in facing wythe attached to ties**] to allow for differential movement regardless of whether bed joints align.
 3. Header Bonding: Provide masonry unit headers extending not less than **3 inches (76 mm)** into each wythe. Space headers not over [**8 inches (203 mm)**] [**12 inches (305 mm)**] clear horizontally and **16 inches (406 mm)** clear vertically.
 4. Masonry Veneer Anchors: Comply with requirements for anchoring masonry veneers.
 - B. Bond wythes of cavity walls together using bonding system indicated on Drawings.
 - C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.
 - D. Parge cavity face of backup wythe in a single coat approximately **3/8 inch (10 mm)** thick. Trowel face of parge coat smooth.
 - E. Coat cavity face of backup wythe to comply with Section 071113 "Bituminous Dampproofing."
 - F. Apply air barrier to face of backup wythe to comply with [**Section 072713 "Modified Bituminous Sheet Air Barriers."**] [**Section 072726 "Fluid-Applied Membrane Air Barriers."**]
 - G. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately **12 inches (300 mm)** o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.
 1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.
- ### 3.8 MASONRY-CELL INSULATION
- A. Pour granular insulation into cavities to fill void spaces. Maintain inspection ports to

show presence of insulation at extremities of each pour area. Close the ports after filling has been confirmed. Limit the fall of insulation to 1 story high, but not more than 20 feet (6 m).

- B. Install molded-polystyrene insulation units into masonry unit cells before laying units.

3.9 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
1. Space reinforcement not more than 16 inches (406 mm) o.c.
 2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
 3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings[**in addition to continuous reinforcement**].
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at[**corners,**] returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.10 ANCHORING MASONRY WORK

- A. General: Provide anchor devices of type indicated.
- B. Anchor masonry to floor slab 36" o.c. unless otherwise noted on drawings.
- C. Anchor masonry to structural members, (includes steel or concrete columns or beams and underside of metal deck), where masonry abuts or faces structural members to comply with the following:
1. Provide an open space not less than 1" in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar or other rigid materials.
 2. Anchor masonry to structural members with flexible anchors embedded in masonry joints and attached to structure.
 3. Space anchors not more than 24" o.c. vertically and 36" o.c. horizontally except at exterior masonry walls provide anchors 8 inch o.c. vertically and 24 inch o.c. horizontally unless otherwise indicated.
- D. Anchor single Wythe masonry veneer to metal studs with masonry veneer anchors to comply with the following requirements:

1. Fasten each anchor section through sheathing to metal studs with 2 metal fasteners of type indicated.
2. Embed tie section in masonry joints. Provide not less than 1" air space between back of masonry veneer wythe and face of sheathing.
3. Locate anchor section relative to course in which tie section is embedded to allow maximum vertical differential movement of tie up and down.
4. Space anchors not more than 16" o.c. vertically and 24" o.c. horizontally unless otherwise noted. At masonry opening locate first anchor not more than 8" above lintel. Install additional anchors within 1' 0" of openings and at intervals around perimeter not exceeding 3' 0".

3.11 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than [1 inch (25 mm)] [2 inches (50 mm)] wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.12 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to [wall framing] [and] [concrete and masonry backup] with [seismic] masonry-veneer anchors to comply with the following requirements:

1. Fasten [screw-attached] [and] [seismic] anchors [through sheathing to wall framing] [and] [to concrete and masonry backup] with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Insert slip-in anchors in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.
3. Embed [tie sections] [connector sections and continuous wire] in masonry joints. Provide not less than 2 inches (50 mm) of air space between back of masonry veneer and face of sheathing.
4. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
5. Space anchors as indicated, but not more than 18 inches (458 mm) o.c. vertically and 24 inches (610 mm) o.c. horizontally, with not less than 1 anchor for each 2 sq. ft. (0.2 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 8 inches (203 mm), around perimeter.
6. Space anchors as indicated, but not more than 16 inches (406 mm) o.c. vertically and [32 inches (813 mm)] [24 inches (610 mm)] o.c. horizontally with not less than 1 anchor for each [3.5 sq. ft. (0.33 sq. m)] [2.67 sq. ft. (0.25 sq. m)] of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 36 inches (914 mm), around perimeter.

3.13 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Provide vertical control and isolation joints in masonry minimum 20'-0" O.C. unless indicated more often. Build in related items as the masonry work progresses.
- C. Construct joint equal to mortar joint width. Seal joint with sealer matching mortar color. Seal both sides of joint. Provide a compressible filler.
- D. Grout each CMU cell either side of control joint full height with number 4 re-bar or provide continuous tee shaped PVC control joint with CMU shaped to accept control joint.
- E. At exterior walls align control joint with a preformed siding joint.
- F. Horizontal joint reinforcement is not to extend thru control joint.
- G. Form control joints in concrete masonry [as follows] [using one of the following methods]:
 - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
 - 2. Install preformed control-joint gaskets designed to fit standard sash block.
 - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
 - 4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.
- H. Form expansion joints in brick as follows:
 - 1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches (100 mm) in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
 - 2. Build flanges of factory-fabricated, expansion-joint units into masonry.
 - 3. Build in compressible joint fillers where indicated.
 - 4. Form open joint full depth of brick wythe and of width indicated, but not less than [3/8 inch (10 mm)] [1/2 inch (13 mm)] <Insert minimum width> for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."
- I. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than [3/8 inch (10 mm)] <Insert minimum width>.
 - 1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting

masonry.

3.14 LINTELS

- A. Install steel lintels where indicated.
- B. Provide **[concrete]** **[or]** **[masonry]** lintels where shown and where openings of more than **12 inches (305 mm)** for brick-size units and **24 inches (610 mm)** for block-size units are shown without structural steel or other supporting lintels.
- C. Provide minimum bearing of **8 inches (200 mm)** at each jamb unless otherwise indicated.

3.15 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. **[Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.]**
- B. Install flashing as follows unless otherwise indicated:
 - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 - 2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of **[4 inches (100 mm)] [8 inches (200 mm)]**, and through inner wythe to within **1/2 inch (13 mm)** of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately **2 inches (50 mm)** on interior face.
 - 3. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of **[4 inches (100 mm)] [8 inches (200 mm)]**, and **1-1/2 inches (38 mm)** into the inner wythe. **[Form 1/4-inch (6-mm) hook in edge of flashing embedded in inner wythe.]**
 - 4. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least **8 inches (200 mm)**; with upper edge tucked under building paper or building wrap, lapping at least **4 inches (100 mm)**.
 - 5. At lintels and shelf angles, extend flashing a minimum of **6 inches (150 mm)** into masonry at each end. At heads and sills, extend flashing **6 inches (150 mm)** at ends and turn up not less than **2 inches (50 mm)** to form end dams.
 - 6. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than **1-1/2 inches (38 mm)** or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.

7. Install metal **[drip edges]** **[and]** **[sealant stops]** with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
 8. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing **1/2 inch (13 mm)** back from outside face of wall and adhere flexible flashing to top of metal drip edge.
- C. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing **1/2 inch (13 mm)** back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
1. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- D. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- E. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- F. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
1. Use **[specified weep/vent products]** to form weep holes.
 2. Space weep holes maximum **[32 inches (800 mm)] [16inches (400 mm)]** o.c. for CMUs unless otherwise indicated.
 3. Space weep holes maximum 24 inches (600 mm) o.c. for brick unless otherwise indicated.
 4. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
- G. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.
- H. Install vents in head joints in exterior wythes at spacing indicated. Use **[specified weep/vent products]** to form vents.
1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.
- 3.16 REINFORCED UNIT MASONRY INSTALLATION
- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
1. Construct formwork to provide shape, line, and dimensions of completed

masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than [60 inches (1520 mm)] [12.67 ft. (3.86 m)] <Insert height>.

3.17 FIELD QUALITY CONTROL

A. Testing and Inspecting: [Owner will] Engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. The Owner may employ a laboratory to perform quality assurance to assure that the contractor and his laboratory are performing in accordance with contract documents.

C. Inspections: [Level 1] [Level 2] special inspections according to the "International Building Code."

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

D. Testing Prior to Construction: One set of tests.

E. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.

F. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.

G. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

H. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

- I. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for **[mortar air content] [and] [compressive strength]**.
- J. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
- K. Prism Test: For each type of construction provided, according to ASTM C 1314 at **[7 days and at]28 days**.
- L. Report test results in writing and in form requested by the DEN Project Manager to DEN Project Manager and Contractor, on same day tests are made. Include on form or plan location of test, name of contractor and person performing test, laboratory performing test.
- M. Evaluation of Quality Control Tests: Masonry work, in absence of other indications of noncompliance with requirements, will be considered satisfactory if results from construction quality control tests comply with minimum requirements indicated.

3.18 PARGING

- A. Parge exterior faces of below-grade masonry walls, where indicated, in 2 uniform coats to a total thickness of **3/4 inch (19 mm)**. Dampen wall before applying first coat and scarify first coat to ensure full bond to subsequent coat.
- B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of **1/8 inch per foot (3 mm per 300 mm)**. Form a wash at top of parging and a cove at bottom.
- C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.19 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.

2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain DEN Project Manager's approval of sample cleaning before proceeding with cleaning of masonry.
 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
 6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
 7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
 8. Clean stone trim to comply with stone supplier's written instructions.
 9. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."
- E. Sealer: Provide sealer at all CMU exposed to the exterior, and on all split face CMU, on the side exposed. Two coats. Install per Manufacturer's recommendations, after cleaning. Do not install over wet or damp masonry.
- F. Protection: Provide final protection and maintain conditions in a manner acceptable to Installer and DEN Project Manager, which ensures unit masonry work being without damage and deterioration at time of substantial completion.

3.20 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
1. Crush masonry waste to less than **4 inches (100 mm)** in each dimension.
 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
 3. Do not dispose of masonry waste as fill within **18 inches (450 mm)** of finished grade.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

SECTION 042300 - GLASS UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Glass block set in mortar.
- 2. Glass block set in silicone sealant.
- 3. Glass block set in glass-block grid systems.

- B. Related Sections:

- 1. Section 055000 "Metal Fabrications" for [**steel channel frames**] [**and**] [**loose steel lintels**] at glass unit masonry assemblies.
- 2. Section 085113 "Aluminum Windows" for aluminum windows installed within glass unit masonry assemblies.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design glass-block grid systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

- B. Structural Performance: Glass-block grid systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

- 1. Wind Load: 115 mph with gust factor of 1.3, acting inward or outward.
- 2. Floor Live Load: <Insert load>.
- 3. Roof Live Load: <Insert load>.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
1. Product Data for Credit IEQ 4.1: For sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
 2. Laboratory Test Reports for Credit IEQ 4: For sealants used inside the weatherproofing system, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Show fabrication and installation details for **[glass unit masonry, including vertical and horizontal coursing, anchors, reinforcement, and expansion strips]** **[and]** **[glass-block grid systems]**.
- D. Samples for Initial Selection: **[Manufacturer's actual glass-block units]** **[glass-block grid material]** **[and]** **[joint materials involving color selection]**.
- E. Samples for Verification: **[Glass-block units]** **[glass-block grid material]** **[and]** **[joint materials involving color selection]**.
- F. Samples for Verification: Panels consisting of four full-size glass-block units with **[glass-block grid]** **[mortar]** **[and]** **[sealant]** joints.
1. Provide Samples for each form, pattern, and color of glass block and color of joint material **[and glass-block grid material]** indicated or selected by DIA Project Manager.
- G. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, documentation including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For qualified professional engineer.
- 1.6 CLOSEOUT SUBMITTALS
- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".
- 1.7 QUALITY ASSURANCE
- A. Source Limitations for Glass Block: Obtain **[each type and pattern of]** glass

block through single source from single manufacturer.

- B. Source Limitations for Accessory Materials: Obtain each [**cementitious material**] [**admixture**] [**and**] [**accessory component**] through single source from single manufacturer[**and each aggregate from single source or producer**].
- C. Fire-Rated Glass Unit Masonry Assemblies: Assemblies listed by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 257.
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup of typical [**exterior**] [**and**] [**interior**] panel, **48 by 48 inches** (1200 by 1200 mm) in size.
 - 2. Build mockup of typical [**exterior wall area**] [**and**] [**interior partition**] containing glass unit masonry assembly as shown on Drawings.
 - 3. Notify DIA Project Manager seven (7) days in advance of the dates and times when mockups will be constructed.
 - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store glass block in unopened cartons on elevated platforms, under cover, and in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.
- B. Store glass-block grid materials in unopened cartons in an enclosed, dry location.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- E. Store accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations for Sealants: Do not install sealants when ambient

and substrate temperatures are outside limits permitted by sealant manufacturer or below 40 deg F (5 deg C) or when joint substrates are wet.

- B. Weather Limitations: Proceed with installation of glass unit masonry assemblies only when ambient and material temperatures are 40 deg F (5 deg C) or higher.
 - 1. Maintain temperature in installation areas at 40 deg F (5 deg C) or above for 48 hours after installing.

1.10 SEQUENCING AND SCHEDULING

- A. Sequence and coordinate completion of glass unit masonry assemblies so sealants can be installed immediately after mortar has attained final set.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GLASS BLOCK

- A. Hollow Glass Block [**GB-<#>**]: Hollow units made from transparent glass, with manufacturer's standard edge coating.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Mulia Inc. (Distributed by Glass Blocks Unlimited and Mulia, Inc.).
 - b. Nippon Electric Glass Co., Ltd. (Distributed by Glass Blocks Unlimited and Nippon Electric Glass America, Inc.).
 - c. Oberland Glas AG, Bauglas Div.; Solaris Glasstein (Distributed by Glass Blocks Unlimited and North America Glass).
 - d. Pittsburgh Corning Corporation.
 - e. Seves (Distributed by Glass Blocks Unlimited, International Product Supply, and Seves North America).
 - f. Vegla Vereinigte Glaswerke GmbH (Saint-Gobain).
 - g. J. Weck GmbH (Distributed by Glashauss, Inc. and Glass Blocks Unlimited).
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.
 - 2. Glass Color: [**Colorless**] [**As indicated by manufacturer's designations**] [**Match DIA Project Manager's samples**] [**As selected by DIA Project Manager from manufacturer's full range**].

3. Pattern: Smooth, undistorted inner and outer faces.
4. Pattern: Wavy, light-diffusive design on inner faces, and smooth outer faces.
5. Pattern: Fluted, light-diffusive design, horizontal on one inner face, vertical on other, and smooth outer faces.
6. Pattern: Linear prismatic design, horizontal on one inner face, vertical on other, and smooth outer faces.
7. Pattern: Prismatic pyramid, light-diffusive design on inner faces, and smooth outer faces.
8. Pattern: As indicated by manufacturer's designation.
9. Pattern: Manufacturer's standard decorative pattern to match DIA Project Manager's sample.
10. Pattern: As selected by DIA Project Manager from manufacturer's full range.
11. Pattern: Custom decorative pattern to match DIA Project Manager's design.
12. Edge-Coating Color: **[White] [As indicated by manufacturer's designations] [Match DIA Project Manager's sample] [As selected by DIA Project Manager from manufacturer's full range].**
 - a. Provide one color throughout for each pattern indicated.
 - b. Provide multiple colors as indicated for each size and pattern.
13. Sizes: Manufacturer's standard sizes corresponding to nominal sizes indicated on Drawings.
14. Square-Block Size: **[5-3/4 inches (146 mm)] [7-3/4 inches (197 mm)]** square by **3-1/8 inches (79 mm)** thick.
15. Square-Block Size: **[5-3/4 inches (146 mm)] [7-3/4 inches (197 mm)] [11-3/4 inches (299 mm)]** square by **3-7/8 inches (98 mm)** thick.
16. Square-Block Size: **[4-1/2 inches (115 mm)] [7-1/2 inches (190 mm)] [9-13/16 inches (240 mm)] [11-13/16 inches (300 mm)]** square by **3-1/8 inches (80 mm)** thick.
17. Square-Block Size: **7-1/2 inches (190 mm)** square by **3-3/4 inches (95 mm)** thick.
18. Square-Block Size: **[7-1/2 inches (190 mm)] [11-13/16 inches (300 mm)]** square by **3-15/16 inches (100 mm)** thick.
19. Rectangular-Block Size: **[3-3/4 by 7-3/4 inches (95 by 197 mm)] [5-3/4 by 7-3/4 inches (146 by 197 mm)]** by **[3-1/8 inches (79 mm)] [3-7/8 inches (98 mm)]** thick.
20. Rectangular-Block Size: **4-1/2 by 9-13/16 inches (115 by 240 mm)** by **3-1/8 inches (80 mm)** thick.
21. Corner-Block Sizes and Shapes: Manufacturer's standard units designed to form **[90] [45] [22.5]**-degree corners when joined with straight units of same height.
22. End-Block Size and Shape: **[7-3/4 inches (197 mm) square] [3-3/4 by 7-3/4 inches (95 by 197 mm)]** by **[3-7/8 inches (98 mm)] [3-1/8 inches (79 mm)]** thick, actual size.
23. Top-Corner-Block Sizes and Shapes: End unit with top matching finished end and with rounded finished corner in manufacturer's standard size to match end units.

24. Thick-Faced Block: **[5-3/4 inches** (146 mm)] **[7-3/4 inches** (197 mm)] square by **3-7/8 inches** (98 mm) thick, actual size, with faces at least **3/4 inch** (19 mm) thick.
 25. Thick-Faced Block: **7-1/2 inches** (190 mm) square by **3-1/8 inches** (80 mm) thick, actual size, with faces at least **3/4 inch** (19 mm) thick.
- B. Solid Glass Block [**GB-#**]: Colorless, transparent, solid glass blocks with [**smooth**] [**stippled**] faces and manufacturer's standard edge coating.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pittsburgh Corning Corporation.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.
 2. Square-Block Size: **[5-3/4 inches** (146 mm)] **[7-3/4 inches** (197 mm)] **[11-3/4 inches** (299 mm)] square by **[1-1/2 inches** (38 mm)] **[3 inches** (76 mm)] thick, actual size.
 3. Rectangular-Block Size: **[3 by 7-3/4 inches** (76 by 197 mm)] **[5-3/4 by 7-3/4 inches** (146 by 197 mm)] by **[1-1/2 inches** (38 mm)] **[3 inches** (76 mm)] thick, actual size.
- C. Glass-Paver Block [**GB-#**]: Transparent, colorless, pressed glass units, with a smooth top surface and a decorative, light-diffusing, patterned bottom surface; **[6 inches** (152 mm) square by **1 inch** (25 mm)] **[4-3/4 inches** (120 mm) square by **1-9/16 inches** (40 mm)] **[6-5/16 inches** (160 mm) square by **1-3/16 inches** (30 mm)] **[7-1/2 inches** (190 mm) square by **1-1-15/16 inches** (50 mm)] **[7-1/2 inches** (190 mm) square by **2-3/4 inches** (70 mm)] **[7-7/8 inches** (200 mm) square by **7/8 inch** (22 mm)] **[7-7/8 inches** (200 mm) square by **1-15/16 inches** (50 mm)] **[4-5/8 inches** (117 mm) in diameter by **2-3/8 inches** (60 mm)] thick, actual size.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Oberland Glas AG, Bauglas Div.; Solaris Glasstein (Distributed by Glass Blocks Unlimited and North America Glass).
 - b. Pittsburgh Corning Corporation.
 - c. L. E. Smith Glass Company.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.

2.2 GLASS-BLOCK GRID SYSTEMS

- A. General: Aluminum extrusions complying with **ASTM B 221** (ASTM B 221M), Alloy 6063-T6 or Alloy 6463-T6, forming a grid system and frame designed for application indicated.
1. Manufacturers: Subject to compliance with requirements, provide

products by one of the following:

- a. IBP; a Berkshire Hathaway company.
 - b. Innovative Building Products, Inc.
 - c. <Insert manufacturer's name>.
 - d. or approved equal.
- B. Window and Wall System: Aluminum T-bar grid with tubular frame and vinyl glass-block boots.
1. Finish: **[White] [Satin aluminum] [Bronze] [Taupe] [Gold] [Silver] [Black] [As selected by DIA Project Manager from manufacturer's full range]**.
 2. Finish: Custom-color, polyester powder-coat finish complying with AAMA 2604 and matching DIA Project Manager's sample.
 3. Glass-Block Size: **7-3/4 inches** (197 mm) square by **3-1/8 inches** (79 mm) thick.
 4. Provide **[self-flashing]** aluminum exterior frame covers with vinyl thermal break.
 5. Provide extruded-aluminum frame receivers (corner starters) at heads, jambs, and sills.
 6. Provide extruded-aluminum mullions where indicated.
 7. Provide aluminum trim and closures as indicated.
- C. Skylight System: Aluminum T-bar grid with tubular frame; vinyl thermal break; extruded-aluminum, curb-mounting frame and counterflashing; and vinyl glass-block boots.
1. Finish: **[White] [Satin aluminum] [Bronze] [Taupe] [Gold] [Silver] [Black] [As selected by DIA Project Manager from manufacturer's full range]**.
 2. Finish: Custom-color, polyester powder-coat finish; complying with AAMA 2604 and Glass-Block Size: **7-3/4 inches** (197 mm) square by **3-1/8 inches** (79 mm) thick.
- D. Floor System: Aluminum T-bar grid and frame with glass-block boots made from UV- and oil-resistant EPDM.
1. Finish: Class II, clear-anodized finish complying with AAMA 611.
 2. Glass-Paver-Block Size: **6 inches** (152 mm) square by **1 inch** (25 mm) thick.
- E. Sealant: Product recommended by glass-block grid system manufacturer.
1. Sealants used inside the weatherproofing system shall have a VOC content of **[250] <Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II. Provide natural color or white cement as required to produce mortar color indicated.
- Where joints are indicated to be raked out and pointed, gray cement may be used for setting mortar.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Masonry Cement: ASTM C 91.
- Products: Subject to compliance with requirements, provide products by one of the following:
 - Capital Materials Corporation; Flamingo Color Masonry Cement.
 - Cemex S.A.B. de C.V.; [**Brikset Type N**] [**Citadel Type S**] [**Dixie Type S**] [**Kosmortar Type N**] [**Richmortar**] [**Victor Plastic Cement**].
 - Essroc, Italcementi Group; [**Brixment**] [**or**] [**Velvet**].
 - Glen-Gery Corporation.
 - Holcim (US) Inc.; [**Mortamix Masonry Cement**] [**Rainbow Mortamix Custom Buff Masonry Cement**] [**White Mortamix Masonry Cement**].
 - Lafarge North America Inc.; [**Magnolia Masonry Cement**] [**Lafarge Masonry Cement**] [**Trinity White Masonry Cement**].
 - Lehigh Cement Company; [**Lehigh Masonry Cement**] [**Lehigh White Masonry Cement**].
 - National Cement Company, Inc.; Coosa Masonry Cement.
 - <**Insert manufacturer's name; product name or designation**>.
 - Riverton Corporation (The).
 - <**Insert manufacturer**>
 - or approved equal.
- E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
- Products: Subject to compliance with requirements, provide products by one of the following:
 - Davis Colors; True Tone Mortar Colors.
 - Lanxess Corporation; Bayferrox Iron Oxide Pigments.
 - Solomon Colors, Inc.; SGS Mortar Colors.
 - <**Insert manufacturer's name; product name or designation**>.
 - or approved equal.
- F. Colored Cement Product: Packaged blend made from [**portland cement and**

hydrated lime] [or] [masonry cement] and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Products: Subject to compliance with requirements, provide products by one of the following:

a. Colored Portland Cement-Lime Mix:

- 1) Capital Materials Corporation; Riverton Portland Cement Lime Custom Color.
- 2) Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
- 3) Lafarge North America Inc.; Eaglebond Portland & Lime.
- 4) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.
- 5) **<Insert manufacturer's name; product name or designation>**.
- 6) or approved equal.

b. Colored Masonry Cement:

- 1) Capital Materials Corporation; Flamingo Color Masonry Cement.
- 2) Cemex S.A.B. de C.V.; Richcolor Masonry Cement.
- 3) Essroc, Italcementi Group; Brixment-in-Color.
- 4) Holcim (US) Inc.; Rainbow Mortamix Custom Color Masonry Cement.
- 5) Lafarge North America Inc.; U.S. Cement Custom Color Masonry Cement.
- 6) Lehigh Cement Company; Lehigh Custom Color Masonry Cement.
- 7) National Cement Company, Inc.; Coosa Masonry Cement.
- 8) **<Insert manufacturer's name; product name or designation>**.
- 9) or approved equal.

2. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.

3. Pigments shall not exceed 10 percent of portland cement by weight.

4. Pigments shall not exceed 5 percent of masonry cement by weight.

G. Aggregate: ASTM C 144, with 100 percent passing **No. 8** (2.36-mm) sieve.

1. For **[pointing mortar] [and] [joints narrower than 1/4 inch (6 mm)]**, use aggregate graded with 100 percent passing **No. 16** (1.18-mm) sieve.

2. White Aggregates: Natural white sand or crushed white stone.

3. Colored Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

H. Water-Repellent Admixture: Manufacturer's standard dry mixture of stearates, water-reducing agents, and fine aggregates intended to reduce capillarity in

mortar.

1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Aktiengesellschaft; Hydrocide Powder.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
- I. Water-Repellent Admixture: Liquid polymeric water-repellent mortar admixture that does not reduce flexural bond strength of mortar.
 1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. ACM Chemistries; RainBloc for Mortar.
 - b. BASF Aktiengesellschaft; Rheopel Mortar Admixture.
 - c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
- J. Water: Potable.

2.4 GLASS UNIT MASONRY ACCESSORIES

- A. Panel Reinforcement: Ladder-type units, butt welded, not lapped and welded; complying with ASTM A 951 in straight lengths of not less than **10 feet** (3 m), and as follows:
 1. Interior Walls: Hot-dip galvanized, carbon-steel wire.
 2. Exterior Walls: **[Hot-dip galvanized, carbon] [Stainless]**-steel wire.
 3. Wire Size: W1.7 or **0.148-inch** (3.8-mm) diameter.
 4. Width: **[2 inches** (50 mm)] **[1-5/8 inches** (40 mm)].
 5. Spacing of Cross Rods: Not more than **16 inches** (407 mm) apart.
- B. Panel Anchors: Glass-block manufacturer's standard perforated steel strips, **0.0359 inch** (0.9 mm) by **1-3/4 inches** (44 mm) wide by **24 inches** (600 mm) long, hot-dip galvanized after fabrication to comply with ASTM A 153/A 153M.
- C. Mortarless Installation System: System of **[aluminum] [or] [plastic]** perimeter framing, anchors, and spacers designed for installing glass block with sealant-filled joints.
 1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Coleman Enterprises; SwiftTrack Glass Block System.
 - b. Pittsburgh Corning Corporation; **[ProVantage] [Thinline Track Spacer System]**.

- c. J. Weck GmbH (Distributed by Glashaus, Inc. and Glass Blocks Unlimited); BlokUp.
 - d. <Insert manufacturer's name; product name or designation>.
 - e. or approved equal.

- D. Fasteners, General: Unless otherwise indicated, provide Type 304 or Type 316 stainless-steel fasteners at exterior walls and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at interior walls. Select fasteners for type, grade, and class required.

- E. Carbon-Steel Bolts: **ASTM A 307, Grade A** (ASTM F 568M, Property Class 4.6) with hex nuts, **ASTM A 563** (ASTM A 563M) if applicable.

- F. Stainless-Steel Bolts: **ASTM F 593** (ASTM F 738M), Alloy Group **1 or 2** (A1 or A4) with hex nuts, **ASTM F 594** (ASTM F 836M) if applicable.

- G. Postinstalled Anchors: Provide [**metal expansion sleeve anchors**] [**or**] [**metal impact expansion anchors**] of type and size necessary for installation indicated, according to manufacturer's written instructions unless otherwise indicated.

- H. Asphalt Emulsion: Cold-applied asphalt emulsion complying with ASTM D 1187 or ASTM D 1227.

- I. Mineral-Fiber Expansion Strips: Comply with requirements of fire-rated assembly listing and glass-block manufacturer.
 - 1. Use for fire-rated assemblies.

- J. Plastic-Foam Expansion Strips: Polyethylene foam complying with requirements of glass-block manufacturer; **3/8 inch** (9 mm) thick by [**4 inches** (100 mm)] [**3-1/2 inches** (89 mm)] [**2-1/2 inches** (63 mm)] wide.
 - 1. Use plastic-foam expansion strips for[**fire-rated and**] non-fire-rated assemblies.

- K. Sealants: Manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated below that comply with applicable requirements in Section 079200 "Joint Sealants."
 - 1. Single-component, [**neutral**] [**acid**]-curing silicone sealant[**ES-<#>**].
 - 2. Single-component, nonsag urethane sealant[**ES-<#>**].
 - 3. Multicomponent, nonsag polysulfide sealant[**ES-<#>**].
 - 4. Sealants used inside the weatherproofing system shall have a VOC content of [**250**] <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 5. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- L. Sealant Accessories: Provide sealant accessories, including primers, bond-breaker tape, and cylindrical sealant backing, that comply with applicable requirements in Section 079200 "Joint Sealants."

2.5 MORTAR MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, or antifreeze compounds unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar.
 - 2. For mortar in exterior panels, use water-repellent admixture according to admixture manufacturer's written instructions.
 - 3. For pointing mortar in exterior panels, use water-repellent admixture according to admixture manufacturer's written instructions.
 - 4. Limit cementitious materials in mortar to portland cement and lime.
- B. Mortar for Glass Unit Masonry Assemblies: Provide mortar, mixed according to glass-block manufacturer's listing with testing and inspecting agency, for fire-resistance rating indicated.
- C. Mortar for Glass Unit Masonry Assemblies: Comply with ASTM C 270, Proportion Specification for Type S mortar.
 - 1. Combine and thoroughly mix cementitious materials, water, and aggregates in a mechanical batch mixer unless otherwise indicated. Mix mortar to produce a stiff but workable consistency that is drier than mortar for brick or concrete masonry. Discard mortar when it has reached initial set.
- D. Pigmented Mortar: Use colored cement product[**or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products**].
 - 1. Pigments shall not exceed 10 percent of portland cement by weight.
 - 2. Pigments shall not exceed 5 percent of masonry cement by weight.
 - 3. Mix to match DIA Project Manager's sample.
- E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
 - 1. Mix to match DIA Project Manager's sample.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine sills, jambs, and heads surrounding glass unit masonry assemblies for compliance with requirements for installation tolerances and other

conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Advise installers of other construction about specific requirements for placement of dovetail slots and other inserts required to anchor and support glass unit masonry assemblies. Furnish installers of other construction with drawings or templates showing locations of these items.

3.3 INSTALLING GLASS BLOCK WITH MORTAR

- A. Apply a heavy coat of asphalt emulsion to sill and adhere expansion strips to jambs and heads with asphalt emulsion. Allow asphalt emulsion to dry before placing mortar. Trim expansion strips to width required to fit glass block and to full lengths of heads and jambs.
- B. Set glass block with completely filled bed and head joints, with no furrowing, accurately spaced and coordinated with other construction. Maintain [**1/4-inch** (6-mm)] [**3/8-inch** (10-mm)] exposed joint widths unless otherwise indicated.
- C. Install panel reinforcement in horizontal joints at spacing indicated and continuously from end to end of panels; comply with the following requirements:
 1. Vertical Spacing of Panel Reinforcement for Exterior Panels: [**Every other course but not more than 16 inches** (407 mm) o.c., starting with first course above sill] [**As indicated on Drawings**].
 2. Vertical Spacing of Panel Reinforcement for Interior Panels: [**Not more than 16 inches** (407 mm) o.c.] [**As indicated on Drawings**].
 3. Do not bridge expansion joints with panel reinforcement.
 4. Place panel reinforcement in joints immediately above and below all openings within glass unit masonry assemblies.
 5. Lap panel reinforcement not less than **6 inches** (150 mm) if more than one length is necessary.
 6. Embed panel reinforcement in mortar bed by placing lower half of mortar bed first, pressing panel reinforcement into place and covering with upper half of mortar bed.
- D. Install panel anchors at locations indicated and in same horizontal joints where panel reinforcement occurs. Extend panel anchors at least **12 inches** (300 mm) into joints, and bend within expansion joints at edges of panels and across the head. Attach panel anchors as follows:
 1. For in-place unit masonry assemblies and concrete, attach panel anchors with **1/4-inch-** (6-mm-) diameter bolt-size, postinstalled anchors, two per panel anchor.

2. For new unit masonry assemblies, embed other ends of panel anchors, after bending portions crossing expansion joint, in horizontal mortar joints closest in elevation to joints in glass unit masonry assemblies containing panel anchors.
 3. For steel members, attach panel anchors with **1/4-inch-** (6-mm-) diameter through bolts and nuts or bolts in tapped holes in steel members.
- E. Use rubber mallet to tap units into position. Do not use steel tools, and do not allow units to come into contact with metal accessories and frames.
- F. Use **[plastic spacers]** **[or]** **[temporary wedges]** in mortar joints to produce uniform joint widths and to prevent mortar from being squeezed out of joints.
1. If temporary wedges are used, remove them after mortar has set and fill voids with mortar.
- G. Keep expansion joints free of mortar.
- H. Rake out joints indicated to be pointed to a uniform depth sufficient to accommodate pointing material, but not less than joint width.
1. If temporary wedges are used, remove them before raking out and pointing joints.
 2. Point joints at **[exterior face]** **[both faces]** of exterior panels with mortar.
 3. Point joints at **[exterior face]** **[both faces]** of exterior panels with sealant.
 4. Point joints at both faces of exterior and interior panels with sealant.
- I. Point joints with mortar by filling raked joints and voids. Place and compact pointing mortar in layers not more than **3/8 inch** (10 mm) thick. Compact each layer thoroughly and allow to become thumbprint hard before applying next layer.
1. Tool exposed joints slightly concave when pointing mortar is thumbprint hard. Use a smooth plastic jointer larger than joint width.
- J. Point joints by filling with sealant to comply with requirements in Section 079200 "Joint Sealants."
- K. Clean glass unit masonry assemblies as work progresses. Remove mortar fins and smears immediately, using a clean, wet sponge or a scrub brush with stiff fiber bristles. Do not use harsh cleaners, acids, abrasives, steel wool, or wire brushes when removing mortar or cleaning glass unit masonry assemblies.
- L. Install sealant at jambs, heads, mullions and other locations indicated. Prepare joints, including installation of primer and bond-breaker tape or cylindrical sealant backing, and apply elastomeric sealants to comply with requirements in Section 079200 "Joint Sealants."
- M. Construction Tolerances: Set glass block to comply with the following tolerances:

1. Variation from Plumb: For vertical lines and surfaces, do not exceed [**1/4 inch in 10 feet** (6 mm in 3 m), **3/8 inch in 20 feet** (9 mm in 6 m), **or 1/2 inch in 40 feet** (12 mm in 12 m)] [**1/8 inch in 10 feet** (3 mm in 3 m), **1/4 inch in 20 feet** (6 mm in 6 m), **or 3/8 inch in 40 feet** (9 mm in 12 m)] or more.
2. Variation from Level: For bed joints, and other conspicuous lines, do not exceed **1/8 inch in 10 feet** (3 mm in 3 m), **1/4 inch in 20 feet** (6 mm in 6 m) or **1/2 inch in 40 feet** (12 mm in 12 m) or more.
3. Variation of Location in Plan: For location of elements in plan do not vary from that indicated by more than plus or minus **1/4 inch** (6 mm).
4. Variation in Mortar-Joint Thickness: Do not vary from joint thickness indicated by more than plus or minus **1/16 inch** (1.5 mm).
5. For faces of adjacent exposed units, do not vary from flush alignment by more than **1/16 inch** (1.5 mm).

3.4 INSTALLING GLASS BLOCK WITH SEALANT

- A. General: Install mortarless glass-block systems in strict accordance with manufacturer's written instructions.
 1. Fasten frames and anchors or clips securely to surrounding construction.
 2. Shim starting track as needed to make it level.
 3. Adhere glass block to starting track and spacers with silicone sealant.
- B. After glass blocks are installed, apply sealant to completely fill channel around each glass block, and tool flush with exterior surface. Remove excess sealant and smears.

3.5 GLASS-BLOCK GRID SYSTEM INSTALLATION

- A. General: Install glass-block grid systems in strict accordance with manufacturer's written instructions.
- B. Window and Wall System Installation: Assemble grid system, apply continuous sealant bead to back of window Z-bar, place in position, adjust as needed to make grid level and plumb, and fasten to substrate.
 1. Insert glass blocks into vinyl glass-block boots and carefully insert into grid from exterior side. Install blocks firmly against T-bars without deforming boots.
 2. Apply sealant to completely fill channel around each glass block, and tool flush with exterior surface. Remove excess sealant and smears.
- C. Skylight System Installation: Assemble grid system, apply continuous sealant bead to top of supporting curb, place in position, adjust as needed to bring grid true to line, and fasten to substrate.
 1. Insert glass blocks into vinyl glass-block boots and carefully insert into grid from exterior side. Install blocks firmly against T-bars without deforming boots.

2. Apply sealant to completely fill channel around each glass block, and tool flush with exterior surface. Remove excess sealant and smears.
- D. Floor System Installation: Assemble grid system in position, adjusting supports as needed to level grid as system is assembled, and fasten to substrate.
1. Insert glass blocks into vinyl glass-block boots and install into grid. Install blocks flush with adjoining floor surfaces and aluminum grid.
 2. Apply sealant to completely fill channel around each glass block and joints of aluminum grid. Tool flush with exterior surface and remove excess sealant and smears.

3.6 CLEANING

- A. On surfaces adjacent to glass unit masonry assemblies, remove mortar, sealants, and other residue resulting from glass-block installation, in a manner approved by manufacturers of materials involved.
- B. Remove excess sealants with commercial solvents according to sealant manufacturer's written instructions. Exercise care not to damage sealant in joints.
- C. Perform final cleaning of glass unit masonry assemblies when surface is not exposed to direct sunlight. Start at top of panel using generous amounts of clean water. Remove water with clean, dry, soft cloths; change cloths frequently to eliminate dried mortar particles and aggregate.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 042300

SECTION 044200 - EXTERIOR STONE CLADDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Dimension stone panels set with individual anchors.
2. Dimension stone panels mechanically anchored on steel trusses.
3. Dimension stone panels mechanically anchored on steel strongback frames.
4. Dimension stone panels mechanically anchored on steel stud frames.
5. Dimension stone panels mechanically anchored (field installed) on a metal-grid system.
6. Dimension stone panels set in architectural precast concrete.
7. Dimension stone panels glazed into aluminum curtain-wall framing system.
8. Dimension stone trim units, including [**bands**] [**copings**] [**sills**] [**jamb**s] [**and**] [**soffits**].
9. Dimension stone with carving or inscriptions.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing [**inserts**] [**and**] [**weld plates**] in concrete for anchoring dimension stone cladding.
2. Section 034500 "Precast Architectural Concrete" for setting dimension stone panels in architectural precast concrete units.
3. Section 042000 "Unit Masonry" [**for installing inserts in unit masonry for anchoring dimension stone cladding**] [**and**] [**for stone trim in unit masonry walls**].
4. Section 054000 "Cold-Formed Metal Framing" for steel stud frames supporting dimension stone cladding.
5. Section 079200 "Joint Sealants" for sealing joints in dimension stone cladding system with elastomeric sealants.
6. Section 084413 "Glazed Aluminum Curtain Walls" for installing dimension stone panels in aluminum curtain-wall systems.
7. Section 096340 "Stone Flooring" for dimension stone used as paving and flooring.
8. Section 097513 "Stone Paneling" for dimension stone applied as trim and paneling on building interiors.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ALLOWANCES

- A. **[Preconstruction] [and] [quality-control]** testing is part of testing and inspecting allowance.

1.4 DEFINITIONS

- A. Definitions contained in ASTM C 119 apply to this Section.
- B. Dimension Stone Cladding Assembly: An exterior wall covering system consisting of dimension stone panels[**and trim**] together with anchors, **[backup structure,] [secondary weather barrier (sheathing),] [mortar,] [adhesives,]** fasteners, and sealants used to secure the stone to the building structure and to produce a weather-resistant covering.
 - 1. Backup structure includes **[steel trusses] [steel strongback frames] [steel stud frames] [metal-grid system] [and] [miscellaneous steel framing required to secure stone to the building structure].**
- C. IBC: International Building Code.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DIA Project Manager] <Insert location>**.

1.6 ACTION SUBMITTALS

- A. Product Data: For each[**variety of stone,**] stone accessory, and manufactured product.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
- C. Shop Drawings: Show fabrication and installation details for dimension stone cladding assembly, including dimensions and profiles of stone units.

1. Show locations and details of joints both within dimension stone cladding assembly and between dimension stone cladding assembly and other construction.
 2. Include details of **[mortar joints] [sealant joints] [and] [mortar joints pointed with sealant]**.
 3. Show locations and details of anchors **[and backup structure]**.
 4. Show direction of veining, grain, or other directional pattern.
 5. Include large-scale shaded elevations and details of decorative surfaces and inscriptions.
- D. Samples for Initial Selection: For joint materials involving color selection.
- E. Stone Samples for Verification: Sets for each variety, color, and finish of stone required; not less than **12 inches** (300 mm) square.
1. Sets shall consist of at least **[two] [three] [four] [five] <Insert number>** Samples, exhibiting extremes of the full range of color and other visual characteristics expected and will establish the standard by which stone will be judged.
- F. Colored Pointing Mortar Samples for Verification: For each color required. Make Samples using same sand and mortar ingredients to be used on Project.
- G. Sealant Samples for Verification: For each type and color of joint sealant required.
- H. Delegated- Design Submittal: For dimension stone cladding assembly.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[Installer] [fabricator] [professional engineer] [and] [testing agency]**.
- B. Welding certificates.
- C. Material Test Reports:
1. Stone Test Reports: For **[each]** stone variety proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, other than abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous **[five] [three] <Insert number>** years.
 2. For metal components, by a qualified testing agency, indicating chemical and physical properties of metal.
 3. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer complying with requirements in Section 079200 "Joint Sealants" and indicating that sealants will not stain or damage stone. Include interpretation of test results and recommendations for primers and substrate preparation needed for adhesion.

- D. Preconstruction test reports.
- E. Source quality-control reports.
- F. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.8 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.9 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Dimension Stone Units: Furnish **<Insert number>** finished stone panels **<Insert required dimensions>** for each finish and variety of stone specified.

1.10 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate dimension stone cladding assemblies similar to that required for this Project and whose products have a record of successful in-service performance.
- B. Installer Qualifications: A firm or individual experienced in installing dimension stone cladding assemblies similar in material, design, and extent to that indicated for this Project, whose work has a record of successful in-service performance.
- C. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- D. Welding Qualifications: Qualify procedures and personnel according to [**AWS D1.1/D1.1M, "Structural Welding Code - Steel"**] [**AWS D1.2/D1.2M, "Structural Welding Code - Aluminum"**] [**AWS D1.3, "Structural Welding Code - Sheet Steel"**].
- E. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockups of typical exterior wall area [**as shown on Drawings**] [**not less than 72 inches** (1800 mm) **long by 48 inches** (1200 mm) **high**] [**not less**

than 15 feet (4.5 m) long by 10 feet (3 m) high].

- a. Include typical components, attachments to building structure, and methods of installation.
 - b. Include window opening with stone [returns] [trim].
 - c. Include sealant-filled joint complying with requirements in Section 079200 "Joint Sealants."
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DIA Project Manager specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.11 PRECONSTRUCTION TESTING

- A. Preconstruction Stone Testing: **[Owner will engage] [Engage]** a qualified independent testing agency to perform preconstruction testing.
 1. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
 2. Furnish test specimens that are representative of materials proposed for incorporation into the Work.
 3. Physical Property Tests: For **[each]** stone variety proposed for use on Project, tested for compliance with physical property requirements, other than abrasion resistance, according to referenced ASTM standards.
 4. Flexural Strength Tests: For **[each combination of]** stone variety, thickness, orientation of cut, and finish, proposed for use on Project, tested according to ASTM C 880/C 880M, in both wet and dry conditions.
 5. Anchorage Tests: For **[each combination of]** stone variety, orientation of cut, finish, and anchor type proposed for use on Project, tested according to ASTM C 1354/C 1354M.
 6. Anchoring System Mockup Test: For stone anchoring system, tested according to ASTM C 1201/C 1201M, Procedure B, with a maximum test load equal to 3 times the design load. Build laboratory mockup at testing agency facility; use personnel, materials, and methods of construction that will be used at Project site. Mockup shall consist of one panel **<Insert dimensions>** in size.
- B. Preconstruction Sealant Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for compatibility and adhesion testing according to sealant manufacturer's standard testing methods and Section 079200 "Joint Sealants" Samples of materials that will contact or affect joint sealants.
- C. Preconstruction Field Testing of Sealants: Before installing joint sealants, field test their adhesion to joint substrates according to Section 079200 "Joint Sealants."

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.
 - 1. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
 - 2. Store stone on wood skids or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.
- B. Mark stone units, on surface that will be concealed after installation, with designations used on Shop Drawings to identify individual stone units. Orient markings on vertical panels so that they are right side up when units are installed.
- C. Deliver sealants to Project site in original unopened containers labeled with manufacturer's name, product name and designation, color, expiration period, pot life, curing time, and mixing instructions for multicomponent materials.
- D. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- E. Store aggregates in locations where grading and other required characteristics can be maintained and where contamination can be avoided.

1.13 FIELD CONDITIONS

- A. Protect dimension stone cladding during erection by doing the following:
 - 1. Cover tops of dimension stone cladding installation with nonstaining, waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress. Extend cover a minimum of **24 inches** (600 mm) down both sides and hold securely in place.
 - 2. Prevent staining of stone from mortar, grout, sealants, and other sources. Immediately remove such materials without damaging stone.
 - 3. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on ground and over wall surface.
 - 4. Protect sills, ledges, and projections from mortar and sealant droppings.
- B. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Remove and replace dimension stone cladding damaged by frost or freezing conditions. Comply with cold-weather construction and protection requirements for masonry contained in ACI 530.1/ASCE 6/TMS 602.

- C. Hot-Weather Requirements: Comply with hot-weather construction and protection requirements for masonry contained in ACI 530.1/ASCE 6/TMS 602.
- D. Environmental Limitations for Sealants: Do not install sealants when ambient and substrate temperatures are outside limits permitted by sealant manufacturer or below 40 deg F (5 deg C) or when joint substrates are wet.

1.14 COORDINATION

- A. Coordinate installation of inserts that are to be embedded in concrete or masonry, flashing reglets, and similar items to be used by dimension stone cladding Installer for anchoring, supporting, and flashing of dimension stone cladding assembly. Furnish setting drawings, templates, and directions for installing such items and deliver to Project site in time for installation.
- B. Time delivery and installation of dimension stone cladding to avoid extended on-site storage and to coordinate with work adjacent to dimension stone cladding.

1.15 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Stone: Obtain[**each variety of**] stone[, **regardless of finish,**] from single quarry[, **whether specified in this Section or in another Section of the Specifications,**] with resources to provide materials of consistent quality in appearance and physical properties.
 - 1. For stone types that include same list of varieties and sources, provide same variety from same source for each.
 - 2. Make quarried blocks available for examination by DIA Project Manager.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of uniform quality for each cementitious component from single manufacturer and each aggregate from single source or producer.
- C. Source Limitations for Other Materials: Obtain each type of stone accessory[, **sealant,**] and other material from single manufacturer for each product.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design dimension stone cladding assembly.
- B. General: Design stone anchors and anchoring systems according to ASTM C 1242.
 - 1. Stone anchors shall withstand not less than two (2) times the weight of the stone cladding in both compression and tension.
- C. Structural Performance: Dimension stone cladding assembly shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Wind Loads: 115 mph with gust factor of 1.3.
 - 2. Altitude: 5,500 feet (1677 m) above sea level.
 - 3. Ambient Temperature Range: Minus 30 deg F (minus 35 deg C) to 120 deg F (49 deg C).
 - 4. Equipment Loads: Allow for loads due to window cleaning and maintenance equipment.
- D. Seismic Performance: Dimension stone cladding assembly shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7] <Insert requirement>.
 - 1. Component Importance Factor: [1.5] [1.0].
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- F. Horizontal Building Movement (Interstory Drift): Allow for maximum horizontal building movement equal to quotient resulting from dividing floor-to-floor height at any floor by 400.
- G. Shrinkage and Creep: Allow for progressive vertical shortening of building frame equal to <Insert value> in 10 feet (3 m).
- H. Safety Factors for Stone: Design dimension stone cladding assembly to withstand loads indicated without exceeding stone's allowable working stress determined by dividing stone's average ultimate strength, as established by testing, by the following safety factors:
 - 1. Safety Factor for Granite: [3] <Insert number>.
 - 2. Safety Factor for Oolitic Limestone: [8] <Insert number>.
 - 3. Safety Factor for Dolomitic Limestone: [6] <Insert number>.
 - 4. Safety Factor for Marble: [5] <Insert number>.

5. Safety Factor for Quartz-Based Stone: [6] <Insert number>.
 6. Safety Factor for Serpentine: [6] <Insert number>.
 7. Safety Factor for Slate: [5] <Insert number>.
 8. Safety Factor for Travertine: [8] <Insert number>.
 9. Safety Factor for Concentrated Stresses: [4] [for granite] [and] [10] [for stone varieties other than granite].
- I. Design stone anchors[**and backup structure**] to withstand loads indicated without exceeding allowable working stresses established by the following:
1. For Structural Steel: AISC 360.
 2. For Cold-Formed Steel: AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
 3. For Cold-Formed Stainless Steel: ASCE 8, "Specification for the Design of Cold-Formed Stainless Steel Structural Members."
 4. For Aluminum: AA ADM-1, "The Aluminum Design Manual."
 5. For Cast-in-Place and Postinstalled Fasteners in Concrete: One-fourth of tested capacity when installed in concrete with compressive strength indicated.
- J. For Postinstalled Fasteners in Masonry: One-sixth of tested capacity when installed in masonry units indicated.
- K. Limit deflection in each prefabricated assembly caused by indicated loads and thermal movements, acting singly or in combination with one another, to not more than [1/720] <Insert ratio> of assembly's clear span or the following, whichever is smaller:
1. 1/16 inch (1.5 mm), measured in plane of wall.
 2. 1/4 inch (6 mm), measured perpendicular to wall.
- L. Provisions for Fabrication and Erection Tolerances: Allow for fabrication and erection tolerances of building's structural system. [**Concrete fabrication and erection tolerances are specified in Section 033000 "Cast-in-Place Concrete."**] [**Structural-steel fabrication and erection tolerances are specified in Section 051200 "Structural Steel Framing."**]
- M. Provision for Deflection of Building Structure:
1. Deflection Due to Weight of Dimension Stone Cladding Assembly: Allow for [1/4-inch (6-mm)] <Insert dimension> vertical deflection in 20-foot (6-m) span of structural members supporting dimension stone cladding assembly.
 2. Live Load Deflection: Allow for [1/4-inch (6-mm)] <Insert dimension> vertical deflection, in 20-foot (6-m) span of structural members supporting dimension stone cladding assembly, due to live loads imposed on building's structural frame after stone installation.
- N. Corrosion and Staining Control: Prevent galvanic and other forms of corrosion as well as staining by isolating metals and other materials from direct contact with incompatible materials. Materials shall not stain exposed surfaces of

stone and joint materials.

2.3 GRANITE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 615.
- B. Regional Materials: Granite shall be fabricated within 500 miles (800 km) of Project site from stone that has been extracted within 500 miles (800 km) of Project site.
- C. Description: Uniform, [fine] [medium]-grained, [white] [pink] [gray] [black] <Insert color> stone [without veining].
- D. Varieties and Sources: Subject to compliance with requirements, [provide the following] [provide one of the following] [available stone varieties that may be incorporated into the Work include, but are not limited to, the following]:
 - 1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
 - 2. or approved equal.
- E. Cut: [Vein] [Fleuri].
 - 1. Orientation of Veining: [Horizontal] [Vertical] [As indicated].
- F. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- G. Finish: [Polished] [Honed] [Thermal] [As indicated] [Match DIA Project Manager's sample] <Insert finish>.
- H. Match DIA Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.
- I. Thickness: Not less than [3/4 inch (20 mm)] [30 mm] [1-1/4 inches (32 mm)] [1-5/8 inches (40 mm)] [2 inches (50 mm)] unless otherwise indicated.

2.4 LIMESTONE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 568.
 - 1. Classification: [I Low-Density] [II Medium-Density] [II Medium-Density except as follows: absorption, 5 percent by weight maximum; density, 150 lb/cu. ft. (2400 kg/cu. m) minimum; compressive strength, 8000 psi (55 MPa) minimum; and modulus of rupture 800 psi (5.5 MPa) minimum] [III High-Density].
- B. Regional Materials: Limestone shall be fabricated within 500 miles (800 km) of Project site from stone that has been extracted within 500 miles (800 km) of

Project site.

- C. Description: **[Dolomitic]** **[Oolitic]** **[Shell]** limestone.
- D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 - 1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>**.
 - 2. or approved equal.
- E. Varieties and Sources: Indiana limestone quarried in Lawrence, Monroe, or Owen Counties, Indiana.
 - 1. Indiana Limestone Grade and Color: **[Select, buff]** **[Select, gray]** **[Standard, buff]** **[Standard, gray]** **[Rustic, buff]** **[Rustic, gray]** **[Variegated]**, according to grade and color classification established by ILI.
- F. Cut: **[Vein]** **[Fleuri]**.
 - 1. Orientation of Veining: **[Horizontal]** **[Vertical]** **[As indicated]**.
- G. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- H. Finish: **[Smooth finish]** **[Sand rubbed]** **[Machine tooled, four bats per 1 inch (25 mm)]** **[Machine tooled, six bats per 1 inch (25 mm)]** **[Machine tooled, eight bats per 1 inch (25 mm)]** **[As indicated]** **[Match DIA Project Manager's sample]** **<Insert finish>**, matching standard ILI finish.
- I. Match DIA Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.
- J. Thickness: Not less than **[1-1/4 inches (32 mm)]** **[2 inches (50 mm)]** **[2-1/2 inches (64 mm)]** **[3 inches (75 mm)]** **[4 inches (100 mm)]** unless otherwise indicated.

2.5 MARBLE **<Insert drawing designation>**

- A. Material Standard: Comply with ASTM C 503, **[Classification I Calcite]** **[Classification II Dolomite]**, **[Group A]**.
- B. Regional Materials: Marble shall be fabricated within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.
- C. Description: Uniform, fine- to medium-grained, **[white]** **<Insert color>** stone with only slight veining.
- D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:

1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.**
 2. or approved equal.
- E. Cut: **[Vein] [Fleuri]**.
1. Orientation of Veining: **[Horizontal] [Vertical] [As indicated]**.
- F. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- G. Finish: **[Polished] [Honed] [As indicated] [Match DIA Project Manager's sample] <Insert finish>.**
- H. Match DIA Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.
- I. Thickness: Not less than **[1 inch (25 mm)] [30 mm] [1-1/4 inches (32 mm)] [1-5/8 inches (40 mm)] [2 inches (50 mm)]** unless otherwise indicated.

2.6 QUARTZ-BASED STONE **<Insert drawing designation>**

- A. Material Standard: Comply with ASTM C 616, **[Classification I Sandstone] [Classification II Quartzitic Sandstone] [Classification III Quartzite]****[except for minimum free silica content].**
- B. Regional Materials: Quartz-based stone shall be fabricated within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.
- C. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.**
 2. or approved equal.
- D. Finish: **[Sand rubbed] [Natural cleft] [Thermal] [As indicated] [Match DIA Project Manager's sample] <Insert finish>.**
- E. Match DIA Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.
- F. Thickness: Not less than **[2 inches (50 mm)] [2-1/2 inches (64 mm)] [3 inches (75 mm)] [4 inches (100 mm)]** unless otherwise indicated.

2.7 SERPENTINE **<Insert drawing designation>**

- A. Material Standard: Comply with ASTM C 1526, **[Classification I Exterior] [Classification II Interior]**.

- B. Regional Materials: Serpentine shall be fabricated within **500 miles** (800 km) of Project site from stone that has been extracted within **500 miles** (800 km) of Project site.
- C. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 - 1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.**
 - 2. or approved equal.
- D. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- E. Finish: [**Polished**] [**Honed**] [**As indicated**] [**Match DIA Project Manager's sample**] **<Insert finish>.**
- F. Match DIA Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.
- G. Thickness: Not less than [**1 inch** (25 mm)] [**30 mm**] [**1-1/4 inches** (32 mm)] [**1-5/8 inches** (40 mm)] [**2 inches** (50 mm)] unless otherwise indicated.

2.8 SLATE **<Insert drawing designation>**

- A. Material Standard: Comply with ASTM C 629, [**Classification I Exterior**] [**Classification II Interior**].
- B. Regional Materials: Slate shall be fabricated within **500 miles** (800 km) of Project site from stone that has been extracted within **500 miles** (800 km) of Project site.
- C. Description: [**Black**] [**Blue-black**] [**Gray**] [**Blue-gray**] [**Green**] [**Purple**] [**Mottled purple and green**] [**Red**] slate with a fine, even grain[**and unfading color,**] from clear, sound stock.
- D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 - 1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.**
 - 2. or approved equal.
- E. Finish: [**Honed**] [**Sand rubbed**] [**Natural cleft**] [**As indicated**] [**Match DIA Project Manager's sample**] **<Insert finish>.**
- F. Match DIA Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.
- G. Thickness: Not less than [**1 inch** (25 mm)] [**1-1/4 inches** (32 mm)] [**1-1/2 inches** (38 mm)] unless otherwise indicated.

2.9 TRAVERTINE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 1527, [**Classification I Exterior**] [**Classification II Interior**].
- B. Regional Materials: Travertine shall be fabricated within **500 miles** (800 km) of Project site from stone that has been extracted within **500 miles** (800 km) of Project site.
- C. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 - 1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
 - 2. or approved equal.
- D. Cut: [**Vein**] [**Fleuri**].
 - 1. Orientation of Veining: [**Horizontal**] [**Vertical**] [**As indicated**].
- E. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- F. Filling: Fill pores on faces of stone with cementitious filler of color [**selected by DIA Project Manager**] [**matching DIA Project Manager's sample**].
- G. Finish: [**Polished**] [**Honed**] [**As indicated**] [**Match DIA Project Manager's sample**] <Insert finish>.
- H. Match DIA Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.
- I. Thickness: Not less than [**1 inch** (25 mm)] [**30 mm**] [**1-1/4 inches** (32 mm)] [**1-5/8 inches** (40 mm)] [**2 inches** (50 mm)] unless otherwise indicated.

2.10 OTHER STONE <Insert drawing designation>

- A. Material Standards:
 - 1. Maximum Absorption per ASTM C 97/C 97M: <Insert value>.
 - 2. Minimum Compressive Strength per ASTM C 170/C 170M: <Insert value>.
 - 3. Minimum Flexural Strength per ASTM C 880/C 880M: <Insert value>.
- B. Regional Materials: Other stone shall be fabricated within **500 miles** (800 km) of Project site from stone that has been extracted within **500 miles** (800 km) of Project site.
- C. Varieties and Sources: Subject to compliance with requirements, provide one of the following:

1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
 2. or approved equal.
- D. Finish: [Polished] [Honed] [Sand rubbed] [Natural cleft] [As indicated] [Match DIA Project Manager's sample] <Insert finish>.
- E. Match DIA Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.
- F. Thickness: Not less than [2 inches (50 mm)] [2-1/2 inches (64 mm)] [3 inches (75 mm)] [4 inches (100 mm)] unless otherwise indicated.

2.11 FRAMING FOR BACKUP STRUCTURE

- A. [Steel Trusses] [Strongback Frames] [and] [Miscellaneous Steel Framing]: For framing members in contact with stone, fabricate from same material and finish specified for anchors. For framing members not in contact with stone, comply with requirements indicated below:
1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M or ASTM A 992/A 992M, minimum thickness of 3/16 inch (5 mm).
 2. Steel Tubing: ASTM A 500/A 500M or ASTM A 513, minimum thickness of 3/16 inch (5 mm).
 3. Slotted Channel Framing: Cold-formed metal channels with continuous slot complying with MFMA-4, made from [galvanized steel complying with ASTM A 653/A 653M, structural steel, Grade 33 (Grade 230), with G90 (Z275) coating, and not less than 0.108-inch (2.74-mm) nominal thickness] [steel sheet complying with ASTM A 1008/A 1008M, structural steel, Grade 33 (Grade 230), not less than 0.105-inch (2.66-mm) nominal thickness, hot-dip galvanized after fabrication to comply with ASTM A 123/A 123M].
- B. Steel Stud Frames: Galvanized-steel wall framing complying with Section 054000 "Cold-Formed Metal Framing."
1. Secondary Weather Barrier (Sheathing): Galvanized-steel sheet complying with ASTM A 653/A 653M, commercial steel, coating designation G90 (Z275).
- C. Metal-Grid Systems: Manufacturer's standard integrated system that combines metal struts, fittings, fasteners, and stone anchors and is engineered expressly for mechanically installing dimension stone cladding.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Canaren Inc.; A-Metal System.
 - b. Hohmann & Barnard, Inc.; HB Stone Support System.
 - c. Meadow Burke; Halfen Anchoring System.

- d. <Insert manufacturer's name; product name or designation>.
 - e. or approved equal.
2. Struts: Cold-formed metal channels with continuous slot complying with MFMA-4, of size and shape required for application indicated, made from **[galvanized steel complying with ASTM A 653/A 653M, with G90 (Z275) coating, and not less than 0.108-inch (2.74-mm) nominal thickness]** **[steel sheet complying with ASTM A 1008/A 1008M, not less than 0.105-inch (2.66-mm) nominal thickness, hot-dip galvanized after fabrication to comply with ASTM A 123/A 123M]**.
 3. Fittings and Fasteners: System manufacturer's standard components of design, size, and material required to securely attach struts to building structure, by method indicated or selected, and stone anchors to struts, as well as to prevent galvanic corrosion. Fabricate components in contact with stone from same material specified for anchors.
 4. Stone Anchors: Shapes and sizes standard with system manufacturer, complying with "Anchors and Fasteners" Article.

2.12 ANCHORS AND FASTENERS

- A. Fabricate anchors[, **including shelf angles,**] from stainless steel, ASTM A 240/A 240M or ASTM A 666, **[Type 304] [Type 316]**; temper as required to support loads imposed without exceeding allowable design stresses. Fabricate dowels and pins for anchors from stainless steel, ASTM A 276, **[Type 304] [Type 316]**.
- B. Fabricate shelf angles for limestone from hot-dip galvanized steel, ASTM A 36/A 36M for materials and ASTM A 123/A 123M for galvanizing.
- C. Fabricate anchors, including shelf angles, from extruded aluminum, **ASTM B 221** (ASTM B 221M), alloy and temper as required to support loads imposed without exceeding allowable design stresses, but not less than strength and durability properties of Alloy 6063-T6.
- D. Cast-in-Place Concrete Inserts: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel, with capability to sustain, without failure, a load equal to 4 times the loads imposed as determined by testing per ASTM E 488, conducted by a qualified independent testing agency. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- E. Postinstalled Anchor Bolts for Concrete and Masonry: **[Chemical anchors] [torque-controlled expansion anchors] [or] [undercut anchors]** made from stainless-steel components complying with **ASTM F 593 and ASTM F 594, Alloy Group 1 or 2** (ASTM F 738M and ASTM F 836M, Alloy Group A1 or A4) for bolts and nuts; ASTM A 240/A 240M, ASTM A 276, or ASTM A 666, Type 304 or 316, for anchors, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as

determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

- F. Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers.
 - 1. For **[stainless steel] [and] [aluminum]**, use annealed stainless-steel bolts, nuts, and washers; for bolts, **ASTM F 593** (ASTM F 738M); and for nuts, **ASTM F 594** (ASTM F 836M), Alloy **[Group 1 (A1)] [Group 2 (A4)]**.
 - 2. For **[galvanized-steel shelf angles] [and] [backup structure]**, use carbon-steel bolts, nuts, and washers; for bolts, **ASTM A 307, Grade A** (ASTM F 568M, Property Class 4.6); for nuts, **ASTM A 563** (ASTM A 563M), Grade A; and for washers, **ASTM F 436** (ASTM F 436M); all hot-dip or mechanically zinc coated.
- G. Weld Plates for Installation in Concrete: Comply with Section 055000 "Metal Fabrications."

2.13 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II, except Type III may be used for cold-weather construction, natural color or white as required to produce mortar color indicated.
 - 1. Low-Alkali Cement: Portland cement for use with limestone shall contain not more than 0.60 percent total alkali when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207.
- C. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Pigments shall have a record of satisfactory performance in mortar.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Davis Colors; True Tone Mortar Colors.
 - b. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
 - c. Solomon Colors; SGS Mortar Colors.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
- D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime.
- E. Colored Portland Cement-Lime Mix: Packaged blend of portland cement, hydrated lime, and mortar pigments. Mix shall produce color indicated or, if not indicated, as selected from manufacturer's standard colors. Pigments shall not exceed 10 percent of portland cement by weight.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
 - b. Lafarge North America Inc.; Eaglebond.
 - c. Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.

- F. Aggregate: ASTM C 144; except for [**joints narrower than 1/4 inch** (6 mm)] [**and**] [**pointing mortar**], 100 percent shall pass **No. 16** (1.18-mm) sieve.
 1. White Aggregates: Natural white sand or ground white stone.
 2. Colored Aggregates: Natural-colored sand or ground marble, granite, or other durable stone; of color necessary to produce required mortar color.

- G. Water: Potable.

2.14 STONE ACCESSORIES

- A. Setting Shims: Strips of [**resilient plastic**] [**or**] [**vulcanized neoprene, Type A Shore durometer hardness of 50 to 70**], nonstaining to stone, of thickness needed to prevent point loading of stone on anchors and of depths to suit anchors without intruding into required depths of pointing materials.

- B. Setting Buttons: Resilient plastic buttons, nonstaining to stone, sized to suit joint thicknesses and bed depths of stone units without intruding into required depths of pointing materials.

- C. Concealed Sheet Metal Flashing: Fabricated from [**zinc-tin, alloy-coated**] stainless steel in thicknesses indicated, but not less than **0.0156 inch** (0.4 mm) thick, and complying with Section 076200 "Sheet Metal Flashing and Trim."

- D. Cementitious Dampproofing[**for Limestone**]: Cementitious formulation recommended by ILI and nonstaining to stone; compatible with joint sealants and noncorrosive to anchors and attachments.

- E. Weep and Vent Tubes: [**Medium-density polyethylene tubing, 1/4-inch** (6-mm) **OD**] [**Rectangular, cellular, polypropylene or clear butyrate extrusion, 3/8 by 1-1/2 inches** (9 by 38 mm)], of length required to extend from exterior face of stone to cavity behind.

- F. Cellular Plastic Weep Hole/Vents: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, of length required to extend from exterior face of stone to cavity behind, in color selected from manufacturer's standard.

- G. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, of length required to extend from exterior face of stone to cavity behind, in color selected from manufacturer's standard.
- H. Sealants for Joints in Dimension Stone Cladding: Manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated below that comply with applicable requirements in Section 079200 "Joint Sealants" and do not stain stone:
1. Silicone Joint Sealant: [**Single component, nonsag, neutral curing, Class 100/50**] [**Single component, nonsag, neutral curing, Class 50**] [**Single component, nonsag, neutral curing, Class 25**] [**Single component, nonsag, acid curing**] [**Multicomponent, nonsag, neutral curing**].
 2. Urethane Joint Sealant: [**Single component, nonsag, Class 100/50**] [**Single component, nonsag, Class 50**] [**Single component, nonsag, Class 25**] [**Multicomponent, nonsag, Class 50**] [**Multicomponent, nonsag, Class 25**].
 3. Polysulfide Joint Sealant: [**Single component**] [**Multicomponent**], nonsag.
 4. Preformed Joint Sealant: Preformed [**silicone**] [**foam**].
 5. Joint Sealant: <Insert joint sealant>.
 6. Joint-Sealant Colors: [**As indicated by manufacturer's designations**] [**Match DIA Project Manager's sample**] [**As selected by DIA Project Manager from manufacturer's full range of colors**] [**Match color of stone**] <Insert color>.
- I. Sealant for Filling Kerfs: [**Same sealant used for joints in dimension stone.**] [**Manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated below that comply with applicable requirements in Section 079200 "Joint Sealants" and that do not stain stone:**]
1. Single-component, nonsag, neutral-curing, medium- to high-modulus silicone sealant; Class 25, Use NT (nontraffic), and Use M (masonry).
 2. Single-component, nonsag, urethane sealant; Class 25, Use T (traffic), and Use M (masonry).
 3. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Omniseal 50.
 - b. Dow Corning Corporation; 756 SMS.
 - c. General Electric Company; GE Advanced Materials - Silicones; SilPruf NB SCS9000.
 - d. Tremco Incorporated; Spectrem 2.
 - e. <Insert manufacturer's name; product name or designation>.
 - f. or approved equal
 - g. BASF Building Systems; Sonolastic NP 1.
 - h. BASF Building Systems; Sonolastic Ultra.
 - i. Sika Corporation; Sikaflex - 1a.
 - j. Tremco Incorporated; Vulkem 116.

- k. **<Insert manufacturer's name; product name or designation>**.
- l. or approved equal.

2.15 STONE FABRICATION

- A. General: Fabricate stone units in sizes and shapes required to comply with requirements indicated.
 - 1. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."
 - 2. For limestone, comply with recommendations in ILI's "Indiana Limestone Handbook."
 - 3. For marble, serpentine, and travertine, comply with recommendations in MIA's "Dimension Stone - Design Manual VII."
- B. Control depth of stone and back check to maintain minimum clearance of **[1 inch (25 mm)] [1-1/2 inches (38 mm)] <Insert dimension>** between backs of stone units and surfaces or projections of structural members, fireproofing (if any), backup walls, and other work behind stone.
- C. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated. Shape beds to fit supports.
- D. Cut and drill sinkages and holes in stone for anchors, fasteners, supports, and lifting devices as indicated or needed to set stone securely in place.
- E. Finish exposed faces and edges of stone[, **except sawed reveals,**] to comply with requirements indicated for finish and to match approved samples[**and mockups**].
- F. Quirk-miter corners unless otherwise indicated; provide for cramp anchorage in top and bottom bed joints of corner pieces.
- G. Cut stone to produce uniform joints [**3/8 inch (10 mm)] [1/2 inch (13 mm)] <Insert dimension>** wide and in locations indicated.
- H. Contiguous Work: Provide chases, reveals, reglets, openings, and similar features as required to accommodate contiguous work.
- I. Fabricate molded work, including washes and drips, to produce stone shapes with a uniform profile throughout entire unit length, with precisely formed arris slightly eased to prevent snipping, and with matching profile at joints between units.
 - 1. Produce moldings and molded edges with machines that use abrasive shaping wheels made to reverse contour of molding shape.
- J. Carve and cut [**inscriptions**] [**and**] [**decorative surfaces**]. Use skilled stone carvers experienced in the successful performance of work similar to that indicated.

- K. Abrasively etch [**inscriptions**] [**and**] [**decorative surfaces**].
- L. Laser etch [**inscriptions**] [**and**] [**decorative surfaces**].
- M. Clean backs of stone to remove rust stains, iron particles, and stone dust.
- N. Inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.
 - 1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved samples and mockups.

2.16 FABRICATION OF BACKUP STRUCTURE

- A. Fabrication of [**Steel Trusses**] [**Strongback Frames**] [**and**] [**Miscellaneous Steel Framing**]: Fabricate in shop to comply with AISC 303.
 - 1. Weld shop connections to comply with applicable provisions of AWS D1.1/D1.1M.
 - 2. Fabricate joints to exclude water or to permit its escape to building exterior, at locations where water could accumulate because of condensation or other causes.
 - 3. Hot-dip galvanize backup structure after fabrication to comply with ASTM A 123/A 123M.
- B. Fabrication of Steel Stud Frames: Fabricate and assemble by welding to comply with requirements in Section 054000 "Cold-Formed Metal Framing."
 - 1. Weld secondary weather barrier (sheathing) to outside face of steel stud frames. Use continuous welds at all four edges of sheets to provide continuous weather seal.
 - 2. Clean welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

2.17 SHOP-PAINTED STEEL FINISHES

- A. General: Paint uncoated steel backup structure before delivering to Project site to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel."
- B. Surface Preparation: After fabricating steel items, prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- C. Apply one coat of fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#76.[**After primer has dried,**

apply one coat of exterior alkyd enamel complying with MPI#96 of a different color than primer.]

D. Apply two-coat, high-performance coating system consisting of epoxy zinc-rich primer, complying with MPI#20 and topcoat of high-build epoxy coating, complying with MPI#108.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Cloverdale Paint; ClovaZinc 3, 83003, and ClovaGuard, 83150.
- b. Columbia Paint & Coatings; Carbozinc 859 and Polyamide Epoxy 07-910.
- c. Coronado Paint; Polyamide Epoxy Zinc Rich Primer, 101-152, and Polyamide Epoxy Coating Semi-Gloss, 101-251.
- d. Frazee Paint; Ameron 68HS and Ameron 400.
- e. General Paint; Ameron 68HS Epoxy Zinc Rich Coating and Amercoat 385 or Amerlock 400, 96 line.
- f. ICI Paints; Catha-Coat 313 and Bar-Rust 235, Bar-Rust 236, or Devran 224HS.
- g. Kwal Paint; Coronado Polyamide Epoxy Zinc Rich Primer, 101-152, and Coronado Polyamide Epoxy Coating Semi-Gloss, 101-251B.
- h. Parker Paint Mfg. Co. Inc.; Amercoat Zinc Rich Epoxy Primer, 68HS, and Amerlock 400.
- i. PPG Architectural Finishes, Inc.; Aquapon Zinc-Rich Primer 97-670 and Aquapon High Build Epoxy Marine Coating 97-130/97-139.
- j. Sherwin-Williams Company (The); Zinc Clad IV, B69A8/B69V8, and Macropoxy 646 Fast Cure Epoxy, B58-600 series.
- k. Sico, Inc.; Rust-Oleum Zinc-Sele, 9334, and Rust-Oleum H.P. Epoxy, 9100 Series.
- l. **<Insert manufacturer's name; product name or designation>**.
- m. or approved equal.

2.18 MORTAR MIXES

A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortar of uniform quality and with optimum performance characteristics.

1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated. Do not use calcium chloride.
2. Combine and thoroughly mix cementitious materials, water, and aggregates in a mechanical batch mixer unless otherwise indicated. Discard mortar when it has reached initial set.

B. Portland Cement-Lime Setting Mortar: Comply with ASTM C 270, Proportion Specification, **[Type S.] [Type N.] [for types of mortar indicated below:]**

1. Set granite with Type S mortar.
 2. Set limestone with Type N mortar.
 3. Set marble with Type S mortar.
 4. Set quartz-based stone with **[Type S] [Type N]** mortar.
 5. Set serpentine with Type S mortar.
 6. Set slate with Type S mortar.
 7. Set travertine with Type N mortar.
 8. Backparge travertine with Type O mortar.
- C. Pointing Mortar: Comply with ASTM C 270, Proportion Specification, **[Type S] [Type N] [Type O] [for types of mortar indicated]**. Provide pointing mortar mixed to match DIA Project Manager's sample and complying with the following:
1. Pigmented Pointing Mortar: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1:10, by weight.
 2. Packaged Portland Cement-Lime Mix Mortar: Use portland cement-lime mix of selected color.
 3. Colored-Aggregate Pointing Mortar: Produce color required by combining colored aggregates with portland cement of selected color.
 4. Point granite with **[Type S] [Type N]** mortar.
 5. Point limestone with **[Type N] [Type O]** mortar.
 6. Point marble with **[Type N] [Type O]** mortar.
 7. Point quartz-based stone with **[Type N] [Type O]** mortar.
 8. Point serpentine with **[Type N] [Type O]** mortar.
 9. Point slate with Type N mortar.
 10. Point travertine with **[Type N] [Type O]** mortar.

2.19 SOURCE QUALITY CONTROL

- A. Testing Agency: **[Owner will engage] [Engage]** a qualified testing agency to perform source quality-control testing.
1. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
 2. Furnish test specimens **[randomly selected] [selected by testing agency]** from same blocks as actual materials proposed for incorporation into the Work.
 3. Flexural Strength Tests: ASTM C 880/C 880M, performed on specimens of same thickness, orientation of cut, and finish as installed stone. One set of test specimens is required to be tested for every **[10,000 sq. ft. (1000 sq. m)] [5000 sq. ft. (500 sq. m)] [3000 sq. ft. (300 sq. m)]**, but not fewer than two sets for each stone variety.

PART 3 - EXECUTION

3.1 GENERAL

- A. Do not use stone units with chips, cracks, voids, stains, or other defects which might be visible in the finished Work. Repair minor defects which would detract from overall appearance or impair the effectiveness of the sealant. Major defects will not be acceptable.
- B. Do not use frozen materials or materials mixed or coated with ice or frost. Do not use salt to thaw ice in anchor holes or slots. Do not lower the freezing point or mortar by use of admixtures or antifreeze agents, and do not use calcium chloride in mortar or grout.

3.2 EXAMINATION

- A. Examine surfaces to receive dimension stone cladding and conditions under which dimension stone cladding will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of dimension stone cladding.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of dimension stone cladding.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

- A. Advise installers of other work about specific requirements relating to their placement of inserts and flashing reglets for anchoring and supporting and flashing of stonework. Furnish installers of other work with drawings or templates showing location of inserts for stone anchors and supports.
- B. Clean stone before setting by thoroughly scrubbing with fiber brushes followed by a thorough drenching with clear water. Use only mild cleaning compounds that do not contain caustic or harsh fillers or abrasives. If not thoroughly wet at time of setting; drench or sponge stone. Do not wet expansion or control joint surface.

3.4 INSTALLING BACKUP STRUCTURE

- A. Installing [**Steel Trusses**] [**Strongback Frames**] [**and**] [**Miscellaneous Steel Framing**]: Comply with AISC 303 and install to accommodate construction tolerances specified.
 - 1. Maintain erection of backup structure within tolerances in AISC 303.

2. For prefabricated units to which stone has been installed before erection, maintain tolerances of stone faces and edges as specified in "Installation Tolerances" Article.
 3. Install by **[welding to steel weld-plates anchored in concrete] [bolting to inserts cast into concrete] [or] [bolting to structural-steel frame]**.
 4. Clean welds, bolted connections, and abraded areas immediately after erection.
 - a. Repair galvanizing to comply with ASTM A 780/A 780M.
 - b. Apply paint to exposed areas using same material as used for shop painting.
- B. Installing Steel Stud Frames: Install **[by welding to steel weld-plates anchored in concrete] [by welding to structural-steel frame] [by bolting to structural-steel frame]** to comply with requirements in Section 054000 "Cold-Formed Metal Framing."
1. Install steel stud frames level, plumb, and true to line with no variation in plane or alignment exceeding **1/16 inch** (1.5 mm) and no variation in position exceeding **1/8 inch** (3 mm).
 2. For prefabricated frames to which stone has been installed before erection, maintain tolerances of stone faces and edges as specified in "Installation Tolerances" Article.
 3. Clean welds, bolted connections, and abraded areas immediately after erection. Repair galvanizing to comply with ASTM A 780/A 780M.
- C. Installing Metal-Grid Systems: Comply with manufacturer's written instructions to provide integrated system that combines metal struts, fittings, fasteners, and stone anchors.
1. Fasten struts by bolting to **[inserts in concrete] [or] [steel angle clips bolted to steel framing]**.
 2. Fasten stone supports and anchors by bolting to struts.
 3. Shim and adjust struts and stone supports and anchors to provide grid that is level, plumb, and true to line with no variation in plane or alignment exceeding **1/16 inch** (1.5 mm) and no variation in position exceeding **1/8 inch** (3 mm).

3.5 STONE INSTALLATION GENERAL

- A. Employ skilled stone fitters at the Site to do necessary field cutting as stone is set.
- B. Provide chases, reveals, reglets, openings, and other spaces as indicated or required for contiguous work. Close up openings in stonework after other work is in place. Use materials and set to match surrounding stonework.
- C. Where stonework will contact ferrous metal surfaces which will be concealed in back up construction (anchors, supports, structural framing and similar surfaces), apply a heavy coat of bituminous paint on metal surfaces, prior to

setting of stone. Do not extend coating onto portions of ferrous metal which will be exposed in the finished work. Do not apply coating to stainless or nonferrous metals.

- D. Provide expansion joints where indicated. Do not fill with mortar. Install continuous strips of preformed joint filler to allow for installation of backer rod and sealant.
- E. Provide anchors, supports, fasteners, and other attachments indicated or necessary to secure stonework in place. Shim and adjust accessories for proper setting of stone. Completely fill holes, slots, and other sinkages for anchors, dowels, fasteners, and supports with mortar during setting of stones.
- F. SETTING DIMENSION STONE CLADDING, GENERAL
- G. Before setting stone, clean surfaces that are dirty or stained by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.
- H. Coat limestone with dampproofing to extent indicated below:
 - 1. Stone at Grade: Beds, joints, and back surfaces to at least **12 inches** (300 mm) above finish-grade elevations.
 - 2. Stone Extending Below Grade: Beds, joints, back surfaces, and face surfaces below grade.
 - 3. Allow dampproofing to cure before setting dampproofed stone. Do not damage or remove dampproofing while handling and setting stone.
- I. Parge back of travertine panels with mortar not less than **3/8 inch** (10 mm) thick.
- J. Execute dimension stone cladding installation by skilled mechanics and employ skilled stone fitters at Project site to do necessary field cutting as stone is set.
 - 1. Use power saws with diamond blades to cut stone. Produce lines cut straight and true, with edges eased slightly to prevent snipping.
- K. Contiguous Work: Provide reveals, reglets, and openings as required to accommodate contiguous work.
- L. Set stone to comply with requirements indicated. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure dimension stone cladding in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated, with uniform joints of widths indicated, and with edges and faces aligned according to established relationships and indicated tolerances.
- M. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.
 - 1. Sealing expansion and other joints is specified in Section 079200 "Joint

Sealants."

2. Keep expansion joints free of mortar and other rigid materials.
- N. Install concealed flashing at continuous shelf angles, lintels, ledges, and similar obstructions to downward flow of water, to divert water to building exterior. Extend flashing **6 inches** (150 mm) at ends and turn up not less than **2 inches** (50 mm) to form end dams.
- O. Keep cavities open where unfilled space is indicated between back of stone units and backup wall; do not fill cavities with mortar or grout.
1. Place weep holes in joints where moisture may accumulate, including at base of cavity walls and above shelf angles and flashing. Locate weep holes at intervals not exceeding **24 inches** (600 mm). Use [**weep and vent tubes**] [**plastic weep hole/vents**] [**or**] [**wicking material**].
 2. Place vents in cavity walls at tops of cavities, below shelf angles and flashing, and at intervals not exceeding **20 feet** (6 m) vertically. Locate vents in joints at intervals not exceeding **60 inches** (1500 mm) horizontally. Use [**weep and vent tubes**] [**or**] [**plastic weep hole/vents**].

3.6 SETTING MECHANICALLY ANCHORED DIMENSION STONE CLADDING

- A. Set dimension stone cladding with mechanical anchors without mortar unless otherwise indicated.
- B. Attach anchors securely to stone and to backup surfaces. Comply with recommendations in ASTM C 1242.
- C. Provide compressible filler in ends of dowel holes and bottoms of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes and kerfs with sealant indicated for filling kerfs.
- D. Set stone supported on clips or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths and to prevent point loading of stone on anchors. Hold shims back from face of stone a distance at least equal to width of joint.

3.7 SETTING DIMENSION STONE CLADDING WITH MORTAR

- A. Set dimension stone cladding with mortar and mechanical anchors [**where indicated**] [**unless otherwise indicated**].
- B. Set stone in full bed of mortar with head joints filled unless otherwise indicated.
 1. Use setting buttons of adequate size, in sufficient quantity, and of thickness required to maintain uniform joint width and to prevent mortar from extruding. Hold buttons back from face of stone a distance at least equal to width of joint, but not less than depth of pointing materials.

2. Do not set heavy units or projecting courses until mortar in courses below has hardened enough to resist being squeezed out of joint.
 3. Support and brace projecting stones until wall above is in place and mortar has set.
 4. Provide compressible filler in ends of dowel holes and bottoms of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes and kerfs with mortar.
- C. Fill space between back of stone units and backup wall solidly with mortar or grout.
- D. Embed ends of sills in mortar; leave remainder of joint open until final pointing.
- E. Rake out joints for pointing with mortar to depths of not less than **1/2 inch** (12 mm). Rake joints to uniform depths with square bottoms and clean sides.
- F. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply first layer of pointing mortar in layers not more than **3/8 inch** (10 mm) until a uniform depth is formed.
- G. Point stone joints by placing pointing mortar in layers not more than **3/8 inch** (10 mm). Compact each layer thoroughly and allow to become thumbprint hard before applying next layer.
- H. Tool joints with a round jointer having a diameter **1/8 inch** (3 mm) larger than width of joint, when pointing mortar is thumbprint hard.
- I. Rake out mortar from sealant-pointed joints to depths required for sealant and sealant backing but not less than **1/2 inch** (12 mm). Rake joints to uniform depths with square bottoms and clean sides.
- J. Set the following dimension stone cladding with unfilled head joints for installing joint sealants:
1. Cornices.
 2. Copings.
 3. Sills.
 4. Belt and other projecting courses.

3.8 STONE PAVING:

- A. Clean subbase to remove dirt, dust, debris, and loose particles. Saturate concrete subbase with clean water several hours before placing setting bed. About one hour prior to placing setting bed, remove surface water.
- B. Apply slush coat of cement grout over surface of concrete subbase about 15 minutes prior to placing setting bed. Limit area of slush coat to avoid drying out prior to placement of setting bed and apply by trowel or brush. Do not exceed 1/16-inch thickness for cement slush coat.

- C. Setting Bed: Mix one 94 pound bag of cement to 3 cubic feet of sand (measured in a damp, loose condition). Use only enough water to produce a moist surface when setting bed is ready for setting of stone. Spread and screed to a uniform thickness, except for minor variations required to produce a true surface, level in plane or uniformly sloped for drainage indicated. Mix and place only the amount which can be covered with stone prior to initial set of bed. Cut back, level edge, remove and discard setting bed material which has reached initial set prior to placing stone.
- D. Wet stone thoroughly before setting.
- E. Set stone before initial set of cement bed occurs. Do not set stone on dry bed. Apply a thin layer of neat cement paste 1/32-inch to 1/16-inch thick by brushing or troweling over setting bed, or apply 1/32-inch thick to bottom of stone. Tamp and beat stone for complete contact between stone and setting bed. Set and level each unit immediately. Do not set large areas and later level. Set stone in pattern shown with uniform joints of the width shown or, if not shown, provide joints not more than 1/4-inch wide.
- F. Grout joints as soon as possible after initial set of setting bed. Force grout into joints, strike flush and tool slightly concave. Wet joint surfaces, if dry, prior to grouting.
- G. Use portland cement grout mixed in the proportion of one bag of portland cement to 2 cubic feet of sand (measured in a damp, loose condition) mixed with water to the consistency of heavy cream.
- H. Cure grout by maintaining in a moist condition for 7 days.
- I. Remove grout spillage from face of stone as work progresses.
- J. Do not permit traffic on horizontal stone surfaces during setting of units or for at least 24 hours after final grouting of joints.

3.9 JOINT-SEALANT INSTALLATION

- A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.10 INSTALLATION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces of walls, do not exceed **1/4 inch in 10 feet** (6 mm in 3 m), **3/8 inch in 20 feet** (10 mm in 6 m), or **1/2 inch in 40 feet** (12 mm in 12 m) or more. For external corners, corners and jambs within **20 feet** (6 m) of an entrance, expansion joints, and other conspicuous lines, do not exceed **1/8 inch in 10 feet** (3 mm in 3 m), **1/4 inch in 20 feet** (6 mm in 6 m), or **3/8 inch in 40 feet** (10 mm in 12 m) or more.

- B. Variation from Level: For lintels, sills, water tables, parapets, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed **1/8 inch in 10 feet** (3 mm in 3 m), **1/4 inch in 20 feet** (6 mm in 6 m), or **3/8 inch** (10 mm) maximum.
- C. Variation of Linear Building Line: For positions shown in plan and related portions of walls and partitions, do not exceed **1/4 inch in 20 feet** (6 mm in 6 m) or **1/2 inch in 40 feet** (12 mm in 12 m) or more.
- D. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated, do not exceed plus or minus **1/4 inch** (6 mm).
- E. Variation in Joint Width: Do not vary from average joint width more than plus or minus **1/8 inch** (3 mm) or a quarter of nominal joint width, whichever is less. For joints within **60 inches** (1500 mm) of each other, do not vary more than **1/8 inch** (3 mm) or a quarter of nominal joint width, whichever is less from one to the other.
- F. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed **1/16-inch** (1.5-mm) difference between planes of adjacent units.

3.11 ADJUSTING AND CLEANING

- A. Remove and replace broken, chipped, stained, or otherwise damaged stone, defective joints, and dimension stone cladding that does not match approved samples[**and mockups**].
 1. Damaged stone may be repaired if DIA Project Manager approves methods and results. Contractor to provide sample of repair work if requested by DIA Project Manager.
- B. Replace damaged or defective work in a manner that results in dimension stone cladding's matching approved samples[**and mockups**], complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean dimension stone cladding as work progresses.[**Remove mortar fins and smears before tooling joints.**] Remove excess sealant and smears as sealant is installed.
- D. Final Cleaning: Clean dimension stone cladding no fewer than six days after completion of pointing and sealing, using clean water and stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning agents containing caustic compounds or abrasives, or other materials or methods that could damage stone.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price

END OF SECTION 044200

SECTION 047200 - CAST STONE MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Cast stone trim[.][**including the following:**]

- a. Window sills.
 - b. Lintels.
 - c. Surrounds.
 - d. Coping.
 - e. Wall caps.
 - f. Belt courses.
 - g. Water tables.
 - h. Quoins.
 - i. Pilasters.
 - j. Column covers.
 - k. Medallions.

- 2. Cast stone steps.
 - 3. Cast stone bollards.
 - 4. Cast stone benches.
 - 5. Cast stone curbing.

- B. Related Sections:

- 1. Section 034500 "Precast Architectural Concrete."
 - 2. Section 042000 "Unit Masonry" for installing cast stone units in unit masonry.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

- 1. Include data substantiating that materials comply with requirements.

2. For cast stone units, include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. LEED Submittals:
1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
- C. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.
1. Include building elevations showing layout of units and locations of joints and anchors.
- D. Samples for Initial Selection: For colored mortar.
- E. Samples for Verification:
1. For each color and texture of cast stone required, **10 inches** (250 mm) square in size.
 2. For colored mortar. Make Samples using same sand and mortar ingredients to be used on Project. [**Label Samples to indicated types and amounts of pigments used.**]
- F. Full-Size Samples: For each [color] [texture] [and] [shape] of cast stone unit required.
1. Make available for DIA Project Manager's review at Project site [**or at manufacturing plant, if acceptable to DIA Project Manager**].
 2. Make Samples from materials to be used for units used on Project [**immediately before beginning production of units for Project**].
 3. Approved Samples may be installed in the Work.
- 1.4 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For [manufacturer] [and] [testing agency].
1. Include copies of material test reports for completed projects, indicating compliance of cast stone with ASTM C 1364.
- B. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C 1364 [**including test for resistance to freezing and thawing**].
1. Provide test reports based on testing within previous two (2) years.

1.5 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer of cast stone units similar to those indicated for this Project, that has sufficient production capacity to manufacture required units, and is a plant certified by **[the Cast Stone Institute] [the Architectural Precast Association] [or] [the Precast/Prestressed Concrete Institute for Group A, Category AT]**.
- B. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- C. Source Limitations for Cast Stone: Obtain cast stone units through single source from single manufacturer.
- D. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, from one manufacturer for each cementitious component and from one source or producer for each aggregate.
- E. Mockups: Furnish cast stone for installation in mockups specified in Section 042000 "Unit Masonry."
- F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects[**and set quality standards for materials and execution**].
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Coordinate mockup with mockups for unit masonry and other systems.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Coordinate delivery of cast stone[**with unit masonry work**] to avoid delaying the Work[**and to minimize the need for on-site storage**].
- B. Pack, handle, and ship cast stone units in suitable packs or pallets.
 - 1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units, if required, using dollies with wood supports.
 - 2. Store cast stone units on wood skids or pallets with nonstaining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.

- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store mortar aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

1.8 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements in ACI 530.1/ASCE 6/TMS 602.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until cast stone has dried, but no fewer than seven days after completing cleaning.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements in ACI 530.1/ASCE 6/TMS 602.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 CAST STONE MATERIALS

- A. General: Comply with ASTM C 1364 and the following:
- B. Portland Cement: ASTM C 150, Type I or Type III, containing not more than 0.60 percent total alkali when tested according to ASTM C 114. Provide natural color or white cement as required to produce cast stone color indicated.
- C. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C 33; gradation and colors as needed to produce required cast stone textures and colors.
- D. Fine Aggregates: Natural sand or crushed stone complying with ASTM C 33, gradation and colors as needed to produce required cast stone textures and colors.
- E. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, [**free of carbon black,**] nonfading, and resistant to lime and other alkalis.

- F. Admixtures: Use only admixtures specified or approved in writing by DIA Project Manager.
1. Do not use admixtures that contain more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use admixtures containing calcium chloride.
 2. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used.
 3. Air-Entraining Admixture: ASTM C 260.[**Add to mixes for units exposed to the exterior at manufacturer's prescribed rate to result in an air content of 4 to 6 percent, except do not add to zero-slump concrete mixes.**]
 4. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 5. Water-Reducing, Retarding Admixture: ASTM C 494/C 494M, Type D.
 6. Water-Reducing, Accelerating Admixture: ASTM C 494/C 494M, Type E.
- G. Reinforcement: Deformed steel bars complying with ASTM A 615/A 615M, **Grade 60** (Grade 420). Use galvanized or epoxy-coated reinforcement when covered with less than **1-1/2 inches** (38 mm) of cast stone material.
1. Epoxy Coating: ASTM A 775/A 775M.
 2. Galvanized Coating: ASTM A 767/A 767M.
- H. Embedded Anchors and Other Inserts: Fabricated from **[stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666, Type 304]** **[steel complying with ASTM A 36/A 36M, and hot-dip galvanized to comply with ASTM A 123/A 123M]**.

2.2 CAST STONE UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. **<Insert, in separate subparagraphs, manufacturers' names>**.
 2. or approved equal.
- B. Regional Materials: Cast stone units shall be manufactured within **500 miles** (800 km) of Project site from aggregates[**and cement**] that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** (800 km) of Project site.
- C. Provide cast stone units complying with ASTM C 1364 using either the vibrant dry tamp or wet-cast method.
1. Provide units that are resistant to freezing and thawing as determined by laboratory testing according to ASTM C 666/C 666M, Procedure A, as modified by ASTM C 1364.

- D. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.
1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
 2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
 3. Provide drips on projecting elements unless otherwise indicated.
- E. Fabrication Tolerances:
1. Variation in Cross Section: Do not vary from indicated dimensions by more than **1/8 inch** (3 mm).
 2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or **1/8 inch** (3 mm), whichever is greater, but in no case by more than **1/4 inch** (6 mm).
 3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or **1/8 inch** (3 mm), whichever is greater.
 4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than **1/8 inch** (3 mm) on formed surfaces of units and **3/8 inch** (10 mm) on unformed surfaces.
- F. Cure units as follows:
1. Cure units in enclosed moist curing room at 95 to 100 percent relative humidity and temperature of **100 deg F** (38 deg C) for 12 hours or **70 deg F** (21 deg C) for 16 hours.
 2. Keep units damp and continue curing to comply with one of the following:
 - a. No fewer than five days at mean daily temperature of **70 deg F** (21 deg C) or above.
 - b. No fewer than six days at mean daily temperature of **60 deg F** (16 deg C) or above.
 - c. No fewer than seven days at mean daily temperature of **50 deg F** (10 deg C) or above.
 - d. No fewer than eight days at mean daily temperature of **45 deg F** (7 deg C) or above.
- G. Acid etch units after curing to remove cement film from surfaces to be exposed to view.
- H. Colors and Textures: **[Match DIA Project Manager's samples] [Match existing units] [As selected by DIA Project Manager from manufacturer's full range].**
- I. Color and Texture: Provide units with fine-grained texture and buff color resembling Indiana limestone.
- J. Color and Texture: Provide units with fine texture and red-brown color resembling brownstone on adjacent buildings.

2.3 MORTAR MATERIALS

- A. Provide mortar materials that comply with Section 042000 "Unit Masonry."
- B. Regional Materials: Aggregate for mortar[, **cement, and lime**] shall be manufactured within **500 miles** (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** (800 km) of Project site.
- C. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- D. Hydrated Lime: ASTM C 207, Type S.
- E. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- F. Masonry Cement: ASTM C 91.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Capital Materials Corporation; Flamingo Color Masonry Cement.
 - b. Cemex S.A.B. de C.V.; [**Brikset Type N**] [**Citadel Type S**] [**Dixie Type S**] [**Kosmortar Type N**] [**Richmortar**] [**Victor Plastic Cement**].
 - c. Essroc, Italcementi Group; [**Brixment**] [**or**] [**Velvet**].
 - d. Holcim (US) Inc.; [**Mortamix Masonry Cement**] [**Rainbow Mortamix Custom Buff Masonry Cement**] [**White Mortamix Masonry Cement**].
 - e. Lafarge North America Inc.; [**Lafarge Masonry Cement**] [**Magnolia Masonry Cement**] [**Trinity White Masonry Cement**].
 - f. Lehigh Cement Company; [**Lehigh Masonry Cement**] [**Lehigh White Masonry Cement**].
 - g. National Cement Company, Inc.; Coosa Masonry Cement.
 - h. <**Insert manufacturer's name; product name or designation**>.
 - i. or approved equal.
- G. Mortar Cement: ASTM C 1329.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Lafarge North America Inc.; [**Lafarge Mortar Cement**] [**or**] [**Magnolia Superbond Mortar Cement**].
 - b. <**Insert manufacturer's name; product name or designation**>.
 - c. or approved equal.

- H. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Davis Colors; True Tone Mortar Colors.
 - b. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
 - c. Solomon Colors, Inc.; SGS Mortar Colors.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
- I. Colored Cement Product: Packaged blend made from [**portland cement and hydrated lime**] [**masonry cement**] [**or**] [**mortar cement**] and mortar pigments, all complying with specified requirements and containing no other ingredients.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Colored Portland Cement-Lime Mix:
 - 1) Capital Materials Corporation; Riverton Portland Cement Lime Custom Color.
 - 2) Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
 - 3) Lafarge North America Inc.; Eaglebond Portland & Lime.
 - 4) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.
 - 5) **<Insert manufacturer's name; product name or designation>**.
 - 6) or approved equal.
 - b. Colored Masonry Cement:
 - 1) Capital Materials Corporation; Flamingo Color Masonry Cement.
 - 2) Cemex S.A.B. de C.V.; Richcolor Masonry Cement.
 - 3) Essroc, Italcementi Group; Brixment-in-Color.
 - 4) Holcim (US) Inc.; Rainbow Mortamix Custom Color Masonry Cement.
 - 5) Lafarge North America Inc.; U.S. Cement Custom Color Masonry Cement.
 - 6) Lehigh Cement Company; Lehigh Custom Color Masonry Cement.
 - 7) National Cement Company, Inc.; Coosa Masonry Cement.
 - 8) **<Insert manufacturer's name; product name or designation>**.
 - 9) or approved equal.

2. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
 3. Pigments shall not exceed 10 percent of portland cement by weight.
 4. Pigments shall not exceed 5 percent of [masonry cement] [or] [mortar cement] by weight.
- J. Aggregate for Mortar: ASTM C 144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- K. Water: Potable.

2.4 ACCESSORIES

- A. Anchors: Type and size indicated, fabricated from [Type 304 stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666] [steel complying with ASTM A 36/A 36M, and hot-dip galvanized to comply with ASTM A 123/A 123M].
- B. Dowels: 1/2-inch- (12-mm-) diameter, round bars, fabricated from [Type 304 stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666] [steel complying with ASTM A 36/A 36M, and hot-dip galvanized to comply with ASTM A 123/A 123M].
- C. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cast stone manufacturer and expressly approved by cleaner manufacturer for use on cast stone and adjacent masonry materials.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
 - a. Diedrich Technologies, Inc.
 - b. EaCo Chem, Inc.
 - c. ProSoCo, Inc.
 - d. <Insert manufacturer's name>.
 - e. or approved equal.

2.5 MORTAR MIXES

- A. Comply with requirements in Section 042000 "Unit Masonry" for mortar mixes.

- B. Do not use admixtures including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Use **[portland cement-lime] [masonry cement] [or] [mortar cement]** mortar unless otherwise indicated.
- C. Comply with ASTM C 270, Proportion Specification.
 - 1. For setting mortar, use **[Type S] [Type N]**.
 - 2. For pointing mortar, use **[Type N] [Type O]**.
- D. Pigmented Mortar: Use colored cement product[**or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products**].
 - 1. Pigments shall not exceed 10 percent of portland cement by weight.
 - 2. Pigments shall not exceed 5 percent of **[masonry cement] [or] [mortar cement]** by weight.
 - 3. Mix to match DIA Project Manager's sample.
 - 4. Application: Use pigmented mortar for exposed mortar joints.
- E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
 - 1. Mix to match DIA Project Manager's sample.
 - 2. Application: Use colored aggregate mortar for exposed mortar joints.

2.6 SOURCE QUALITY CONTROL

- A. Engage a qualified independent testing agency to sample and test cast stone units according to ASTM C 1364.
 - 1. Include one test for resistance to freezing and thawing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SETTING CAST STONE IN MORTAR

- A. Install cast stone units to comply with requirements in Section 042000 "Unit Masonry."
- B. Set cast stone as indicated on Drawings. Set units accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
 - 1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
 - 2. Coordinate installation of cast stone with installation of flashing specified in other Sections.
- C. Wet joint surfaces thoroughly before applying mortar or setting in mortar.
- D. Set units in full bed of mortar with full head joints unless otherwise indicated.
 - 1. Set units with joints [**1/4 to 3/8 inch** (6 to 10 mm)] [**3/8 to 1/2 inch** (10 to 13 mm)] **<Insert dimension>** wide unless otherwise indicated.
 - 2. Build anchors and ties into mortar joints as units are set.
 - 3. Fill dowel holes and anchor slots with mortar.
 - 4. Fill collar joints solid as units are set.
 - 5. Build concealed flashing into mortar joints as units are set.
 - 6. Keep head joints in coping and other units with exposed horizontal surfaces open to receive sealant.
 - 7. Keep joints at shelf angles open to receive sealant.
- E. Rake out joints for pointing with mortar to depths of not less than **3/4 inch** (19 mm). Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.
- F. Point mortar joints by placing and compacting mortar in layers not greater than **3/8 inch** (10 mm). Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
- G. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- H. Provide sealant joints at copings and other horizontal surfaces, at expansion, control, and pressure-relieving joints, and at locations indicated.
 - 1. Keep joints free of mortar and other rigid materials.
 - 2. Build in compressible foam-plastic joint fillers where indicated.
 - 3. Form joint of width indicated, but not less than [**3/8 inch** (10 mm)] [**1/2 inch** (13 mm)] **<Insert dimension>**.
 - 4. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
 - 5. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.3 SETTING ANCHORED CAST STONE WITH SEALANT-FILLED JOINTS

- A. Set cast stone as indicated on Drawings. Set units accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
 - 1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
 - 2. Shim and adjust anchors, supports, and accessories to set cast stone in locations indicated with uniform joints.
- B. Keep cavities open where unfilled space is indicated between back of cast stone units and backup wall; do not fill cavities with mortar or grout.
- C. Fill anchor holes with sealant.
 - 1. Where dowel holes occur at pressure-relieving joints, provide compressible material at ends of dowels.
- D. Set cast stone supported on clip or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths. Hold shims back from face of cast stone a distance at least equal to width of joint.
- E. Keep joints free of mortar and other rigid materials. Remove temporary shims and spacers from joints after anchors and supports are secured in place and cast stone units are anchored. Do not begin sealant installation until temporary shims and spacers are removed.
 - 1. Form open joint of width indicated, but not less than [3/8 inch (10 mm)] [1/2 inch (13 mm)] <Insert dimension>.
- F. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
- G. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.4 INSTALLATION TOLERANCES

- A. Variation from Plumb: Do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
- B. Variation from Level: Do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
- C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches (3 mm in 900 mm) or one-fourth of nominal joint width, whichever is less.
- D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush

with units by more than **1/16 inch** (1.5 mm), except where variation is due to warpage of units within tolerances specified.

3.5 ADJUSTING AND CLEANING

- A. Remove and replace stained and otherwise damaged units and units not matching approved Samples.
 - 1. Cast stone may be repaired if methods and results are approved by DIA Project Manager. Contractor to provide sample of repair method if requested by DIA Project Manager.
- B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean cast stone as work progresses.
 - 1. Remove mortar fins and smears before tooling joints.
 - 2. Remove excess sealant immediately, including spills, smears, and spatter.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain DIA Project Manager's approval of sample cleaning before proceeding with cleaning of cast stone.
 - 3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
 - 5. Clean cast stone by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
 - 6. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 047200

SECTION 050170 - MAINTENANCE OF DECORATIVE METAL

PART 1 - GENERAL (Not Applicable)

This Section has no Section Text as it has been replaced by the Sections listed below. If Bindings in e-SPECS for Revit have been associated to this Section, they should be updated to refer to the replacement sections below.

- A. SECTION 050170.51 - DECORATIVE METAL CLEANING
- B. SECTION 050170.61 - DECORATIVE METAL REPAIR
- C. SECTION 050170.63 - DECORATIVE METAL REFINISHING

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 050170

SECTION 050510 - WELDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Welding is that work defined in American Welding Society (AWS) "Standard Welding Terms and Definitions - AWS A2.4" and as otherwise shown on Drawings.
 - 1. All welding on this project shall comply with requirement of this Section, and other Contract Documents such as, but not limited to Drawings. If there is a conflict between Project Drawings, codes, and specifications, the more stringent shall apply.
- B. Extent of welding Work is shown on Drawings, including schedules, notes, and details to show size and location of welds. Welding Symbols shall be in accordance with AWS/A2.4-Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- C. Nothing stated in this Section shall be interpreted as diminishing or eliminating requirements stated in other Sections.
- D. Related Sections:
 - 1. This Section 050510 "Welding" will apply to all welding performed under all other sections of this specification.
 - 2. Other Division 5, Division 22, and Division 23 <Insert division> Sections.
- E. Related Requirements:
 - 1. Drawings, General and Special conditions, general requirements and other applicable Technical Specifications apply to Work of this Section.
 - 2. IEEE-1992. Only welding machines that have been tested and comply with harmonic distortion requirements of IEEE-1992 shall be allowed to operate off of DEN electrical power system.

1.3 REFERENCE STANDARDS

- A. Welding shall comply with the requirements of the reference standards noted herein, except where more stringent requirements are listed herein or otherwise required by

the Contract Documents.

1. AISC - American Institute of Steel Construction.
2. AWS - American Welding Society.
3. API - American Petroleum Institute.
4. AWWA - American Water Works Association.
5. ASME - American Society of Mechanical Engineers.
6. ASTM - American Society for Testing and Materials.
7. ASNT - American Society for Nondestructive Testing.

1.4 SUBMITTALS

- A. Product Data: Submit producers or manufacturer's specifications and installation instructions for all products, including, but not limited to those listed below. Include laboratory test reports and other data to show compliance with specifications (including specified standards).
1. Welding Electrodes: Submit manufactures specifications, to include recommended parameters and technique, for each electrode to be used on this project.
 2. Include data substantiating that materials comply with requirements.
- B. Submittal Requirements for Steel Studs:
1. Stud manufacturer's certification that the studs, as delivered, conform to the applicable requirements of AWS D1.1-2000, sections 7.2 and & 7.3.
 2. Certified copies of the stud manufacturer's test reports covering the last completed set of in-plant quality control mechanical tests, required by AWS D1.1-2000, 7.3 for each diameter delivered. The quality control test shall have been made within the six-month period before delivery of the studs.
 3. Certified material test reports (CMTR) from the steel supplier indicating diameter, chemical properties, and grade on each heat number delivered.
 4. In the absence of Quality Control tests the provisions of AWS D1.1-2000, 7.3.4 and 7.3.5 shall apply with the exception that DEN Project Manager or DEN Project Manager's representative will replace engineer in the process. All costs shall be at Contractor's expense.
- C. Submit shop drawings as specified under Section 013325 "Shop and Working Drawings, Product Data and Samples" for all Work specified herein, including complete details and schedules for fabrication and assembly of members, procedures and diagrams. Shop drawings shall indicate how each and every component shall be welded. If another company manufactures a component to be welded to another part(s) or piece(s) to form a larger assembly, then the shop drawings shall include that manufacturer's recommended welding procedures for that component. Design Construction Drawings shall not be re-used as bases for submitted shop drawings. Shop drawings, which use reproductions of design plans or details, will not be reviewed. Drawings shall be submitted in complete units. Do not submit partial sets.
- D. Shop drawings shall clearly indicate profiles, sizes, and locations of structural

members, connections, attachments, anchorage's, framed openings, size and type of fasteners, and clearances. Indicate welded connections using standard AWS welding symbols, per AWS A2.4. Clearly indicate net weld lengths and sizes, root openings, bevel angles and other information required to satisfactorily complete welding operations.

- E. Contractor shall submit fully dimensioned Isometric drawings (spool drawings) for all welded piping work. Drawings shall indicate all weld types, sizes, and materials to be used. The spool drawing size shall match the full size Contract Documents. Spool drawings shall be submitted in in latest format as approved by Owner. Adobe Acrobat files shall not contain security. Other file formats will not be accepted.
- F. Calculations required in other Sections shall show all pertinent members and pieces. Calculations shall be submitted prior to, or with, relevant shop drawing submittals. It is contractor's responsibility to insure that field construction uses connection design as submitted and reviewed.
- G. Test Reports: Submit copies of all test reports conducted on shop and field welded connections. Include data on type(s) of tests conducted and test results. Reports must be sequentially numbered and submitted to the DEN Project Manager within 48 hours of completion.
- H. Individual Welder Qualifications: Submit Welding Performance Qualification Records (WPQR) for all welders, shop and field, prior to any welding per Paragraph 1.5. B below.
- I. Procedures: Submit Welding Procedure Specifications for all shop and field welding prior to any welding per Part 1 of this Section.

1.5 QUALITY REQUIREMENTS

- A. Codes and Standards: Comply with provisions of following, as applicable:
 - 1. AISC - American Institute of Steel Construction:
 - a. AISC "Code of Standard Practice for Steel Buildings and Bridges", 1986.
 - b. AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings", including "Commentary" and Supplements thereto as issued.
 - 2. American Welding Society (AWS) D1.1 "Structural Welding Code Steel" and all other applicable A.W.S codes (latest editions).
 - 3. ASTM A 6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use".
 - 4. All welding shall be performed in accordance with the latest addition of applicable AWS, API, ASME code, and ASTM Standards.
- B. Qualifications for Welding Work:
 - 1. All Welders shall have been qualified through welding tests in accordance with

- applicable AWS code per paragraph 1.5.A above within one (1) year prior to welding taking place. Evidence of qualification shall be through Welding Performance Qualification Records (WPQR).
2. All welder qualifications test shall be or shall have been administered and witnessed by an Independent Testing Agency (ITA), AWS Certified Welding Inspector, (CWI).
 3. If recertification of welders is required, delay costs and retesting costs shall be borne by the Contractor.
 4. Welding that is to take place at each and every type of joint shall be per approved AWS procedure for that type of joint. Evidence of intended procedure shall be through written Welding Procedure Specifications.
 5. Any welding done without submission to and approval by the DEN Project Manager of Welding Performance Qualification Records of the individual welder(s) doing the welding and Procedure Specifications for the actual welding shall be considered defective and subject to the provisions of Title 17 of the General Conditions.
 6. All WPS and WPQR qualification testing shall be in accordance with this specification and the applicable welding code requirements.
- C. The Contractor shall periodically review each welders work quality and take any steps required to insure high quality work. This is in addition to Quality Control requirements.
- D. Fabricator Qualifications: Minimum of three (3) years experience specializing in fabrication for similar projects.
- E. Design of Members and Connections: Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at site whenever possible without causing delay in the Work.
1. Promptly notify DEN Project Manager whenever design of members and connections for any portion of structure are not clearly indicated.
- F. Welding and materials shall be inspected and tested by an Independent Testing Agency furnished and paid for by the Contractor. The Independent Testing Agency will have authority to reject weldments and materials. Such rejection may be based on visual inspection where, in the Inspector's opinion, the weldment or material would not pass more detailed investigation. Reference Article 3.01 below for inspection and testing requirements. DEN's Quality Assurance Inspector(s), per the provisions of General Conditions Title 17, will also inspect welding and materials. Inspections by either the Independent Testing Agency or DEN's Quality Assurance Inspector may take place in the mill, shop, and field.
1. Promptly remove and replace materials or fabricated components that do not comply with requirements as set forth in the Contract Documents.
- 1.6 CONSTRUCTION WASTE MANAGEMENT
- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to

satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Electrodes for Welding: Comply with AWS Code. Use E70 grade minimum unless otherwise approved. Store all electrodes and welding materials inside and protect from moisture, corrosion, and any other damage. Damaged electrodes shall not be used.

2.2 FABRICATION

- A. Shop Fabrication and Assembly: Fabricate and assemble components in shop to greatest extent possible.
 - 1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
 - 2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.
- B. Holes for Other Work: Provide holes required for securing other work to components, and for passage of other work through components, as shown on final shop drawings.
 - 1. Provide threaded nuts welded to framing, and other specialty items as indicated to receive other work.
 - 2. Cut, drill, or punch holes perpendicular to metal surfaces. The DEN Project Manager shall approve any enlarging of holes by flame cutting
- C. Contractor will notify DEN Project Manager or DEN Project Manager's representative at least 48 hours prior to any commencing fabrication. Notification to include starting date and duration of the Work.

2.3 SHOP CLEANING AND PAINTING

- A. Components to be painted are as shown on the Drawings.
 - 1. Do not paint surfaces, which are to be welded.
 - 2. Do not paint over welded joints until after Independent Testing Agency and DEN Quality Assurance Inspector have approved them.

PART 3 - EXECUTION

3.1 ERECTION

- A. Do not enlarge misaligned or undersized holes in members by burning or by use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.
- B. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members, which are not under stress, as acceptable to DEN Project Manager. Finish gas-cut sections equal to a sheared appearance when permitted.
- C. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Once Independent Testing Agency and DEN Quality Assurance Inspector have approved welds, apply paint to exposed areas using same material as used for shop painting.
- D. No welding machines are to be operated off of DEN power until such machines have been tested for harmonic distortion per IEEE-1992 and approved by DEN Project Manager.
- E. Contractor will notify DEN Project Manager or DEN Project Manager's representative at least 48 hours prior to any inspections to be performed by ITA.

3.2 TESTING AND INSPECTION

- A. Independent Testing Agency (ITA):
 - 1. See Division 1 for Independent Testing Agency requirements.
 - 2. The General Contractor shall provide the ITA for all subcontractors. Subcontractors shall not contract with a separate ITA.
 - 3. Contractor will engage an Independent Testing Agency to inspect welded connections and to perform tests and prepare test reports. The Contractor's Quality Control Inspector will coordinate the inspections and tests performed by the testing lab inspectors and testing personnel.
 - a. The Contractor's Independent Testing Agency and DEN Project Manager's staff shall conduct and interpret tests and state in each report whether test specimens comply with requirements, and specifically state any deviations therefrom. All reports shall be delivered to the DEN Project Manager. Results not complying with requirements are to be brought to the DEN Project Manager's attention within 24 hours of discovery. All reports shall be sequentially numbered.
 - b. Provide access for Independent Testing Agency to places where work is being fabricated or produced so that required inspection and testing can be accomplished.
 - c. The Independent Testing Agency shall inspect Work at the plant before

shipment; however, DEN Project Manager reserves right, at any time before final acceptance, to reject material not complying with specified requirements.

- 1) Inspections and tests conducted by the ITA or DEN shall not in any way relieve the Contractor of the Contractor's responsibility and obligation to meet all specifications and referenced standards. Employment of the ITA does not relieve the Contractor of providing the required Quality Control Program.
 - d. Welding Inspection Personnel Qualifications: All visual welding inspections shall be performed by AWS Certified Welding Inspectors CWI, qualified in accordance with AWS QC1. Inspectors qualified in accordance with the most current edition of the American Society for Nondestructive Testing Recommended Practice No. SNT-TC 1A, shall perform all non-destructive inspections other than visual inspections
 - e. Independent Testing Agency Inspectors working for the Contractor shall identify with a distinguishing mark all parts and joints they have inspected and accepted. Marks to be visible from at least 50 feet. DEN Project Manager and the Quality Control Inspectors shall mutually agree upon identifying marks.
 - f. Independent Testing Agency welding inspector shall be on job site however much time it takes to guaranty that all requirements of Project Specifications and codes are being met and provide written reports showing specific requirements have been met. Shop inspections by ITA welding inspector shall be performed in such a manner as to guaranty that all provisions of Project Specifications and codes are being met and provide written reports showing specific requirements have been met.
4. The Contractor shall furnish such facilities and provide such assistance as may be required for carrying out the inspection prescribed herein. The Contractor shall notify the Independent Testing Agency and the DEN Project Manager at least two weeks in advance of the start of any qualification testing for welding.
 5. The Testing Agency's Inspector will perform the Inspector's duties in such a way that neither fabrication nor erection is unnecessarily delayed or impeded. The Testing Agency shall notify the DEN Project Manager of any scheduled inspections at least 48 hours prior to such time. The DEN Project Manager shall also be notified as soon as possible prior to any unscheduled inspections. In no case will the inspector recommend or prescribe the method of repair of a defect.
 6. Inspection of welding will be such as to assure that all requirements of Project Specifications AWS D1.1, and other applicable welding codes are being complied with. Reports shall show the following items as being in conformance, but not be limited to just the items shown:
 - a. Verify that electrodes used for welding conform to the requirements Manufacturer, AWS, and other applicable Welding Codes and Standards.
 - b. Verify that the approved Welding Procedure Specifications and the approved welding sequence are followed without deviation.
 - c. Verify that only welding operators and welders who have been properly qualified will perform the welding. The inspection agency will witness such

- d. qualification testing of welding operations and welders, as may be required.
 - d. Verify that the fit up, joint preparation, size, contour, extent of reinforcement, and length and location of welds conform to specified requirements such as but not limited to applicable welding codes, Welding Procedure Specifications, and Drawings.
 - e. Review Mill Test Reports of material for compliance with Project Specifications, all applicable Codes, and Drawings.
 - f. ITA inspection reports shall list all inspected, nonconforming, repaired, and accepted welds.
7. DEN Project Manager shall be informed at least 48 hours prior to shop and field welding so random inspections can be performed as stipulated in these specifications and General Conditions, TITLE 17.
8. All welders shall mark their welds with identifying marks. Contractor shall furnish DEN Project Manager with list of welders and their marks. List shall be updated each time a welder is added or subtracted.

B. Structural Steel:

1. The Independent Testing Agency will test shop and field welds per ASTM E 543 and applicable welding code requirements as follows:
- a. All welds: 100% visual.
 - b. Delamination and non-metallic inclusion tests of base metal:
 - 1) Plates and portions of rolled shapes three inches or greater in thickness shall be 100% ultrasonically tested in a zone extending six inches in all directions from any full penetration groove weld which transmits stress through the thickness of the material, or any weld which, because of restraint and/or weld shrinkage will, in the opinion of the inspector, cause significant through-thickness (Z-direction) stress in the material. Such tests shall be made after completion of welding. Acceptance Criteria for such tests shall be in accordance with ASTM A435.
 - c. All full penetration or partial penetration groove welds require 100% ultrasonic testing.
 - d. All fabricated trusses including all fabricated trusses acting, as girders shall be 100% magnetic particle tested.
 - e. Studs on all embed assemblies: 100% of studs tested by hammer method and visual inspection.
 - f. Wall and roof deck connections:
 - 1) 10% Magnetic Particle.
 - g. All other welded connections: 10% Magnetic Particle.
 - h. Additional Testing shall be performed by the Independent Testing Agency.
2. Additional Field Weld Testing:

- a. In addition, if defective welds are discovered, the remaining un-inspected welds shall receive such ultrasonic or magnetic particle inspection as may be required by the DEN Project Manager. If more than 10 percent of a welder's welds fail or when a CWI (Certified Welding Inspector) feels that the quality of the qualified welder's work appears to be below the requirements of the applicable AWS Code, he/she shall be removed from the job and retested to demonstrate compliance with AWS D1.1 (Latest Edition) or other applicable AWS codes and all other applicable AWS codes.
- b. Additional testing shall be required if more than 10% of the Magnetic Particle tested welds are rejected. Then an additional 10% will be tested using either Magnetic Particle or Dye Penetrant Testing. This 10% additional testing shall be repeated until rejection rate drops below one in 10.
- c. When ultrasonic indications arising from the weld root can be interpreted as either a weld defect or the backing strip, the backing strip shall be removed at the expense of the contractor, and if no root defect is indicated on this retest, and no significant amount of the base and weld metal have been removed, the joint needs no further repair or welding. If a defect is still indicated, it shall be repaired.
- d. The welding inspector will have the authority to reject weldments. Such rejection may be based on visual inspection where in the welding inspector's opinion the weldment would not pass a more detailed investigation.
- e. Reports by the Independent Testing Agency inspector will contain, as a minimum, an adequate description of each weld tested, the identifying mark of the welder responsible for the weld, a critique of any defects noted by visual inspection or testing, and a statement regarding the acceptability of the weld tested, as judged by current A.W.S. standards. A copy of all tests results, including ultrasonic and x-ray, shall be provided to the DEN Project Manager within 48 hours of the test occurrence. This requirement includes all failed tests. Any test that shows work not in conformance with the contract requirement shall be retaken after the non-conformity is corrected. The retest shall refer to the failed test. Radiographic testing may be substituted for ultrasonic.

3. Stud Connectors

- a. Stud connectors: The testing agency will inspect headed stud connectors as follows:
 - 1) All studs shall be acoustically inspected. Studs, which do not ring when struck with a hammer, shall be bent 15 degrees. If no fracture occurs, stud is considered acceptable and left bent.
 - 2) In addition to the above, not less than one of each 50 studs shall be tested by bending 15 degrees. If no fracture occurs, stud is considered acceptable and left bent.
 - 3) If at any time the number of rejectable studs on any level of structural steel framing exceeds 3% additional testing in accordance with paragraph above shall be performed on one of each 25 studs at this

level and this increased frequency of testing shall be continued on all succeeding levels until the number of rejectable studs at a level is 3% or less. All cost of additional testing required by this paragraph shall be borne by the Contractor.

- 4) 100% visual inspection to be performed in accordance with AWS D1.1 acceptance criteria.

4. Correct deficiencies in structural steel work, which inspections and laboratory test reports have indicated to be not in compliance with requirements. Perform additional tests, at Contractor's expense, as may be necessary to reconfirm any non-compliance of original work, and as may be necessary to show compliance of corrected work.

C. Metal Decking:

1. Welding shall be performed in accordance with AWS D1.3 and this specification.
2. 100 % visual inspection of all welds, per AWS D1.3 Structural Welding Code Sheet Steel.
 - a. Requires the removal of all slag from welds.
3. 10% Magnetic Particle testing of all welds.
 - a. Additional testing shall be required if more than 10% of the Magnetic Particle tested welds are rejected. Then an additional 10% will be tested using either Magnetic Particle or Dye Penetrant Testing. This 10% additional testing shall be repeated until rejection rate drops below one in 10.
4. All weld areas shall be repaired after inspection. Repair painted decking per Section 053100 "Steel Decking".

D. Metal Fabrications:

1. Welding shall be performed in accordance with applicable AWS welding code and these specifications.
2. 100% visual inspection of all welds.
3. 10% Magnetic Particle testing of all welds.
 - a. Additional testing shall be required if more than 10% of the Magnetic Particle tested welds are rejected. Then an additional 10% will be tested using either Magnetic Particle or Dye Penetrant Testing. This 10% additional testing shall be repeated until rejection rate drops below one in 10.
4. Applicable paragraphs of Structural Steel paragraph above shall be met also.

E. Concrete Reinforcing Bars:

1. Welding shall be performed in accordance with this specification, AWS D1.4, and other applicable AWS Codes and Standards.

2. 100 % visual inspection of all welds, Per AWS D1.4 Structural Welding Code Reinforcing Steel, or other AWS Codes as applicable.
3. 10% Magnetic Particle testing of all welds.
 - a. Additional testing shall be required if more than 10% of the Magnetic Particle tested welds are rejected. Then an additional 10% will be tested using either Magnetic Particle or Dye Penetrant Testing. This 10% additional testing shall be repeated until rejection rate drops below one in 10.

F. Precast Concrete:

1. All Shop and Field welding including embed assemblies, shall be inspected per these specifications, AISC, AWS D1.1, AWS D1.4, and other applicable AWS codes.
2. In addition to the requirements listed below, the requirements of paragraphs for Structural Steel and Concrete Reinforcing Bars above shall apply to this section also.
3. AISC Manual of Steel Construction, Chapter J, Section J2 shall be complied with.
 - a. If welds with larger effective throat thickness than shown in Table J2.2 are to be used, random testing will have to be performed on shop and field welds to insure that effective throats sizes are being met.
 - 1) Three percent of all such welds shop and field will have to be tested by removing, cross sectioning, and Macroetch tested as called out in AWS D1.4-98, Section 6.2.5.2.
 - 2) Welds to be tested will be randomly picked by DEN Project Manager.
4. Weld plates shall NOT be bent by hammering or heating to close up gaps in connections between uneven embeds.
 - a. Filler plates shall be used in accordance with AWS D1.1.
 - b. Designer of Record shall review all connections requiring filler plates 1/4 and thicker for compliance with design load requirements.
 - c. Minimal hammering and bending will be allowed on plate and connection designated as "For Erection Only". Drawings shall clearly designate which welds are for erection only. Drawings shall clearly state that welds indicated as "for erection only", have no value after structure is completed.
 - 1) An assortment of prebent plates shall be furnished by Precast supplier to minimize the amount of beating on connection plates. Plates shall be bent in 1/2-inch increments and no plates shall be bent any more than 1/2 inch after one side is welded in place.
 - 2) All welds, erection or permanent, shall be applied and inspected per applicable AWS code. The only exception will be to allow the connection plates for the "for erection only" welds to be bent a maximum of 1/2 inch.
5. No welding is allowed unless specifically shown on Drawings.

- a. All welds shown on Drawings are structural and shall meet all requirements of Project Specifications and welding codes.

G. Sheet Steel:

1. Welding shall be in accordance with AWS D1.3 Structural Welding Code- Sheet Steel.
2. Inspection:
 - a. 100 % visual in accordance with acceptance criteria of AWS D1.3.
 - b. 10% Magnetic Particle testing of all welds.
 - c. Additional testing shall be required if more than 10% of the Magnetic Particle tested welds are rejected. Then an additional 10% will be tested using either Magnetic Particle or Dye Penetrant Testing. This 10% additional testing shall be repeated until rejection rate drops below one in 10.

H. Division 22 and Division 23 - Basic Mechanical Materials and Methods:

1. All welding in Division 22 and Division 23 shall comply with the applicable AWS, ASME, AWWA, and API codes, latest editions.
2. All shop and field welds will be inspected per these specifications and applicable code for work being performed.
3. All welds shall be 100% visually inspected by ITA supplied by Contractor. Additional testing shall be as required by other parts of this Section, applicable codes, DEN Project Manager and Designer of Record.
 - a. Natural Gas piping (underground and transportation mains upstream of the meter): ASME B31.8
 - 1) 100% visual inspection per acceptance criteria of ASME B31.8.
 - 2) All other requirements of ASME B31.8 as required for the application.
 - b. Natural Gas piping (less than 5 psi and downstream of the meter): ASME B31.9:
 - 1) 100% visual inspection per acceptance criteria of ASME B31.9.
 - 2) All other requirements of ASME B31.9 as required for the application.
 - c. Hot and chilled water piping/Hydronic Piping: ASME B31.9:
 - 1) 100% visual inspection per acceptance criteria of ASME B31.9.
 - 2) All other requirements of ASME B31.9 as required for the application.
 - d. Hot water piping (in excess of 200°F) /Hydronic Piping: ASME B31.3:
 - 1) 100% visual inspection per acceptance criteria of ASME B31.3.
 - 2) All other requirements of ASME B31.1 as required for the application.
 - e. Ductwork applicable AWS Code, such as but not limited to AWS D1.3 Structural Welding Code-Sheet Steel or AWS D9.1M/D9.1-Sheet Metal

Welding Code:

- 1) 100% Visual inspection per acceptance criteria of applicable code.
 - 2) Magnetic Particle Test requirements are the same as paragraph above for Structural Steel.
 - 3) Additional requirements of SMACNA duct construction standards.
- f. Fuel Piping: ASME B31.4:
- 1) 100% visual inspection per acceptance criteria of ASME B31.4.
 - 2) All other requirements of ASME B31.4 as required for the application.
- g. Refrigerant Piping: ASME B31.5:
- 1) 100% visual inspection per acceptance criteria of ASME B31.5.
 - 2) All other requirements of ASME B31.5 as required for the application.
- h. Steam piping: ASME B31.1:
- 1) 100% visual inspection per acceptance criteria of ASME B31.1.
 - 2) All other requirements of ASME B31.1 as required for the application.
- i. Piping, ductwork and mechanical equipment supports: AWS D1.1: and other applicable AWS Codes.
- 1) 100 % visual inspection.
 - 2) Magnetic Particle Test requirements are the same as 4.02 Structural Steel.
- j. Water Lines: Per AWWA, AWS D1.1 latest edition, and Denver Water Board Specifications. If there is a conflict the more stringent shall apply:
- 1) 100% visual inspection per AWS D1.1 visual acceptance criteria.
 - 2) AWWA requires that welds be 100% Dye Penetrant Tested in place of Magnetic Particle testing.
4. Forged fittings, for branch connections and etc. shall be welded in accordance with this specification, ASME B31.1, and manufacturer's recommendations. In the event of a conflict, the more stringent shall apply:
- a. Fittings shall be full penetration welded.
 - b. Inside of fitting shall be inspected for full penetration. This shall be done prior to any welding on inside if so required. If weld is required on inside of full penetration joint, it shall be ground or back gouged to sound base metal.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this section. The cost of the work described in this section shall be included in the applicable unit price item, work order or lump sum bid item.

END OF SECTION 050510

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Structural steel.
2. Prefabricated building columns.
3. Grout.

B. Related Sections:

1. Section 014000 "Quality Requirements" for independent testing agency procedures and administrative requirements.
2. Section 050510 "Welding" for general welding requirements.
3. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
4. Section 053100 "Steel Decking" for field installation of shear connectors through deck.
5. Section 055000 "Metal Fabrications" for **[steel lintels and shelf angles not attached to structural-steel frame] [miscellaneous steel fabrications] [and] [other metal items]** not defined as structural steel.
6. Section 055100 "Metal Stairs."
7. Section 059990 "Welding". Contractor shall comply with requirements of 059990 "Welding" in addition to requirements of this Section. In the case of a conflict between Section 059990 and this Section, the more stringent requirements shall apply.
8. **[Section 099113 "Exterior Painting" and Section 099123 "Interior Painting"] [and] [Section 099600 "High-Performance Coatings"]** for surface-preparation and priming requirements.
9. Section 133419 "Metal Building Systems" for structural steel.

- C. Extent of structural steel Work is shown on drawings, including schedules, notes and details to show size and location of members, typical connections, and type of steel required.

- D. Structural steel is that work defined in American Institute of Steel Construction (AISC) "Code of Standard Practice" and as otherwise shown on drawings.

- E. Members in a structure that carry an imposed load in addition to their own weight.
- F. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:
 - 1. Shapes included in ASTM A 6/A 6M with flanges thicker than **1-1/2 inches** (38 mm).
 - 2. Welded built-up members with plates thicker than **2 inches** (50 mm).
 - 3. Column base plates thicker than **2 inches** (50 mm).
- D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
- E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 REFERENCE STANDARDS

- A. Comply with the requirements of the reference standards noted herein, except where more stringent requirements are listed herein or otherwise required by the Contract Documents.

1.5 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of[**simple shear**] connections required by the Contract Documents to be selected or completed by structural-steel fabricator[, **including comprehensive engineering analysis by a qualified professional engineer,**] to withstand loads indicated and comply with other information and restrictions indicated.
 - 1. Select and complete connections using [**schematic details indicated**] [**and**] [**AISC 360**] <Insert source>.
 - 2. Use [**LRFD; data are given at factored-load level**] [**ASD; data are given at service-load level**].
- B. Moment Connections: Type [**PR, partially**] [**FR, fully**] restrained.

- C. Construction: [**Moment frame**] [**Braced frame**] [**Shear wall system**] [**Combined system of moment frame and braced frame**] [**Combined system of moment frame and shear walls**] [**Combined system of braced frame and shear walls**] [**Combined system of moment frame, braced frame, and shear walls**].

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Submit producer's or manufacturer's specifications and installation instructions for the following products. Include laboratory test reports and other data to show compliance with specifications, including specified standards.

1. Structural steel (each type), including certified copies of mill reports covering chemical and physical properties.
2. High strength bolts (each type), including nuts and washers.
3. Structural steel primer paint.
4. Shrinkage resistant grout.
5. Welding Electrodes: Per Section 059990 "Welding".
6. Provide fully traceable certificates of compliance with ASTM.
7. Include data substantiating that materials comply with requirements.

- B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Laboratory Test Reports for Credit IEQ 4: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Shop Drawings: Show fabrication of structural-steel components. Submit shop drawings for all Work specified herein, including complete details and schedules for fabrication and assembly of structural steel members, procedures, and diagrams.

1. Submit design calculations and drawings prepared under the supervision and sealed by a professional engineer registered in Colorado for all standard shear connections moment connections, and fabricated truss member connections as shown on drawings.
2. Submit non-standard connections for design review.
3. Design construction drawings shall not be re-used as bases for submitted shop drawings. Shop drawings that use reproductions of design plans or details may not be reviewed.
4. Erection and piece drawings shall be submitted in complete units. Do not submit partial sets. Calculations shall be submitted only with relevant erection plans with clear references between each.
5. Include details of cuts, connections, splices, camber, holes, and other pertinent

- data.
6. Include embedment drawings.
 7. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 8. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
 9. Identify members and connections of the seismic-load-resisting system.
 10. Indicate locations and dimensions of protected zones.
 11. Identify demand critical welds.
 12. Shop drawings shall clearly indicate profiles, sizes, and locations of structural members, connections, attachments, anchorages, framed openings, size and type of fasteners, and clearances. Clearly indicate net weld lengths and sizes, root openings, bevel angles and other information required to satisfactorily complete welding operations.
 13. Calculations shall show all pertinent members and pieces. Calculations shall be submitted prior to, or with, relevant shop drawing submittals. It is contractor's responsibility to insure that field construction uses connection design as submitted and reviewed.
 14. For structural-steel connections indicated to comply with design loads, include structural analysis data [**signed and sealed by the qualified professional engineer responsible for their preparation**].
- D. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint [**whether prequalified or qualified by testing**] [**qualified by testing**], including the following:
1. Power source (constant current or constant voltage).
 2. Electrode manufacturer and trade name, for demand critical welds.
- 1.7 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For qualified [**Installer**] [**fabricator**] [**professional engineer**] [**testing agency**].
 - B. Welding certificates.
 - C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
 - D. Mill test reports for structural steel, including chemical and physical properties.
 - E. Product Test Reports: For the following:
 1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 2. Direct-tension indicators.
 3. Tension-control, high-strength bolt-nut-washer assemblies.
 4. Shear stud connectors.

5. Shop primers.
6. Nonshrink grout.
7. **<Insert product>**.

- F. Source quality-control reports.
- G. Surveys: Submit certified copies of each survey conducted by a registered professional engineer, showing elevations and locations of all base plates and anchor bolts to receive structural steel, and final elevations and locations for major members. Indicate discrepancies between actual installation and Contract Documents.
- H. Submit WPS (Welding Procedure Specifications) and WPQR (Welder performance Qualification Records) in accordance with Specification 059990 "Welding".
- I. Submit Quality Control Plan for approval by DEN Project Manager and Designer of Record.

1.8 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.9 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category **[ACSE]** **[CSE]**.
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement **[P1]** **[P2]** **[P3]** or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel." Reference Section 050510 "Welding" for general welding requirements.
1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- E. Comply with applicable provisions of the following specifications and documents:
1. AISC 303.
 2. AISC 341 and AISC 341s1.

3. AISC 360.
 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- F. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.
- G. The erection sequence indicated on the drawing is the basis for bidding the Work. The contractor may submit alternate method(s) for the erection sequence. The alternate method(s) shall be priced as a separate line item and shall be inclusive of cost of the Work complete including:
- H. All engineering required for the alternate design.
- I. Design of connections: Standard shear connections moment connections, and fabricated truss member connections shall be designed by the fabricator for loads indicated in drawings. Calculations shall be prepared by or under the direct supervision of a Colorado registered engineer and submitted to the DEN Project Manager for review prior to fabrication.
- J. An allowance of \$15,000.00 <Insert number> for the Engineer of Record to review the alternate proposal, fabricator-designed connections, and related engineering calculations.
- K. Qualifications for welding work shall be in accordance with Specification Section 059990 "Welding" and applicable welding and inspection codes.
- L. The Contractor shall periodically review each welder's work quality and take any steps required to endure high quality work. This is in addition to Quality Control requirements.
- M. Fabricator Qualifications: Minimum of three (3) <Insert number> years' experience specializing in fabrication of structural steel for similar projects and is an AISC Class III shop.
- N. Fabricator shall provide full traceability of all steel used in the fabrication of this project. Procedures for providing traceability shall be included in the Quality Control Plan.
- O. Source Quality Control: Materials and fabrication procedures are subject to inspection and tests in mill, shop, and field, conducted by a qualified independent inspection agency furnished and paid for by contractor.
- P. Promptly remove and replace materials or fabricated components that do not comply.
- Q. Design of Members and Connections: Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at site whenever possible without causing delay in the Work.
- R. Promptly notify DEN Project Manager whenever design of members and connections for any portion of structure are not clearly indicated.
- S. Paint testing: Provide certification that factory applied paint complies with specified

requirements. Submit copy to DEN Project Manager prior to steel erection.

- T. Independent Testing Agency or DEN Project Manager's Quality Control Inspector will have authority to reject weldments. Such rejection may be based on visual inspection where, in the opinion of the Independent Testing Agency or DEN Project Manager, weldment would not pass more detailed investigation.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site at such intervals to insure uninterrupted progress of work. All material shall bear easily readable identification mark numbers as noted on shop drawings. Deliveries to the jobsite shall be made in the order that material is being erected. The direction of camber shall be clearly shown.
- B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast in place concrete or masonry, in ample time to not to delay work.
- C. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- D. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.11 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419

"Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. Metal Surfaces, General: For fabrication of steel exposed to view, use only materials that are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names and roughness. Reference Section 051213 "Architecturally exposed Structural Steel Framing" for exposed structural steel framing.
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25] [50] <Insert number> percent.
- C. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than the following:
1. W-Shapes: [60] <Insert number> percent.
 2. Channels, Angles[, M] [, S]-Shapes: [60] <Insert number> percent.
 3. Plate and Bar: [25] <Insert number> percent.
 4. Cold-Formed Hollow Structural Sections: [25] <Insert number> percent.
 5. Steel Pipe: [25] <Insert number> percent.
 6. <Insert Category Name>: <Insert number> percent.
 7. All Other Steel Materials: [25] <Insert number> percent.
- D. W-Shapes: [ASTM A 992/A 992M] [ASTM A 572/A 572M, Grade 50 (345)] [ASTM A 529/A 529M, Grade 50 (345)] [ASTM A 913/A 913M, Grade 50 (345)].
- E. Materials complying with third and fourth options in first paragraph below are widely available. Fifth and sixth options include specialty-steel materials; verify availability if required Channels, Angles[, M] [, S]-Shapes: [ASTM A 36/A 36M] [ASTM A 572/A 572M, Grade 50 (345)] [ASTM A 529/A 529M, Grade 50 (345)] [ASTM A 913/A 913M, Grade 50 (345)].
- F. Plate and Bar: [ASTM A 36/A 36M] [ASTM A 572/A 572M, Grade 50 (345)] [ASTM A 529/A 529M, Grade 50 (345)].
- G. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588/A 588M, Grade 50 (345).
- H. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade [B] [C], structural tubing.
- I. Hot Formed Steel Tubing: ASTM A 501.
- J. Corrosion-Resisting Cold-Formed Hollow Structural Sections: ASTM A 847/A 847M, structural tubing.

- K. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
 - 1. Finish: Black, except where indicated to be galvanized.
 - 2. Weight Class: **[Standard] [Extra strong] [Double-extra strong]**.
 - 3. Finish: **[Black] [Galvanized] [Black except where indicated to be galvanized]**.
- L. Steel Castings: ASTM A 216/A 216M, Grade WCB with supplementary requirement S11.
- M. Steel Forgings: ASTM A 668/A 668M.
- N. Welding Electrodes: Comply with AWS requirements and with Specifications Section 059990 "Welding", and applicable welding codes and specifications.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: [ASTM A 325](#) (ASTM A 325M), Type 1, heavy-hex steel structural bolts; [ASTM A 563, Grade C](#), (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and [ASTM F 436](#) (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: [ASTM F 959, Type 325](#) (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.
- B. High-Strength Bolts, Nuts, and Washers: [ASTM A 490](#) (ASTM A 490M), Type 1, heavy-hex steel structural bolts[**or tension-control, bolt-nut-washer assemblies with splined ends**]; [ASTM A 563, Grade DH](#), (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and [ASTM F 436](#) (ASTM F 436M), Type 1, hardened carbon-steel washers with plain finish.
 - 1. Direct-Tension Indicators: [ASTM F 959, Type 490](#) (ASTM F 959M, Type 10.9), compressible-washer type with plain finish.
- C. Zinc-Coated High-Strength Bolts, Nuts, and Washers: [ASTM A 325](#) (ASTM A 325M), Type 1, heavy-hex steel structural bolts; [ASTM A 563, Grade DH](#) (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and [ASTM F 436](#) (ASTM F 436M), Type 1, hardened carbon-steel washers.
 - 1. Finish: **[Hot-dip zinc coating] [Mechanically deposited zinc coating] [Hot-dip or mechanically deposited zinc coating]**.
 - 2. Direct-Tension Indicators: [ASTM F 959, Type 325](#) (ASTM F 959M, Type 8.8), compressible-washer type with **[mechanically deposited zinc coating] [mechanically deposited zinc coating, baked epoxy-coated]** finish.
- D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, **[heavy-hex] [round]** head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
 - 1. Finish: **[Plain] [Mechanically deposited zinc coating]**.

- E. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- F. Unheaded Anchor Rods: **[ASTM F 1554, Grade 36]** **[ASTM F 1554, Grade 55, weldable]** **[ASTM A 354]** **[ASTM A 449]** **[ASTM A 572/A 572M, Grade 50 (345)]** **[ASTM A 36/A 36M]**.
1. Configuration: **[Straight]** **[Hooked]**.
 2. Nuts: **ASTM A 563** (ASTM A 563M) **[heavy-]**hex carbon steel.
 3. Plate Washers: ASTM A 36/A 36M carbon steel.
 4. Washers: **ASTM F 436** (ASTM F 436M), Type 1, hardened carbon steel.
 5. Finish: **[Plain]** **[Hot-dip zinc coating, ASTM A 153/A 153M, Class C]** **[Mechanically deposited zinc coating, ASTM B 695, Class 50]**.
- G. Headed Anchor Rods: **[ASTM F 1554, Grade 36]** **[ASTM F 1554, Grade 55, weldable]** **[ASTM A 354]** **[ASTM A 449]**, straight.
1. Nuts: **ASTM A 563** (ASTM A 563M) **[heavy-]**hex carbon steel.
 2. Plate Washers: ASTM A 36/A 36M carbon steel.
 3. Washers: **ASTM F 436** (ASTM F 436M), Type 1, hardened carbon steel.
 4. Finish: **[Plain]** **[Hot-dip zinc coating, ASTM A 153/A 153M, Class C]** **[Mechanically deposited zinc coating, ASTM B 695, Class 50]**.
- H. Threaded Rods: **[ASTM A 36/A 36M]** **[ASTM A 193/A 193M, Grade B7]** **[ASTM A 354, Grade BD]** **[ASTM A 449]** **[A 572/A 572M, Grade 50 (345)]**.
1. Nuts: **ASTM A 563** (ASTM A 563M) **[heavy-]**hex carbon steel.
 2. Washers: **[ASTM F 436** (ASTM F 436M), **Type 1, hardened]** **[ASTM A 36/A 36M]** carbon steel.
 3. Finish: **[Plain]** **[Hot-dip zinc coating, ASTM A 153/A 153M, Class C]** **[Mechanically deposited zinc coating, ASTM B 695, Class 50]**.
- I. **[Clevises]** **[and]** **[Turnbuckles]**: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.
- J. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.
- K. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.
- L. Structural Slide Bearings: Low-friction assemblies, of configuration indicated, that provide vertical transfer of loads and allow horizontal movement perpendicular to plane of expansion joint while resisting movement within plane of expansion joint.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amscot Structural Products Corp.
 - b. Fluorocarbon Company Limited.
 - c. R.J. Watson Bridge & Structural Engineered Systems.

- d. Seismic Energy Products, L.P.
 - e. **<Insert manufacturer's name>**.
 - f. or approved equal.
2. Mating Surfaces: **[PTFE and PTFE] [PTFE and mirror-finished stainless steel]**.
 3. Coefficient of Friction: Not more than **[0.03] [0.04] [0.05] [0.06] [0.10] [0.12] <Insert value>**.
 4. Design Load: Not less than **[2,000 psi (13.7 MPa)] [5,000 psi (34 MPa)] [6,000 psi (41 MPa)] <Insert value>**.
 5. Total Movement Capability: **[2 inches (50 mm)] <Insert value>**.

2.3 PRIMER

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Primer: Comply with **[Section 099113 "Exterior Painting" and Section 099123 "Interior Painting. "] [Section 099600 "High-Performance Coatings. "] [Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings. "]**
- C. Primer: SSPC-Paint 25, **[Type I] [Type II]**, zinc oxide, alkyd, linseed oil primer.
- D. Primer: SSPC-Paint 25 BCS, **[Type I] [Type II]**, zinc oxide, alkyd, linseed oil primer.
- E. Primer: SSPC-Paint 23, latex primer.
- F. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- G. Galvanizing Repair Paint: **[MPI#18, MPI#19, or SSPC-Paint 20] [ASTM A 780]**.

2.4 GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
- B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate

according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.

1. Camber structural-steel members where indicated.
 2. Fabricate beams with rolling camber up.
 3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
 4. Mark and match-mark materials for field assembly.
 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
 6. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, [**mechanically thermal cut,**] or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to [**SSPC-SP 1, "Solvent Cleaning"**] [**SSPC-SP 2, "Hand Tool Cleaning"**] [**SSPC-SP 3, "Power Tool Cleaning"**]."
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural steel. Straighten as required to provide uniform, square, and true members in completed wall framing.
- H. Welded Door Frames: Build up welded doorframes attached to structural steel. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than **10 inches** (250 mm) o.c. unless otherwise indicated.
- I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut boltholes or enlarge holes by burning. Any enlarging of holes by flame cutting shall be performed only if approved by the DEN Project Manager.
 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.

3. Weld threaded nuts to framing and other specialty items indicated to receive other work.
 4. Provide threaded nuts welded to framing, and other specialty items as indicated to receive other work.
- J. Expansion Joints: Provide expansion joints in steel shelf angles to match locations of expansion joints in structural steel frame.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: [**Snug tightened**] [**Pretensioned**] [**Slip critical**].
- B. Weld Connections: Comply with AWS D1.1/D1.1M[**and AWS D1.8/D1.8M**] for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work. Reference Section 050510 "Welding" for general welding requirements.
1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 PREFABRICATED BUILDING COLUMNS

- A. Prefabricated building columns consisting of load-bearing structural-steel members protected by concrete fireproofing encased in an outer non-load-bearing steel shell.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Black Rock Column, Inc.
 - b. Dean, George H., Inc.
 - c. Dean Lally L. P.; Fire-Trol Division.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
- B. Fire-Resistance Ratings: Provide prefabricated building column listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for ratings indicated, based on testing according to ASTM E 119.
1. Fire-Resistance Rating: [**4 hours**] [**3 hours**] [**2 hours**] [**As indicated**].

2.8 SHOP PRIMING

- A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of **2 inches** (50 mm).
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."
3. SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
5. SSPC-SP 14/NACE No. 8, "Industrial Blast Cleaning."
6. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
7. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."
8. SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."
9. SSPC-SP 8, "Pickling."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of **1.5 mils** (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

D. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than **1.5 mils** (0.038 mm).

2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize [**lintels**] [**shelf angles**] [**and**] [**welded doorframes**] attached to structural-steel frame and located in exterior walls.

2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage an independent testing and inspecting agency to

perform shop tests and inspections and prepare test reports.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Shop-bolted connections will be[**tested and**] inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
1. Liquid Penetrant Inspection: ASTM E 165.
 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 3. Ultrasonic Inspection: ASTM E 164.
 4. Radiographic Inspection: ASTM E 94.
- E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads

and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Surveys: Employ a registered professional engineer or land surveyor for accurate erection of structural steel. Check elevations of concrete and masonry bearing surfaces, and locations of anchor bolts and similar devices, before erection work proceeds, and report discrepancies to DEN Project Manager along with a suggested plan on how to correct the discrepancy.
1. Do not proceed with erection until corrections have been made, or until compensating adjustments to structural steel work have been agreed upon with DEN Project Manager.
- B. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and all final connections are made. Provide temporary guidelines to achieve proper alignment of structures as erection proceeds. Temporary shoring and bracing shall be designed by a Licensed Colorado Professional Engineer.
1. The Engineer shall inspect finished shoring and bracing and document compliance with the design plans.
- C. Temporary Planking: Provide temporary planking handrails, nets, anchorages and working platforms as necessary to effectively and safely complete work.
- D. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- E. Base **[Bearing]** **[and]** **[Leveling]** Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
1. Set plates for structural members on wedges, shims, or setting nuts as required.
 2. Weld plate washers to top of baseplate.
 3. **[Snug-tighten]** **[Pretension]** anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. **[Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.]**

- F. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- G. Set structural frames accurately to lines and elevations indicated. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure within specified AISC tolerances and as follows:
 - a. At all slab edge conditions, provide a maximum deviation from grid line (or dimensioned point from grid line), to beam or column center, on the exterior or open side, of 1/2" at any given point. Grid line shall be considered a theoretically perfect plane.
 - b. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- H. Splice members only where indicated and approved on shop drawings.
- I. Do not use thermal cutting during erection unless approved by DEN Project Manager. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- J. Do not enlarge unfair holes in members by burning or using drift pins, except in secondary members. Ream holes that must be enlarged to admit bolts.
- K. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- L. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds, and grind smooth at exposed surfaces.
- M. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds. Where welding to existing steel, clean existing steel surfaces prior to welding.
- N. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members that are not under stress, as acceptable to DEN Project Manager. Finish gas cut sections equal to a sheared appearance when permitted.

- O. Touch Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.
- P. Beam Members: Deviation of member working point horizontal location and elevation with respect to the supporting member shall not exceed $\pm 1/16$ " from the location and elevation shown on the drawings.
 - 1. Leveling and Plumbing: Based on mean temperature of 70 degrees F.
 - 2. Compensate for difference in temperature at time of erection.
- Q. Headed Stud Shear Connectors: Automatically end weld in accordance with Specification Section 059990 "Welding", AWS D1.1 and manufacturer's printed instructions.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: [**Snug tightened**] [**Pretensioned**] [**Slip critical**].
- B. Weld Connections: Comply with AWS D1.1/D1.1M[**and AWS D1.8/D1.8M**] for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work. Reference Section 050510 "Welding" for general welding requirements.
 - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs[**where indicated**], back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 PREFABRICATED BUILDING COLUMNS

- A. Install prefabricated building columns to comply with AISC 360, manufacturer's written recommendations, and requirements of testing and inspecting agency that apply to the fire-resistance rating indicated.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect [**field welds**] [**and**] [**high-strength bolted connections**].

- B. Bolted Connections: Bolted connections will be [**tested and**] inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.
 - 1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.
- E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
 - 1. Additional testing, if required, will be performed at Contractor's expense, as may be necessary to reconfirm any non-compliance of original work, and as may be necessary to show compliance of corrected work.

3.7 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
- C. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" Section 099123 "Interior Painting."

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 051200

SECTION 051213 - ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes architecturally exposed structural steel (AESS) framing.
 - 1. Requirements in Section 051200 "Structural Steel Framing" also apply to AESS framing.
- B. Extent of structural steel work is shown on drawings, including schedules, notes and details to show size and location of members, typical connections, and type of steel required.
- C. Structural steel is that work defined in American Institute of Steel Construction (AISC) "Code of Standard Practice" and as otherwise shown on drawings.
- D. Members in a structure that carries an imposed load in addition to their own weight.
- E. Related Sections:
 - 1. Section 014000 "Quality Requirements" for independent testing agency procedures and administrative requirements.
 - 2. Section 050510 "Welding" for general welding requirements.
 - 3. Section 051200 "Structural Steel Framing" for additional requirements applicable to AESS.
 - 4. Section 055000 "Metal Fabrications" for **[steel lintels and shelf angles not attached to structural-steel frame] [miscellaneous steel fabrications] [and] [other metal items]** not defined as structural steel.
 - 5. Section 055100 "Metal Stairs."
 - 6. Section 059990 "Welding".
 - 7. **[Section 099113 "Exterior Painting" and Section 099123 "Interior Painting"] [and] [Section 099600 "High-Performance Coatings"]** for surface preparation and priming requirements.
- F. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 DEFINITIONS

- A. Architecturally Exposed Structural Steel: Structural steel designated as "architecturally exposed structural steel" or "AESS" in the Contract Documents.
- B. Category 1 AESS: AESS that is within **96 inches** (2400 mm) vertically and **36 inches** (900 mm) horizontally of a walking surface and is visible to a person standing on that walking surface or is designated as "Category 1 architecturally exposed structural steel" or "AESS-1" in the Contract Documents.
- C. Category 2 AESS: AESS that is within **20 feet** (6 m) vertically and horizontally of a walking surface and is visible to a person standing on that walking surface or is designated as "Category 2 architecturally exposed structural steel" or "AESS-2" in the Contract Documents.
- D. Category 3 AESS: AESS that is not defined as Category 1 or Category 2 or that is designated as "Category 3 architecturally exposed structural steel" or "AESS-3" in the Contract Documents.

1.4 ACTION SUBMITTALS

- A. In addition to providing submittals indicated below, comply with submittal requirements of Section 051200 "Structural Steel".
- B. Shop Drawings: Show fabrication of AESS components.[**Shop Drawings for structural steel may be used for AESS provided items of AESS are specifically identified and requirements below are met for AESS.**]
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.[**Indicate grinding, finish, and profile of welds.**]
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.[**Indicate orientation of bolt heads.**]
 - 5. Indicate exposed surfaces and edges and surface preparation being used.
 - 6. Indicate special tolerances and erection requirements.
- C. Samples: Submit samples of AESS to set quality standards for exposed welds[**for Category 1 AESS**].
 - 1. Two steel plates, **3/8 by 8 by 4 inches** (9.5 by 200 by 100 mm), with long edges joined by a groove weld[**and with weld ground smooth**].
 - 2. Steel plate, **3/8 by 8 by 8 inches** (9.5 by 200 by 200 mm), with one end of a short length of rectangular steel tube, **4 by 6 by 3/8 inches** (100 by 150 by 9.5 mm),

welded to plate with a continuous fillet weld[**and with weld ground smooth and blended**].

3. Round steel tube or pipe, minimum **8 inches** (200 mm) in diameter, with end of another round steel tube or pipe, approximately **4 inches** (100 mm) in diameter, welded to its side at a 45-degree angle with a continuous fillet weld[**and with weld ground smooth and blended**].

1.5 INFORMATIONAL SUBMITTALS

- A. In addition to providing submittals indicated below, comply with submittal requirements of Section 051200 "Structural Steel".
- B. Qualification Data: For qualified [**Installer**] [**fabricator**].

1.6 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category [**ACSE**] [**CSE**].
- B. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement [**P1**] [**P2**] [**P3**] or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- D. Mockups: Build mockups of AESS to set quality standards for fabrication and installation.
 1. Build mockup of typical portion of AESS as shown on Drawings.
 2. Coordinate finish painting requirements with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Retain paragraph below if Work of this Section is extensive or complex enough to justify a preinstallation conference and a preinstallation conference is not required in Section 051200 "Structural Steel Framing." If retaining, coordinate with Division 01 Sections.

- F. Preinstallation Conference: Conduct conference at **[Project site]** <[location and time as determined by DEN Project Manager]Insert location>.
- G. The erection sequence indicated on the drawing is the basis for bidding the Work. The Contractor may submit alternate method(s) for the erection sequence. The alternate method(s) shall be priced as a separate line item and shall be inclusive of cost of the work complete including:
- H. All engineering required for the alternate design.
- I. Design of connections: Standard shear connections moment connections, and fabricated truss member connections shall be designed by the fabricator for loads indicated in drawings. Calculations shall be prepared by or under the direct supervision of a Colorado registered engineer and submitted to the DEN Project Manager for review prior to fabrication.
- J. An allowance of **[\$15,000.00]** <Insert amount> for the Engineer of Record to review the alternate proposal, fabricator-designed connections, and related engineering calculations.
- K. Qualifications for welding work shall be in accordance with Specification Section 0505100 "Welding" and applicable welding and inspection codes.
- L. The Contractor shall periodically review each welder's work quality and take any steps required to endure high quality work. This is in addition to Quality Control requirements.
- M. Fabricator Qualifications: Minimum of three (**three (3)**) <Insert number> years experience specializing in fabrication of structural steel for similar projects and be an AISC Class III shop.
- N. Fabricator shall provide full traceability of all steel used in the fabrication of this project. Procedures for providing traceability shall be included in the Quality Control Plan.
- O. Source Quality Control: Materials and fabrication procedures are subject to inspection and tests in mill, shop, and field, conducted by a qualified independent inspection agency furnished and paid for by contractor.
- P. Promptly remove and replace materials or fabricated components which do not comply.
- Q. Design of Members and Connections: Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at site whenever possible without causing delay in the work.
- R. Promptly notify DEN Project Manager whenever design of members and connections for any portion of structure are not clearly indicated.
- S. Paint testing: Provide certification that factory applied paint complies with specified requirements. Submit copy to DEN Project Manager prior to steel erection.

- T. Independent Testing Agency or DEN Project Manager's Quality Control Inspector will have authority to reject weldments. Such rejection may be based on visual inspection where, in the opinion of the Independent Testing Agency or DEN Project Manager, weldment would not pass more detailed investigation.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site at such intervals to insure uninterrupted progress of work. All material shall bear easily readable identification mark numbers as noted on shop drawings. Deliveries to the jobsite shall be made in the order that material is being erected. The direction of camber shall be clearly shown.
- B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast in place concrete or masonry, in ample time to not to delay work.
- C. Use special care in handling to prevent twisting, warping, nicking, and other damage. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.9 PROJECT CONDITIONS

- A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

1.10 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Metal Surfaces, General: For fabrication of steel exposed to view, use only materials which are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names and roughness, in accordance with requirements of this Section.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round-head assemblies, consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
1. Finish: **[Plain] [Mechanically deposited zinc coating]**.
- B. Corrosion-Resisting (Weathering Steel), Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 3, round-head assemblies, consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

2.3 PRIMER

- A. Primer: Comply with **[Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."]** **[Section 099600 "High-Performance Coatings."]** **[Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."]**
- B. Primer: SSPC-Paint 25, **[Type I] [Type II]**, zinc oxide, alkyd, linseed oil primer.
- C. Primer: SSPC-Paint 25 BCS, **[Type I] [Type II]**, zinc oxide, alkyd, linseed oil primer.
- D. Primer: SSPC-Paint 23, latex primer.
- E. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- F. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- G. Galvanizing Repair Paint: **[MPI#18, MPI#19, or SSPC-Paint 20] [ASTM A 780]**.
- H. Shop Primer for Galvanized Steel: **[Cementitious galvanized metal primer complying with MPI#26] [Vinyl wash primer complying with MPI#80] [Water-based galvanized metal primer complying with MPI#134]**.

2.4 FABRICATION

- A. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.
- B. In addition to special care used to handle and fabricate AESS, comply with the following:
1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, and roughness.
 2. Grind sheared, punched, and flame-cut edges of **[Category 1]** <Insert categories> AESS to remove burrs and provide smooth surfaces and edges.
 3. Fabricate **[Category 1]** <Insert categories> AESS with exposed surfaces free of mill marks, including rolled trade names and stamped or raised identification.
 4. Fabricate **[Category 1 and Category 2]** <Insert categories> AESS with exposed surfaces free of seams to maximum extent possible.
 5. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
 6. Fabricate with piece marks fully hidden in the completed structure or made with media that permits full removal after erection.
 7. Fabricate **[Category 1]** <Insert categories> AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
 8. Fabricate **[Category 2 and Category 3]** <Insert categories> AESS to the tolerances specified in AISC 303 for steel that is not designated AESS.
 9. Seal-weld open ends of hollow structural sections with **3/8-inch** (9.5-mm) closure plates for **[Category 1]** <Insert categories> AESS.
- C. Curved Members: Fabricate indicated members to curved shape by rolling to final shape in fabrication shop.
1. Distortion of webs, stems, outstanding flanges, and legs of angles shall not be visible from a distance of **20 feet** (6 m) under any lighting conditions.
 2. Tolerances for walls of hollow steel sections after rolling shall be approximately **1/2 inch** (13 mm).
- D. Coping, Blocking, and Joint Gaps: Maintain uniform gaps of **1/8 inch** (3.2 mm) with a tolerance of **1/32 inch** (0.8 mm) for **[Category 1]** <Insert categories> AESS.
- E. Bolt Holes: Cut, drill, **[mechanically thermal cut]**, or punch standard bolt holes perpendicular to metal surfaces.
- F. Cleaning Corrosion-Resisting Structural Steel: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut

- bolt holes or enlarge holes by burning.
- 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
- 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.
- 4. Provide threaded nuts welded to framing, and any other specialty items as indicated to receive other work.

H. Expansion Joints: Provide expansion joints in steel shelf angles to match locations of expansion joints in structural steel frame.

2.5 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

- 1. Joint Type: [**Snug tightened**] [**Pretensioned**] [**Slip critical**].

B. Weld Connections: Reference Section 050510 "Welding" for general welding requirements. Comply with AWS D1.1/D1.1M[**and AWS D1.8/D1.8M**] for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work, and comply with the following:

- 1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding specified tolerances.
- 2. Use weld sizes, fabrication sequence, and equipment for AESS that limit distortions to allowable tolerances.
- 3. Provide continuous, sealed welds at angle to gusset-plate connections and similar locations where [**Category 1**] <Insert categories> AESS is exposed to weather.
- 4. Provide continuous welds of uniform size and profile where [**Category 1**] <Insert categories> AESS is welded.
- 5. Grind butt and groove welds flush to adjacent surfaces within tolerance of **plus 1/16 inch, minus 0 inch** (plus 1.5 mm, minus 0 mm) for [**Category 1 and Category 2**] <Insert categories> AESS.
- 6. Make butt and groove welds flush to adjacent surfaces within tolerance of **plus 1/16 inch, minus 0 inch** (plus 1.5 mm, minus 0 mm) for [**Category 1 and Category 2**] <Insert categories> AESS. Do not grind unless required for clearances or for fitting other components, or unless directed to correct unacceptable work.
- 7. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for [**Category 1 and Category 2**] <Insert categories> AESS.
- 8. At locations where welding on the far side of an exposed connection of [**Category 1 and Category 2**] <Insert categories> AESS occurs, grind distortions and marking of the steel to a smooth profile aligned with adjacent material.
- 9. Make fillet welds for [**Category 1 and Category 2**] <Insert categories> AESS oversize and grind to uniform profile with smooth face and transition.

10. Make fillet welds for [**Category 1 and Category 2**] <Insert categories> AESS of uniform size and profile with exposed face smooth and slightly concave. Do not grind unless directed to correct unacceptable work.

2.6 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
 1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
 2. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
 3. Galvanize [**lintels**] [**shelf angles**] attached to structural-steel frame and located in exterior walls.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of **2 inches** (50 mm).
 2. Surfaces to be field welded.
 3. Surfaces to be high-strength bolted with slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials.
 5. Galvanized surfaces.
- B. Surface Preparation[**for Nongalvanized Steel**]: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 1. SSPC-SP 2, "Hand Tool Cleaning."
 2. SSPC-SP 3, "Power Tool Cleaning."
 3. SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
 4. SSPC-SP 14/NACE No. 8, "Industrial Blast Cleaning."
 5. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
 6. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 7. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."
 8. SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."
 9. SSPC-SP 8, "Pickling."
- C. Preparing Galvanized Steel for Shop Priming: After galvanizing, thoroughly clean steel of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- D. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a

minimum dry film thickness of **1.5 mils** (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep AESS secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
 1. If possible, locate welded tabs for attaching temporary bracing and safety cabling where they will be concealed from view in the completed Work.
 2. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set AESS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
 1. Erect [**Category 1**] <Insert categories> AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
 2. Erect [**Category 2 and Category 3**] <Insert categories> AESS to the tolerances specified in AISC 303 for steel that is not designated AESS.
- B. Do not use thermal cutting during erection[**unless approved by DEN Project**

Manager. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M].

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: [**Snug tightened**] [**Pretensioned**] [**Slip critical**].
 2. Orient bolt heads [**as indicated on Drawings**] [**in same direction for each connection and to maximum extent possible in same direction for similar connections**].
- B. Weld Connections: Comply with requirements in "Weld Connections" Paragraph in "Shop Connections" Article. Reference Section 050510 "Welding" for general welding requirements.
1. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for [**Category 1 and Category 2**] <Insert categories> AESS.
 2. Remove erection bolts in [**Category 1 and Category 2**] <Insert categories> AESS, fill holes, and grind smooth.
 3. Fill weld access holes in [**Category 1 and Category 2**] <Insert categories> AESS and grind smooth.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect AESS as specified in Section 051200 "Structural Steel Framing." The testing agency will not be responsible for enforcing requirements relating to aesthetic effect.
- B. DEN Project Manager will observe all AESS in place to determine acceptability relating to aesthetic effect.

3.6 REPAIRS AND PROTECTION

- A. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Grind steel smooth.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.
- C. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
- D. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 051213

SECTION 052100 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. K-series steel joists.
2. KCS-type K-series steel joists.
3. K-series steel joist substitutes.
4. LH- and DLH-series long-span steel joists.
5. CJ-series composite steel joists.
6. Joist girders.
7. Joist accessories.

- B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing bearing plates in concrete.
2. Section 042000 "Unit Masonry" for installing bearing plates in unit masonry.
3. Section 050510 "Welding" for general welding requirements.
4. Section 051200 "Structural Steel Framing" for field-welded shear connectors.
5. Section 078100 "Applied Fireproofing" for spray-applied fireproofing requirements.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 DEFINITIONS

- A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables, and Weight Tables for Steel Joists and Joist Girders."
- B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.4 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's specifications and installation instructions for each type of joist and accessories. Include manufacturer's certification that joists comply with SJI "Specifications". Submit product data for primer.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Laboratory Test Reports for Credit EQ 4: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings:
 - 1. Include layout, designation, number, type, location, and spacing of joists.
 - 2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
 - 3. Provide templates, location drawings, and details of bearing plates and anchor bolts to be embedded in other construction.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For [manufacturer] [professional engineer].
- B. Welding certificates.
- C. Manufacturer certificates.
- D. Mill Certificates: For each type of bolt.
- E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications[.]" and "**Standard Specifications for Composite Steel Joists, CJ-Series**" in "**Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice.**"

1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
 - B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel." Reference Section 050510 "Welding" for general welding requirements.
 - C. Provide joists fabricated in compliance with the following, and as herein specified.
 1. Steel Joist Institute (SJI) "Standard Specifications, Load Tables and Weight Tables" for:
 - a. K Series Open Web Steel Joists
 - b. LH Series Longspan Steel Joists
 - c. DLH Series Deep Longspan Steel Joists
 - d. Joist Girders
 - D. Design of Members and the shop drawings shall be prepared under the direction of a Colorado registered professional engineer. Shop drawings and calculations shall be sealed by the Professional Engineer.
 - E. Members shall be clearly marked with the stated designation as shown on the shop drawings.
 - F. Inspection: Inspect joists and girders in accordance with SJI specifications.
 - G. Performance Test: If required by the DEN Project Manager, conduct performance tests in accordance with procedures described in SJI "Recommended Code of Standard Practice".
 - H. Paint Testing: Contractor to employ a independent testing laboratory to assure that all rust areas, etc., have been removed prior to priming and to test actual dry film paint thickness applied. One sample for each 600 lineal feet of joist. Submit written report.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Deliver, store, and handle joists as recommended in SJI's "Specifications[.]" and **"Standard Specifications for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice."**
 - B. Handle and store joists in a manner to avoid deforming members and to avoid excessive stresses. Materials shall be delivered to the worksite in the order they will be installed.
 - C. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.8 SEQUENCING

- A. Deliver steel bearing plates to be built into **[cast-in-place concrete] [and] [masonry]** construction.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
 - 1. Use **[ASD; data are given at service-load level] [LRFD; data are given at factored-load level]**.
 - 2. Design special joists to withstand design loads with live-load deflections no greater than the following:
 - a. Floor Joists: Vertical deflection of **[1/360] [1/240]** of the span.
 - b. Roof Joists: Vertical deflection of **[1/360] [1/240]** of the span.
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25] [50] [60] <Insert number>** percent.

2.2 K-SERIES STEEL JOISTS

- A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
 - 1. Joist Type: **[K-series steel joists] [and] [KCS-type K-series steel joists]**.
- B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
- C. Provide holes in chord members for connecting and securing other construction to joists.
 - 1. Deduct area of holes from the area of chord when calculating strength of member.

- D. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."
- E. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."
- F. Do not camber joists.
- G. Camber joists [**according to SJI's "Specifications."**] [**as indicated**] <Insert camber requirements>.
- H. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds **1/4 inch per 12 inches (1:48)**.
- I. End Anchorage: Provide end anchorages including bearing plates, to secure joists to adjacent construction, complying with SJI "Specifications", unless otherwise indicated.
- J. Header Units: Provide header units to support tail joists at openings in floor or roof system not framed with steel shapes.

2.3 LONG-SPAN STEEL JOISTS

- A. Manufacture steel joists according to "Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements [**as follows:**] [**as indicated.**]
 - 1. Joist Type: [**LH-series steel joists**] [**and**] [**DLH-series steel joists**].
 - 2. End Arrangement: [**Underslung**] [**Square**].
 - 3. Top-Chord Arrangement: [**Parallel**] [**Pitched 1/8 inch per 12 inches (1:96), one way**] [**Pitched 1/8 inch per 12 inches (1:96), two ways**] <Insert pitch>.
- B. Provide holes in chord members for connecting and securing other construction to joists.
 - 1. Deduct area of holes from the area of chord when calculating strength of member.
- C. Camber long-span steel joists [**according to SJI's "Specifications."**] [**as indicated**] <Insert camber requirements>.
- D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds **1/4 inch per 12 inches (1:48)**.
- E. End Anchorage: Provide end anchorages including bearing plates, to secure joists to adjacent construction, complying with SJI "Specifications", unless otherwise indicated.
- F. Header Units: Provide header units to support tail joists at openings in floor or roof system not framed with steel shapes.

2.4 COMPOSITE STEEL JOISTS

- A. Manufacture steel joists according to "Standard Specifications for Composite Steel Joists, CJ-Series" in SJI's "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice," with steel-angle top- and bottom-chord members and parallel top chord, and with **[underslung] [square]** ends.
- B. Camber composite steel joists **[as indicated]** <Insert camber requirements>.

2.5 JOIST GIRDERS

- A. Manufacture joist girders according to "Standard Specifications for Joist Girders" in SJI's "Specifications," with steel-angle top- and bottom-chord members; with end and top-chord arrangements **[as follows:] [as indicated.]**
 - 1. End Arrangement: **[Underslung] [Underslung with bottom-chord extensions] [Square]**.
 - 2. Top-Chord Arrangement: **[Parallel] [Pitched 1/8 inch per 12 inches (1:96), one way] [Pitched 1/8 inch per 12 inches (1:96), two ways]** <Insert pitch>.
- B. Provide holes in chord members for connecting and securing other construction to joist girders.
 - 1. Deduct area of holes from the area of chord when calculating strength of member.
- C. Camber joist girders **[according to SJI's "Specifications."] [as indicated]** <Insert camber requirements>.
- D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds **1/4 inch per 12 inches (1:48)**.
- E. End Anchorage: Provide end anchorages including bearing plates, to secure joists to adjacent construction, complying with SJI "Specifications", unless otherwise indicated.
- F. Header Units: Provide header units to support tail joists at openings in floor or roof system not framed with steel shapes.

2.6 PRIMERS

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

- C. Primer: Provide shop primer that complies with **[Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."]** **[Section 099600 "High-Performance Coatings."]**

2.7 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of **[horizontal] [or] [diagonal]** bridging of material, size, and type required by SJI's "Specifications"[**and "Standard Specifications for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice"**] for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications[.]"[**and "Standard Specifications for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice."**] Furnish additional erection bridging if required for stability.
- C. Bridging: Fabricate as indicated and according to SJI's "Specifications[.]"[**and "Standard Specifications for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice."**] Furnish additional erection bridging if required for stability.
- D. Fabricate steel bearing plates from ASTM A 36/A 36M steel with integral anchorages of sizes and thicknesses indicated. **[Shop prime paint] [Hot-dip zinc coat according to ASTM A 123/A 123M]**.
- E. Steel bearing plates with integral anchorages are specified in Section 055000 "Metal Fabrications."
- F. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within **1/2 inch (13 mm)** of finished wall surface unless otherwise indicated.
- G. Carbon-Steel Bolts and Threaded Fasteners: **ASTM A 307, Grade A** (ASTM F 568M, Property Class 4.6), carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.
1. Finish: **[Plain, uncoated] [Hot-dip zinc coating, ASTM A 153/A 153M, Class C] [Mechanically deposited zinc coating, ASTM B 695, Class 50]**.
- H. High-Strength Bolts, Nuts, and Washers: **ASTM A 325** (ASTM A 325M), Type 1, heavy hex steel structural bolts; **ASTM A 563** (ASTM A 563M) heavy hex carbon-steel nuts; and **ASTM F 436** (ASTM F 436M) hardened carbon-steel washers.
1. Finish: **[Plain] [Hot-dip zinc coating, ASTM A 153/A 153M, Class C] [Mechanically deposited zinc coating, ASTM B 695, Class 50]**.

- I. Welding Electrodes: Comply with AWS standards.
- J. Galvanizing Repair Paint: **[MPI#18, MPI#19, or SSPC-Paint 20] [ASTM A 780]**.
- K. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.
- L. Bedding Mortar: For joist ends bearing on concrete or masonry, provide bedding mortar as follows:
 - 1. Portland cement (ASTM C 150, Type I or Type III) and clean, uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum water required for placement and hydration.
 - 2. Nonmetallic shrinkage resistant mortar; premixed, non-corrosive, non-staining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents.
 - a. Subject to compliance with requirements, provide one of the following:
 - 1) Euco N.S.; Euclid Chemical Co
 - 2) Crystex; L&M Construction Chemicals
 - 3) Masterflow 713; Master Builders
 - 4) Five Star Grout; U.S. Grout Corp.
 - 5) Upcon; Upco Chem. Div., USM Corp.
 - 6) Propak; Protex Industries, Inc.
 - 7) **<Insert manufacturer's name?**
 - 8) or approved equal.

2.8 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by **[hand-tool cleaning, SSPC-SP 2] [or] [power-tool cleaning, SSPC-SP 3]**.
- B. Do not prime paint joists and accessories **[to receive sprayed fire-resistive materials]**. Reference Section 078100 "Applied Fireproofing" for requirements.
- C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than **1.5 mil (0.038 mm)** thick.
- D. Shop priming of joists and joist accessories is specified in **[Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."]** **[Section 099600 "High-Performance Coatings."]**

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Anchors: Furnish anchor bolts, bearing plates, and other devices to be built into concrete and masonry construction.
 - 1. Provide unfinished threaded fasteners for anchor bolts, unless otherwise indicated.
 - 2. Refer to Section 033000, "Cast-In-Place Concrete" for installation of anchors set in concrete.
- C. Placing Joists: Do not start placement of steel joists until supporting work is in place and secured and able to carry the construction loads. Place joists on supporting work, adjust and align in accurate locations, and spacing before permanently fastening.
 - 1. Provide temporary bridging, connections, and anchors to ensure lateral stability during construction.
 - a. Where "open web" joist lengths are 40 feet and longer, install a center row of bolted bridging to provide lateral stability before slackening of hoisting lines.
 - b. Temporary planking: Provide temporary planking, handrails, nets, anchorages, and working platforms as necessary to effectively and safely complete work.
- D. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJ's "Specifications,]"[" and "**Standard Specifications for Composite Steel Joists, CJ-Series**" in "**Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice,**]" joist manufacturer's written recommendations, approved shop drawings, and requirements in this Section.
 - 1. Before installation, splice joists delivered to Project site in more than one piece.
 - 2. Space, adjust, and align joists accurately in location before permanently fastening.
 - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.

4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.
- E. Field weld joists to supporting steel [**bearing plates**] [**and**] [**framework**]. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work. Field weld joists to supporting steel framework in accordance with SJI "Specifications" for type of joists used. Coordinate welding sequence and procedure with placing of joists.
- F. Bolt joists to supporting steel framework for temporary field erection procedures in accordance with SJI "Specifications" for type of joists used.
- G. Bolt joists to supporting steel framework using carbon-steel bolts.
- H. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with Research Council on Structural Connection's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.
- I. Provide unfinished threaded fasteners for bolted connections, unless otherwise required.
- J. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.
- K. Field Cutting: Field cutting is not allowed unless previously reviewed and approved by DEN Project Manager.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect [**field welds**] [**and**] [**bolted connections**] and to perform field tests and inspections and prepare test and inspection reports.
- B. Visually inspect field welds according to AWS D1.1/D1.1M.
 1. In addition to visual inspection, test field welds according to AWS D1.1/D1.1M and the following procedures, as applicable:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709.
 - c. Ultrasonic Testing: ASTM E 164.
 - d. Radiographic Testing: ASTM E 94.
- C. Visually inspect bolted connections.
- D. The DEN Project Manager may visually inspect joist installation including bolted and welded connections before work is closed in. Bolted and welded connections which do

not pass visual inspection shall be tested as specified in Section 051200 "Structural Steel Framing".

- E. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.
- F. Perform additional testing to determine compliance of corrected Work with specified requirements.

3.4 PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists[, **bearing plates,**] [**abutting structural steel,**] and accessories.
 - 1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.
 - 2. Remove all rust, runs or sags in paint by sanding and by wire brushing surfaces and clean with solvent and paint. All solvent or other foreign matter shall be removed prior to painting.
 - 3. Apply a compatible primer of same type as primer used on adjacent surfaces.
 - 4. Use same type of paint as used for shop painting and apply in minimum 1.5 mil thickness.
- C. Touchup Painting: Cleaning and touchup painting are specified in [**Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."**] [**Section 099600 "High-Performance Coatings."**]
- D. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work

described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 052100

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Roof deck.
2. Acoustical roof deck.
3. Cellular roof deck.
4. Acoustical cellular roof deck.
5. Composite floor deck.
6. Electrified cellular floor deck.
7. Noncomposite form deck.
8. Noncomposite vented form deck.

- B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 035216 "Lightweight Insulating Concrete" for lightweight insulating concrete fill over steel deck.
3. Section 050510 "Welding" for general welding requirements.
4. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
5. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
6. Section 099113 "Exterior Painting" for repair painting of primed deck and finish painting of deck.
7. Section 099123 "Interior Painting" for repair painting of primed deck and finish painting of deck.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, product, paint and primer indicated.

1. Provide test data for mechanical fasteners used in lieu of welding for fastening deck to supporting structures.
2. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Laboratory Test Reports for Credit EQ 4: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, closure strips, supplementary framing, reinforcing channels, pans, cant strips cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Powder-actuated mechanical fasteners. Powder-actuated fasteners to be used only if approved by DEN Project Manager.
2. Acoustical roof deck.

D. Evaluation Reports: For steel deck.

E. Field quality-control reports.

F. Submit bill of materials for all items needed to install the material listed in this section for the Project.

1.5 QUALITY ASSURANCE

A. Comply with the following:

1. American Iron and Steel Institute (AISI), "Specification for the Design of Cold Formed Steel Structural Members."

2. Steel Deck Institute (SDI), "Design Manual for Composite Decks, Form Decks, and Roof Decks."
 - B. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
 - C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel." Reference Section 050510 "Welding" for general welding requirements.
 - D. Electrical Raceway Units: Provide UL-labeled cellular floor-deck units complying with UL 209 and listed in UL's "Electrical Construction Equipment Directory" for use with standard header ducts and outlets for electrical distribution systems.
 - E. Underwriters' Label: Provide metal floor deck units listed in Underwriters' Laboratories "Fire Resistance Directory", with each deck unit bearing the UL label and marking for specific system detailed.
 - F. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
 - B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
 1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.
- 1.7 CONSTRUCTION WASTE MANAGEMENT
- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

- B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25] <Insert number> percent.
- D. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 ROOF DECK

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - 1. [ASC Profiles, Inc.; a Blue Scope Steel company.](#)
 - 2. [Canam United States; Canam Group Inc.](#)
 - 3. [CMC Joist & Deck.](#)
 - 4. [Consolidated Systems, Inc.; Metal Dek Group.](#)
 - 5. [Cordeck.](#)
 - 6. [DACS, Inc.](#)
 - 7. [Epic Metals Corporation.](#)
 - 8. [Marlyn Steel Decks, Inc.](#)
 - 9. [New Millennium Building Systems, LLC.](#)
 - 10. [Nucor Corp.; Vulcraft Group.](#)
 - 11. [Roof Deck, Inc.](#)
 - 12. [Valley Joist; Subsidiary of EBSCO Industries, Inc.](#)
 - 13. [Verco Manufacturing Co.](#)
 - 14. [Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.](#)
 - 15. <Insert manufacturer's name>.
 - 16. or approved equal.
- B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
 - 1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), [Grade 33 (230)] [Grade 40 (275)] [Grade 80 (550)] minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: [Manufacturer's standard] [Gray] [White] [Gray top surface with white underside].
 - 2. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), [Grade 33 (230)] [Grade 40 (275)] [Grade 80 (550)], [G60 (Z180)] [G90 (Z275)] zinc coating.

3. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), [Grade 33 (230)] [Grade 40 (275)] [Grade 80 (550)], G60 (Z180) zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: [Manufacturer's standard] [Gray] [White] [Gray top surface with white underside].
4. Aluminum-Zinc-Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Structural Steel (SS), Grade 33 (230) minimum, AZ50 (AZ150) aluminum-zinc-alloy coating.
5. Deck Profile: [As indicated] [Type NR, narrow rib] [Type IR, intermediate rib] [Type WR, wide rib] [Type 3DR, deep rib] [Long span].
6. Cellular Deck Profile: [As indicated] [Type WR, wide rib] [Type 3DR, deep rib] [Long span], with bottom plate.
7. Profile Depth: [As indicated] [1-1/2 inches (38 mm)] [2 inches (51 mm)] [3 inches (76 mm)] [4-1/2 inches (114 mm)] [6 inches (152 mm)] [7-1/2 inches (190 mm)].
8. Design Uncoated-Steel Thickness: [As indicated] [0.0295 inch (0.75 mm)] [0.0358 inch (0.91 mm)] [0.0474 inch (1.20 mm)] [0.0598 inch (1.52 mm)] [0.0747 inch (1.90 mm)].
9. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: [As indicated] [0.0358/0.0358 inch (0.91/0.91 mm)] [0.0358/0.0474 inch (0.91/1.20 mm)] [0.0474/0.0474 inch (1.20/1.20 mm)] [0.0474/0.0598 inch (1.20/1.52 mm)] [0.0598/0.0474 inch (1.52/1.20 mm)] [0.0598/0.0598 inch (1.52/1.52 mm)].
10. Span Condition: [As indicated] [Simple span] [Double span] [Triple span or more].
11. Side Laps: [Overlapped] [Interlocking seam] [Overlapped or interlocking seam at Contractor's option].

2.3 ACOUSTICAL ROOF DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. [ASC Profiles, Inc.; a Blue Scope Steel company.](#)
2. [Canam United States; Canam Group Inc.](#)
3. [CMC Joist & Deck.](#)
4. [Consolidated Systems, Inc.; Metal Dek Group.](#)
5. [Cordeck.](#)
6. [DACS, Inc.](#)
7. [Epic Metals Corporation.](#)
8. [Marlyn Steel Decks, Inc.](#)
9. [New Millennium Building Systems, LLC.](#)
10. [Nucor Corp.; Vulcraft Group.](#)
11. [Roof Deck, Inc.](#)
12. [Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.](#)
13. <Insert manufacturer's name>.
14. or approved equal.

- B. Acoustical Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), **[Grade 33 (230)] [Grade 40 (275)] [Grade 80 (550)]** minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: **[Manufacturer's standard] [Gray] [White] [Gray top surface with white underside]**.
 2. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), **[Grade 33 (230)] [Grade 40 (275)] [Grade 80 (550)]**, **[G60 (Z180)] [G90 (Z275)]** zinc coating.
 3. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), **[Grade 33 (230)] [Grade 40 (275)] [Grade 80 (550)]**, **G60 (Z180)** zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: **[Manufacturer's standard] [Gray] [White] [Gray top surface with white underside]**.
 4. Aluminum-Zinc-Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Structural Steel (SS), Grade **33 (230)** minimum, **AZ50 (AZ150)** aluminum-zinc-alloy coating.
 5. Deck Profile: **[As indicated] [Type WR, wide rib] [Type 3DR, deep rib] [Long span]**.
 6. Cellular Deck Profile: **[As indicated] [Type WR, wide rib] [Type 3DR, deep rib] [Long span]**, with bottom plate.
 7. Profile Depth: **[As indicated] [1-1/2 inches (38 mm)] [2 inches (51 mm)] [3 inches (76 mm)] [4-1/2 inches (114 mm)] [6 inches (152 mm)] [7-1/2 inches (190 mm)]**.
 8. Design Uncoated-Steel Thickness: **[As indicated] [0.0295 inch (0.75 mm)] [0.0358 inch (0.91 mm)] [0.0474 inch (1.20 mm)] [0.0598 inch (1.52 mm)]**.
 9. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: **[As indicated] [0.0358/0.0358 inch (0.91/0.91 mm)] [0.0358/0.0474 inch (0.91/1.20 mm)] [0.0474/0.0358 inch (1.20/0.91 mm)] [0.0474/0.0474 inch (1.20/1.20 mm)] [0.0474/0.0598 inch (1.20/1.52 mm)] [0.0598/0.0474 inch (1.52/1.20 mm)] [0.0598/0.0598 inch (1.52/1.52 mm)]**.
 10. Span Condition: **[As indicated] [Simple span] [Double span] [Triple span or more]**.
 11. Side Laps: **[Overlapped] [Interlocking seam] [Overlapped or interlocking seam at Contractor's option]**.
 12. Acoustical Perforations: **[Deck units with manufacturer's standard perforated vertical webs] [Cellular deck units with manufacturer's standard perforated flat-bottom plate welded to ribbed deck]**.
 13. Sound-Absorbing Insulation: Manufacturer's standard premolded roll or strip of glass or mineral fiber. **<Insert actual physical properties and thicknesses of insulation>**.
 - a. Factory install sound-absorbing insulation into cells of cellular deck.

b. Installation of sound-absorbing insulation is specified in Section <Insert Section number> "<Insert title of applicable roofing Section>."

14. Acoustical Performance: NRC [0.65] [0.75] [0.80] [0.85] [0.90], tested according to ASTM C 423.

2.4 COMPOSITE FLOOR DECK

A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

1. [ASC Profiles, Inc.; a Blue Scope Steel company.](#)
2. [Canam United States; Canam Group Inc.](#)
3. [CMC Joist & Deck.](#)
4. [Consolidated Systems, Inc.; Metal Dek Group.](#)
5. [Cordeck.](#)
6. [DACS, Inc.](#)
7. [Epic Metals Corporation.](#)
8. [Marlyn Steel Decks, Inc.](#)
9. [New Millennium Building Systems, LLC.](#)
10. [Nucor Corp.; Vulcraft Group.](#)
11. [Roof Deck, Inc.](#)
12. [Verco Manufacturing Co.](#)
13. [Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.](#)
14. <Insert manufacturer's name>.
15. or approved equal.

B. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:

1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), [Grade 33 (230)] [Grade 40 (275)] [Grade 80 (550)] minimum, with top surface phosphatized and unpainted and underside surface shop primed with manufacturers' standard [gray] [or] [white] baked-on, rust-inhibitive primer.
2. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230), [G30 (Z90)] [G60 (Z180)] [G90 (Z275)] zinc coating.
3. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230), [G30 (Z90)] [G60 (Z180)] zinc coating; with unpainted top surface and cleaned and pretreated bottom surface primed with manufacturer's standard [gray] [white] baked-on, rust-inhibitive primer.
4. Profile Depth: [1-1/2 inches (38 mm)] [2 inches (51 mm)] [3 inches (76 mm)] [As indicated].
5. Design Uncoated-Steel Thickness: [0.0295 inch (0.75 mm)] [0.0358 inch (0.91 mm)] [0.0474 inch (1.20 mm)] [0.0598 inch (1.52 mm)].
6. Span Condition: [As indicated] [Simple span] [Double span] [Triple span or more].

2.5 ELECTRIFIED CELLULAR FLOOR DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [Cordeck.](#)
 2. [HH Robertson Floor Systems; a CENTRIA company.](#)
 3. **<Insert manufacturer's name>.**
 4. or approved equal.
- B. Source Limitations for Electrified Cellular Floor Deck: Obtain cellular floor-deck units and compatible electrical components, such as preset inserts, activation kits, afterset inserts, service fittings, header ducts, and trench header ducts, from single manufacturer.
- C. Electrified Cellular Floor Deck: Fabricate steel-sheet cellular floor-deck panels, consisting of a ribbed top section welded to a lower flat-bottom sheet with interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck" in SDI Publication No. 31. Fabricate deck to the minimum section properties, width of panel, number and area of cells per panel indicated, and the following:
1. Cellular Deck Type: [**Composite**] [**Noncomposite**].
 2. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade **33** (230), [**G60 (Z180)**] [**G90 (Z275)**] zinc coating.
 3. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade **33** (230), **G60 (Z180)** zinc coating; with underside surface cleaned, pretreated, and primed with manufacturer's standard [**gray**] [**white**] baked-on, rust-inhibitive primer.
 4. Profile Depth: [**1-1/2 inches (38 mm)**] [**2 inches (51 mm)**] [**3 inches (76 mm)**] [**As indicated**].
 5. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: [**0.0358/0.0358 inch (0.91/0.91 mm)**] [**0.0358/0.0474 inch (0.91/1.20 mm)**] [**0.0358/0.0598 inch (0.91/1.52 mm)**] [**0.0474/0.0358 inch (1.20/0.91 mm)**] [**0.0474/0.0474 inch (1.20/1.20 mm)**] [**0.0474/0.0598 inch (1.20/1.52 mm)**] [**0.0598/0.0474 inch (1.52/1.20 mm)**] [**0.0598/0.0598 inch (1.52/1.52 mm)**].
 6. Span Condition: [**As indicated**] [**Simple span**] [**Double span**] [**Triple span or more**].
 7. Factory punch holes, of size and arrangement indicated, into each deck cell at preset inserts and header duct locations.

2.6 NONCOMPOSITE FORM DECK

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. [ASC Profiles, Inc.; a Blue Scope Steel company.](#)
 2. [Canam United States; Canam Group Inc.](#)
 3. [CMC Joist & Deck.](#)

4. [Consolidated Systems, Inc.; Metal Dek Group.](#)
 5. [Cordeck.](#)
 6. [DACS, Inc.](#)
 7. [Marlyn Steel Decks, Inc.](#)
 8. [New Millennium Building Systems, LLC.](#)
 9. [Nucor Corp.; Vulcraft Group.](#)
 10. [Roof Deck, Inc.](#)
 11. [Valley Joist; Subsidiary of EBSCO Industries, Inc.](#)
 12. [Verco Manufacturing Co.](#)
 13. [Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.](#)
 14. **<Insert manufacturer's name>.**
 15. or approved equal.
- B. Noncomposite Form Deck: Fabricate ribbed-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
1. Uncoated Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), [**Grade 33 (230)**] [**Grade 40 (275)**] [**Grade 80 (550)**] minimum.
 2. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), [**Grade 33 (230)**] [**Grade 40 (275)**] [**Grade 80 (550)**] minimum, with [**top and**] underside surface shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: [**Manufacturer's standard**] [**Gray**] [**White**] [**Gray top surface with white underside**].
 3. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), [**Grade 33 (230)**] [**Grade 40 (275)**] [**Grade 80 (550)**], [**G30 (Z90)**] [**G60 (Z180)**] [**G90 (Z275)**] zinc coating.
 4. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), [**Grade 33 (230)**] [**Grade 80 (550)**], **G60 (Z180)** zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: [**Manufacturer's standard**] [**Gray**] [**White**] [**Gray top surface with white underside**].
 5. Profile Depth: [**9/16 inch (14 mm)**] [**15/16 inch (24 mm)**] [**1-5/16 inches (33 mm)**] [**1-1/2 inches (38 mm)**].
 6. Design Uncoated-Steel Thickness: [**0.0149 inch (0.38 mm)**] [**0.0179 inch (0.45 mm)**] [**0.0239 inch (0.61 mm)**] [**0.0295 inch (0.75 mm)**] [**0.0358 inch (0.91 mm)**] [**0.0474 inch (1.20 mm)**] [**0.0598 inch (1.52 mm)**].
 7. Span Condition: [**As indicated**] [**Simple span**] [**Double span**] [**Triple span or more**].
 8. Side Laps: [**Overlapped**] [**Interlocking seam**] [**Overlapped or interlocking seam at Contractor's option**].

2.7 NONCOMPOSITE VENTED FORM DECK

A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

1. [ASC Profiles, Inc.; a Blue Scope Steel company.](#)
2. [Canam United States; Canam Group Inc.](#)
3. [CMC Joist & Deck.](#)
4. [Consolidated Systems, Inc.; Metal Dek Group.](#)
5. [Marlyn Steel Decks, Inc.](#)
6. [New Millennium Building Systems, LLC.](#)
7. [Nucor Corp.; Vulcraft Group.](#)
8. [Roof Deck, Inc.](#)
9. [Verco Manufacturing Co.](#)
10. [Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.](#)
11. **<Insert manufacturer's name>.**
12. or approved equal.

B. Noncomposite Vented Form Deck: Fabricate ribbed- and vented-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, and with the following:

1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), [**Grade 33 (230)**] [**Grade 40 (275)**] [**Grade 80 (550)**], [**G30 (Z90)**] [**G60 (Z180)**] [**G90 (Z275)**] zinc coating.
2. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), [**Grade 33 (230)**] [**Grade 80 (550)**], [**G30 (Z90)**] [**G60 (Z180)**] zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: [**Manufacturer's standard**] [**Gray**] [**White**] [**Gray top surface with white underside**].
3. Profile Depth: [**9/16 inch (14 mm)**] [**15/16 inch (24 mm)**] [**1-5/16 inches (33 mm)**] [**1-1/2 inches (38 mm)**].
4. Design Uncoated-Steel Thickness: [**0.0149 inch (0.38 mm)**] [**0.0179 inch (0.45 mm)**] [**0.0239 inch (0.61 mm)**] [**0.0295 inch (0.75 mm)**] [**0.0358 inch (0.91 mm)**] [**0.0474 inch (1.20 mm)**] [**0.0598 inch (1.52 mm)**].
5. Span Condition: [**As indicated**] [**Simple span**] [**Double span**] [**Triple span or more**].
6. Side Laps: [**Overlapped**] [**Interlocking seam**] [**Overlapped or interlocking seam at Contractor's option**].
7. Vent Slot Area: Manufacturer's standard vent slots providing [**1-1/2**] **<Insert number>** percent open area.

2.8 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, **No. 10 (4.8-mm)** minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of **33,000 psi (230 MPa)**, not less than **0.0359-inch (0.91-mm)** design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of **33,000 psi (230 MPa)**, of same material and finish as deck, and of thickness and profile **[indicated] [recommended by SDI Publication No. 31 for overhang and slab depth]**.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, **[0.0598 inch (1.52 mm)] [0.0747 inch (1.90 mm)]** thick, with factory-punched hole of **3/8-inch (9.5-mm)** minimum diameter.
- J. Flat Sump Plates: Single-piece steel sheet, **0.0747 inch (1.90 mm)** thick, of same material and finish as deck. For drains, cut holes in the field.
- K. Recessed Sump Pans: Single-piece steel sheet, **0.0747 inch (1.90 mm)** thick, of same material and finish as deck, with **3-inch- (76-mm-)** wide flanges and **[level] [sloped]** recessed pans of **1-1/2-inch (38-mm)** minimum depth. For drains, cut holes in the field.
- L. Galvanizing Repair Paint: **[ASTM A 780] [SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight]**.
- M. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.
- N. Acoustic Sound Barrier Closures: Manufacturer's standard mineral fiber closures.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FABRICATION

- A. General: Form deck units in lengths to span three or more supports, with flush, telescoped, or nested 2-inch laps at ends and interlocking or nested side laps, of metal thickness, depth, and properties as indicated on the drawings.
- B. Roof Deck Units: Provide deck configurations that comply with SDI "Specifications and Commentary for Steel Roof Deck."
- C. Acoustical Roof Deck Units:
 - 1. Single pan units: Single pan fluted units with vertical webs perforated with approximate 5/32 inch diameter holes staggered 3/8 inch o.c. Provide mineral fiber acoustical insulation strips of profile to fit void space between vertical ribs.
 - 2. Multiple pan cellular units: Composite units consisting of upper fluted section combined with lower flat plate section having interlocking side laps and approximate 5/32 inch perforations staggered on 3/8 inch centers under cells formed by upper unit. Provide mineral fiber acoustical insulation strips of profile to fit void space of each cell.
 - 3. Non Composite Steel Form Deck: Provide fluted sections of metal deck as permanent forms for reinforced concrete slabs.
- D. Composite Steel Floor Deck: Fabricate deck units with integral embossing or raised pattern to furnish mechanical bond with concrete slabs. Fabricate open beam deck units with fluted section having interlocking side laps.
- E. Metal Cover Plates: Fabricate metal cover plates for end abutting floor deck units of not less than same thickness as decking. Form to match contour of deck units and approximately 6 inches wide.
- F. Metal Closure Strips: Fabricate metal closure strips, for cell raceways and openings between decking and other construction, of not less than 0.045 inch min. (18 gage) sheet steel. Form to provide tight fitting closures at open ends of cells or flutes and sides of decking.

3.3 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
 - F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
 - G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
 - H. Do not place deck units on concrete supporting structure until concrete has cured and is dry.
 - I. Coordinate and cooperate with structural steel erector in locating decking bundles to prevent overloading of structural members.
 - J. Do not use floor deck units for storage or working platforms until permanently secured.
 - K. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
 - L. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.
 - M. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work.
 - N. Use welding washers where recommended by deck manufacturer.
 - O. Mechanical fasteners, either powder actuated or pneumatically driven, may be used in lieu of welding if approved by DEN Project Manager.
 1. Locate mechanical fasteners and install in accordance with deck manufacturer's instructions. Where decking will be used to contain fluid materials, such as fresh concrete, deck shall be placed so that fluid will not leak through or underneath.
 - P. Mechanically fasten side laps of adjacent deck units between supports, at intervals not exceeding 36 inches o.c., using self tapping No. 8 or larger machine screws.
 - Q. Keep the interiors of cells that will be used as raceways free of welds having sharp points or edges.
 - R. Cutting and Fitting: Cut and neatly fit deck units and accessories around other work projecting through or adjacent to the decking, as shown.
 - S. Reinforcement at Openings: Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking, and support of other work shown.

- T. Hanger Slots or Clips: Provide UL approved punched hanger slots between cells or flutes of lower element where floor deck units are to receive hangers for support of ceiling construction, air ducts, diffusers, or lighting fixtures.
1. Hanger clips designed to clip over male side lap joints of floor deck units may be used instead of hanger slots.
 2. Locate slots or clips at not more than 14 inches o.c. in both directions, not over 9 inches from walls at ends, and not more than 12 inches from walls at sides, unless otherwise indicated.
 3. Provide manufacturer's standard hanger attachment devices. Submit manufacturer's material data and instructions to DEN Project Manager for acceptance.
- U. Joint Covers: Provide galvanized metal joint covers at abutting ends and changes in direction of floor deck units, except where taped joints are required.
- V. Preparation: Clean top flange of beams to receive studs of all debris. Field weld studs to structural members after all steel framing, deck, and forms are in place. Install deck so that bottom plate or rib is in continuous contact with the surface to receive studs.
- W. Shear Stud Connector Capacity: Number of shear connectors indicated on Drawings is based on 100% of allowable capacity for shear connectors in normal weight or lightweight concrete as listed in the AISC Specification. Determine actual shear connector capacities by tests on each type of deck supplied and number of shear connectors required in each rib. If additional shear connectors are required due to decreases in capacity of shear connectors for type of deck and stud placement supplied, provide additional shear connectors at no additional cost to Owner.
- X. Installation: Install shear connectors in accordance with manufacturer's published instructions. Use only personnel and equipment authorized by deck manufacturer. Use through-deck shear connector welding where deck material thickness permits proper weld fusion to develop required connector capacity.
- Y. Shear stud testing is specified in Section 051200 "Structural Steel Framing".
- Z. Closure Strips: Provide metal closure strips at open uncovered ends and edges of roof decking and in voids between decking and other construction. Weld into position to provide a complete decking installation.
- AA. Provide flexible closure strips instead of metal closures, at Contractor's option, wherever their use will ensure complete closure. Install with adhesive in accordance with manufacturer's instructions.
- BB. Touch Up Painting: After decking installation, wire brush, clean, and paint scarred areas, welds, and rust spots on top and bottom surfaces of decking units and supporting steel members.
- CC. Touch up galvanized surfaces with galvanizing repair paint applied in accordance with manufacturer's instructions.

- DD. Touch up painted surfaces with same type of shop paint used on adjacent surfaces.
- EE. In areas where shop painted surfaces are to be exposed, apply touch up paint to blend into adjacent surfaces.

3.4 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than **1-1/2 inches (38 mm)** long, and as follows:
 - 1. Weld Diameter: **[5/8 inch (16 mm)]** , nominal, or elongated welds of equal strength.
 - 2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds **12 inches (305 mm) apart in the field of roof and 6 inches (150 mm) apart in roof corners and perimeter, based on roof-area definitions in FMG Loss Prevention Data Sheet 1-28 [as indicated]**, spaced one in each valley at every support, and at closer spacing where indicated.
 - 3. Weld Washers: Install weld washers at each weld location.
 - 4. Reference Section 050510 "Welding" for general welding requirements.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or **[18 inches (457 mm)] [36 inches (914 mm)]**, and as follows:
 - 1. Mechanically fasten with self-drilling, **No. 10 (4.8-mm-)** diameter or larger, carbon-steel screws.
 - 2. Mechanically clinch or button punch.
 - 3. Fasten with a minimum of **1-1/2-inch- (38-mm-)** long welds.
- C. Attach roof deck to support members parallel to deck span with 5/8" diameter welds or screws at 6" on center. Longitudinal joints between deck units shall be fastened together with 5/8" diameter weld or screws at 12"
- D. End Bearing: Install deck ends over supporting frame with a minimum end bearing of **1-1/2 inches (38 mm)**, with end joints as follows:
 - 1. End Joints: **[Lapped 2 inches (51 mm) minimum] [Butted] [Lapped 2 inches (51 mm) minimum or butted at Contractor's option]**.
- E. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and **[weld] [mechanically fasten]** flanges to top of deck. Space **[welds] [mechanical fasteners]** not more than **12 inches (305 mm)** apart with at least one **[weld] [fastener]** at each corner.
 - 1. Install reinforcing channels or zees in ribs to span between supports and **[weld] [or] [mechanically fasten]**.

- F. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. **[Weld] [or] [mechanically fasten]** to substrate to provide a complete deck installation.
 - 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
- G. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.
- H. Sound-Absorbing Insulation: Installation into topside ribs of deck as specified in Section **<Insert Section number> "<Insert title of applicable roofing Section>."**

3.5 FLOOR-DECK INSTALLATION

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 - 1. Weld Diameter: **[5/8 inch (16 mm)]**, nominal, or elongated welds of equal strength..
 - 2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of **12 inches (305 mm)** apart, or as indicated. .
 - 3. Weld Washers: Install weld washers at each weld location.
 - 4. Reference Section 050510 "Welding" for general welding requirements.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or **36 inches (914 mm)**, and as follows:
 - 1. Mechanically fasten with self-drilling, **No. 8 (4.0-mm-)** diameter or larger, carbon-steel screws.
 - 2. Mechanically clinch or button punch.
 - 3. Fasten with a minimum of **1-1/2-inch- (38-mm-)** long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of **[1-1/2 inches (38 mm)] <Insert dimension>**, with end joints as follows:
 - 1. End Joints: **[Lapped] [Butted] [Lapped or butted at Contractor's option]**.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.
- E. Revise "Floor-Deck Closures" Paragraph below to suit Project. Sealing cellular deck openings, butt joints, and junctions with trench headers with tape is not included in this Section. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

- F. Electrified Cellular Floor Deck: Install cellular floor system with deck assembled from **[all-cellular units] [alternating cellular units with noncellular composite units] [units indicated]**.
1. Coordinate layout and installation of trench headers, preset inserts, duct fittings, and other components specified in Section 260539 "Underfloor Raceways for Electrical Systems" with installation of electrified cellular metal floor deck.
- G. Install piercing hanger tabs at **[14 inches (355 mm)] <Insert spacing>** apart in both directions, within **9 inches (228 mm)** of walls at ends, and not more than **12 inches (305 mm)** from walls at sides unless otherwise indicated.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
1. Testing agency shall conduct and interpret inspections and tests and state in written reports all findings and conclusions with reference made to specific deck location, date, ambient conditions, and specific reasons for acceptance, or deviations.
 2. Steel deck shall be inspected and accepted per the "AWS-Sheet Welding Specifications".
- B. Field welds will be subject to inspection. Any steel deck welded connection which is not acceptable per these specifications shall be repaired with screw connections at the ratio of two (2) #8 minimum screws for each deficient weld.
- C. Testing agency will report inspection results promptly and in writing to Contractor and DEN Project Manager.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.7 PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on **[both surfaces] [top surface]** of prime-painted deck immediately after installation, and apply repair paint.
1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- D. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Load-bearing wall framing.
2. Exterior non-load-bearing wall framing.
3. Floor joist framing.
4. Roof rafter framing.
5. Ceiling joist framing.
6. Soffit framing.

B. Related Requirements:

1. Section 050510 "Welding" for general welding requirements.
2. Section 055000 "Metal Fabrications" for masonry shelf angles and connections.
3. Section 092216 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.
4. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.
5. Section 092216 "Non-Structural Metal Framing" for steel framing for gypsum board and plaster partitions and ceilings.
6. Section 092900 "Gypsum Board" for interior gypsum board, exterior gypsum board for ceilings and soffits, and tile backing boards.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of cold-formed steel framing product and accessory.

1. Include data substantiating that materials comply with requirements.
 - B. LEED Submittals:
 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - C. Shop Drawings:
 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
 - D. Samples: Submit one foot long sample of each type of stud, head and runner channels, expansion head track, fasteners, anchors, and accessories.
 - E. Certificate from manufacturer stating that all materials are per Contract requirements and providing proof of minimum five (5) years experience manufacturing products required of similar size.
 - F. Certificate from installer evidencing a minimum five (5) years successful experience installing this type of work on projects.
 - G. Mock-ups: Provide mock-ups of components of this section as follows:
 1. **<Insert requirements for mockups>**
 - H. Structural calculation signed and stamped by a structural engineer registered in the State of Colorado.
 - I. Delegated-Design Submittal: For cold-formed steel framing.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For testing agency.
 - B. Welding certificates.
 - C. Product Test Reports: For each listed product, for tests performed by **[manufacturer and witnessed by a qualified testing agency] [a qualified testing agency]**.
 1. Steel sheet.
 2. Expansion anchors.
 3. **[Powder actuated fasteners]**
 4. Mechanical fasteners.

5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

D. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Product Tests: Mill certificates or data from a qualified independent testing agency[, **or in-house testing with calibrated test equipment**] indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
 3. Reference Section 050510 "Welding" for general welding requirements.
- D. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."
- E. Component Design: Calculate structural properties of studs and joists in accordance with American Iron and Steel Institute (AISI) "Specification for Design of Cold Formed Steel Structural Members".
- F. Fire Rated Assemblies: Where framing units are components of assemblies indicated for a fire resistance rating, including those required for compliance with governing regulations, provide units which have been approved by governing authorities having jurisdiction.
- G. Pre-installation conference: Prior to installation of Work, meet at the project site or other mutually agreed location with installer, contractor, DEN Project Manager, DEN Structural Engineer and other job related contractors including representatives of curtain wall installer and preformed siding installer.
- H. Warranty: Installer to warrant system for two (2) years, including framing and finish.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.
- B. Deliver to project site in manufacturer's unopened containers or bundles, fully identified with name, brand, type, and grade. Store off ground in a dry ventilated space or protect with breathable waterproof tarpaulins.

1.8 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alabama Metal Industries Corp.
2. AllSteel & Gypsum Products, Inc.
3. American Studco, Inc.
4. Bostwick Steel Framing Co.
5. California Expanded Metal Products Company (CEMCO).
6. Clark Western Building Systems, Inc.
7. Consolidated Fabricators Corp.; Building Products Division.
8. Consolidated Systems, Inc.
9. Craco Manufacturing, Inc.
10. Custom Stud, Inc.
11. Dale Industries Inc.
12. Design Shapes in Steel.
13. Dietrich Metal Framing; a Worthington Industries Company.
14. Formetal Co. Inc. (The).
15. Marino/WARE.
16. Milcor Division, Inryco Inc.
17. MBA Building Supplies, Inc.
18. Olmar Supply, Inc.
19. Quail Run Building Materials, Inc.
20. SCAFECO Corporation.
21. Southeastern Stud & Components, Inc.
22. State Building Products, Inc.
23. Steel Construction Systems.
24. Steel Structural Systems.
25. Steeler, Inc.
26. Super Stud Building Products, Inc.
27. Telling Industries, LLC.
28. The Steel Network, Inc.
29. United Metal Products, Inc.
30. U.S. Gypsum Co.
31. United Steel Manufacturing
32. Western Metal
33. **<Insert manufacturer's name>**
34. or approved equal.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
1. Design Loads: **[As indicated.] <Insert design loads>**.
 2. Deflection Limits: Design framing systems to withstand **[design loads]** without deflections greater than the following:
 - a. Exterior Load-Bearing Wall Framing: Horizontal deflection of **[1/240] [1/360] [1/600] [1/720]** of the wall height.
 - b. Interior Load-Bearing Wall Framing: Horizontal deflection of **[1/240] [1/360]** of the wall height under a horizontal load of **5 lbf/sq. ft. (239 Pa)**.
 - c. Exterior Non-Load-Bearing Framing: Horizontal deflection of **[1/240] [1/360] [1/600] [1/720] <Insert ratio>** of the wall height.
 - d. Floor Joist Framing: Vertical deflection of **[1/360] [1/480]** for live loads and **l/360** for total loads of the span.
 - e. Roof Rafter Framing: Horizontal deflection of **[1/240] [1/360]** of the horizontally projected span.
 - f. Ceiling Joist Framing: Vertical deflection of **[1/240] [1/360]** of the span.
 - g. **<Insert deflection limits.>**
 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of **120 deg F (67 deg C)**.
 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of **[1/2 inch (13 mm)] [3/4 inch (19 mm)] [1 inch (25 mm)] [1-1/2 inches (38 mm)]**.
 5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold-Formed Steel Framing Design Standards:
1. Floor and Roof Systems: AISI S210.
 2. Wall Studs: AISI S211.
 3. Headers: AISI S212.
 4. Lateral Design: AISI S213.
- D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

- E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.3 COLD-FORMED STEEL FRAMING, GENERAL

- A. System Components: With each type of metal framing required, provide manufacturer's standard steel runners (tracks), blocking, lintels, clip angles, shoes, reinforcements, fasteners, and accessories as recommended by manufacturer for applications indicated, as needed to provide a complete metal framing system.
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25] <Insert number>** percent.
- C. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 - 1. Grade: **[ST33H (ST230H)] [ST50H (ST340H)] [As required by structural performance] <Insert grade>**.
 - 2. Coating: **[G60 (Z180), A60 (ZF180), AZ50 (AZ150), or GF30 (ZGF90)] [G90 (Z275) or equivalent] <Insert coating weight>**.
- D. Steel Sheet for [Vertical Deflection] [Drift] Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: **[33 (230)] [50 (340), Class 1 or 2] [As required by structural performance]**.
 - 2. Coating: **[G60 (Z180)] [G90 (Z275)]**.
- E. Finish of installation accessories to match that of main framing components, unless otherwise indicated.
- F. Fasteners: Provide nuts, bolts washers, screws, and other fasteners with corrosion-resistant plated finish.
- G. Electrodes for Welding: Comply with AWS Code and as recommended by stud manufacturer, and only as allowed by DEN Project Manager. Reference Section 050510 "Welding" for general welding requirements.
- H. Galvanizing Repair: Where galvanized surfaces are damaged, prepare surfaces and repair in accordance with procedures specified in ASTM A 780.

2.4 LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: [0.0428 inch (1.09 mm)] [0.0538 inch (1.37 mm)] [0.0677 inch (1.72 mm)] [0.0966 inch (2.45 mm)].
 2. Flange Width: [1-5/8 inches (41 mm)] [2 inches (51 mm)] [2-1/2 inches (63 mm)].
 3. Section Properties: **<Insert minimum allowable calculated section modulus, moment of inertia, and allowable moment.>**
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
1. Minimum Base-Metal Thickness: [0.0428 inch (1.09 mm)] [0.0538 inch (1.37 mm)] [0.0677 inch (1.72 mm)] [0.0966 inch (2.45 mm)] **[Matching steel studs]**.
 2. Flange Width: [1-1/4 inches (32 mm)] **<Insert dimension if manufacturer's standard width is insufficient>**.
- C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: [0.0428 inch (1.09 mm)] [0.0538 inch (1.37 mm)] [0.0677 inch (1.72 mm)] [0.0966 inch (2.45 mm)].
 2. Flange Width: [1-5/8 inches (41 mm)] [2 inches (51 mm)] [2-1/2 inches (63 mm)].
 3. Section Properties: **<Insert minimum allowable calculated section modulus, moment of inertia, and allowable moment.>**
- D. Steel Single- or Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths indicated, and as follows:
1. Minimum Base-Metal Thickness: [0.0428 inch (1.09 mm)] [0.0538 inch (1.37 mm)] [0.0677 inch (1.72 mm)] [0.0966 inch (2.45 mm)].
 2. Top Flange Width: [1-5/8 inches (41 mm)] [2 inches (51 mm)] [2-1/2 inches (63 mm)].
 3. Section Properties: **<Insert minimum allowable calculated section modulus, moment of inertia, and allowable moment.>**

2.5 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: [0.0428 inch (1.09 mm)] [0.0538 inch (1.37 mm)] [0.0677 inch (1.72 mm)] [0.0966 inch (2.45 mm)].
 2. Flange Width: [1-5/8 inches (41 mm)] [2 inches (51 mm)] [2-1/2 inches (63 mm)].
 3. Section Properties: **<Insert minimum allowable calculated section modulus, moment of inertia, and allowable moment.>**
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: [0.0428 inch (1.09 mm)] [0.0538 inch (1.37 mm)]

- [0.0677 inch (1.72 mm)] [0.0966 inch (2.45 mm)] [Matching steel studs].
2. Flange Width: [1-1/4 inches (32 mm)] <Insert dimension if manufacturer's standard width is insufficient>.
- C. Vertical Deflection Clips: Manufacturer's standard [bypass] [head] clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AllSteel & Gypsum Products, Inc.
 - b. ClarkWestern Bulding Systems, Inc.
 - c. Dietrich Metal Framing; a Worthington Industries Company.
 - d. Marino/WARE.
 - e. SCAFCO Corporation
 - f. Steeler, Inc.
 - g. The Steel Network, Inc.
 - h. <Insert manufacturer's name>
 - i. or approved equal.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
1. Minimum Base-Metal Thickness: [0.0428 inch (1.09 mm)] [0.0538 inch (1.37 mm)] [0.0677 inch (1.72 mm)] [0.0966 inch (2.45 mm)].
 2. Flange Width: [1 inch (25 mm) plus the design gap for 1-story structures] [and] [1 inch (25 mm) plus twice the design gap for other applications] <Insert dimension>.
- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - a. Minimum Base-Metal Thickness: [0.0428 inch (1.09 mm)] [0.0538 inch (1.37 mm)] [0.0677 inch (1.72 mm)] [0.0966 inch (2.45 mm)].
 - b. Flange Width: [1 inch (25 mm) plus the design gap for 1-story structures] [and] [1 inch (25 mm) plus twice the design gap for other applications] <Insert dimension>.
 2. Inner Track: Of web depth indicated, and as follows:
 - a. Minimum Base-Metal Thickness: [0.0428 inch (1.09 mm)] [0.0538 inch (1.37 mm)] [0.0677 inch (1.72 mm)] [0.0966 inch (2.45 mm)].

- b. Flange Width: <Insert dimension equal to sum of outer deflection track flange width plus 1 inch (25 mm).>

- F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure.

2.6 FLOOR JOIST FRAMING

- A. Steel Joists: Manufacturer's standard C-shaped steel joists, of web depths indicated, [unpunched,] [punched,] [punched, with enlarged service holes,] with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: [0.0428 inch (1.09 mm)] [0.0538 inch (1.37 mm)] [0.0677 inch (1.72 mm)] [0.0966 inch (2.45 mm)].
2. Flange Width: [1-5/8 inches (41 mm)] [2 inches (51 mm)] [2-1/2 inches (63 mm)], minimum.
3. Section Properties: <Insert minimum allowable calculated section modulus, moment of inertia, and allowable moment.>

- B. Steel Joist Track: Manufacturer's standard U-shaped steel joist track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: [0.0428 inch (1.09 mm)] [0.0538 inch (1.37 mm)] [0.0677 inch (1.72 mm)] [0.0966 inch (2.45 mm)] [Matching steel joists].
2. Flange Width: [1-1/2 inches (38 mm)] [2 inches (51 mm)], minimum.

2.7 ROOF-RAFTER FRAMING

- A. Steel Rafters: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: [0.0428 inch (1.09 mm)] [0.0538 inch (1.37 mm)] [0.0677 inch (1.72 mm)] [0.0966 inch (2.45 mm)].
2. Flange Width: [1-5/8 inches (41 mm)] [2 inches (51 mm)] [2-1/2 inches (63 mm)], minimum.
3. Section Properties: <Insert minimum allowable calculated section modulus, moment of inertia, and allowable moment.>

2.8 CEILING JOIST FRAMING

- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, [unpunched,] [punched with enlarged service holes,] [punched with standard holes,] with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: [0.0428 inch (1.09 mm)] [0.0538 inch (1.37 mm)] [0.0677 inch (1.72 mm)] [0.0966 inch (2.45 mm)].
2. Flange Width: [1-5/8 inches (41 mm)] [2 inches (51 mm)] [2-1/2 inches (63 mm)], minimum.

3. Section Properties: **<Insert minimum allowable calculated section modulus, moment of inertia, and allowable moment.>**

2.9 SOFFIT FRAMING

- A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
 1. Minimum Base-Metal Thickness: [0.0428 inch (1.09 mm)] [0.0538 inch (1.37 mm)] [0.0677 inch (1.72 mm)] [0.0966 inch (2.45 mm)].
 2. Flange Width: [1-5/8 inches (41 mm)] [2 inches (51 mm)] [2-1/2 inches (63 mm)], minimum.
 3. Section Properties: **<Insert minimum allowable calculated section modulus, moment of inertia, and allowable moment.>**

2.10 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 1. Supplementary framing.
 2. Bracing, bridging, and solid blocking.
 3. Web stiffeners.
 4. Anchor clips.
 5. End clips.
 6. Foundation clips.
 7. Gusset plates.
 8. Stud kickers and knee braces.
 9. Joist hangers and end closures.
 10. Hole reinforcing plates.
 11. Backer plates.

2.11 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- B. Anchor Bolts: ASTM F 1554, Grade [36] [55], threaded carbon-steel [hex-headed bolts] [headless, hooked bolts] [headless bolts, with encased end threaded,] and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by [hot-dip process according to ASTM A 153/A 153M, Class C] [mechanically deposition according to ASTM B 695, Class 50].

- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
- D. Powder-Actuated Anchors: Powder-actuated anchors are not permitted and shall not be used.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

2.12 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: [**SSPC-Paint 20 or MIL-P-21035**] [**ASTM A 780**].
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, Portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.
- D. Shims: Load bearing, high-density multimonomer plastic, nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.
- E. Sealer Gaskets: Closed-cell neoprene foam, **1/4 inch** (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.13 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding

- work.
- b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of **1/8 inch in 10 feet** (1:960) and as follows:
1. Spacing: Space individual framing members no more than plus or minus **1/8 inch** (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of **1/8 inch** (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.
- C. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than **1/4 inch** (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.

- D. Install sealer gaskets at the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Reference Section 050510 "Welding" for general welding requirements.
- B. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- C. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.
- D. Powder-actuated fasteners are not permitted and shall not be used.
- E. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding **1/16 inch** (1.6 mm).
- F. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- G. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- H. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- I. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- J. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

- K. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
- L. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of **1/8 inch in 10 feet** (1:960) and as follows:
1. Space individual framing members no more than plus or minus **1/8 inch** (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 2. Bolt or weld wall panels (at both horizontal and vertical junctures) to produce flush, even, true to line joints.
 3. Step in face and jog in alignment between panels not to exceed 1/16".
- M. Runner Tracks: Install continuous tracks sized to match studs unless otherwise noted. Align tracks accurately to layout at base and tops of studs. Secure tracks as recommended by stud manufacturer for type of construction involved, except do not exceed 24" o.c. spacing for fasteners, or 16" o.c. for other types of attachment. Provide fasteners at corners and ends of tracks.
- N. Where stud system abuts structural columns or walls, including masonry walls, anchor ends of stiffeners to supporting structure.
- O. Install supplementary framing, blocking and bracing in metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim railings and furnishings, and similar work requiring attachment to the wall or partition.
1. Where type of supplementary support is not otherwise indicated, comply with stud manufacturer's recommendations and industry standards in each case, considering weight or loading resulting from item supported. Provide horizontal stiffeners in stud system at 4'-6" O.C.
- P. Installation of Wall Stud System: Secure studs to top and bottom runner tracks by either welding or screw fastening at both inside and outside flanges. Provide head slip connection.
- Q. Frame wall openings larger than 2' 0" square with double stud at each jamb of frame except where more than 2 are either shown or indicated in manufacturer's instructions. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with stud shoes or by welding, and space jack studs same as full height studs of wall. Secure stud system wall opening frame in manner indicated.
- R. Frame both sides of expansion and control joints, with separate studs; do not bridge the joint with components of stud system.
- S. Install horizontal stiffeners in stud system, spaced (vertical distance) at not more than 4' 6" o.c. Weld at each intersection.
- T. Field Painting: Touch up shop applied protective coatings damaged during handling and installation. Use compatible primer for prime coated surfaces; use galvanizing

repair paint for galvanized surfaces.

3.4 LOAD-BEARING WALL INSTALLATION

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
1. Anchor Spacing: [24 inches (610 mm)] [32 inches (813 mm)] [To match stud spacing] [As shown on Shop Drawings].
- B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch (3 mm) between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
1. Stud Spacing: [12 inches (305 mm)] [16 inches (406 mm)] [19.2 inches (488 mm)] [24 inches (610 mm)] [As indicated].
 2. Stud Spacing: [300 mm] [400 mm] [600 mm] [As indicated].
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- E. Align floor and roof framing over studs in accordance with AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.
- G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
 2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

- I. Install horizontal bridging in stud system, spaced vertically [48 inches (1220 mm)] [as indicated] [as indicated on Shop Drawings]. Fasten at each stud intersection.
 - 1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of 2 screws into each flange of the clip angle for framing members up to 6 inches (150 mm) deep.
 - 2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - 3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.
- K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to [top and] bottom track, unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: [12 inches (305 mm)] [16 inches (406 mm)] [19.2 inches (488 mm)] [24 inches (610 mm)] [As indicated].
 - 2. Stud Spacing: [300 mm] [400 mm] [480 mm] [600 mm] [As indicated].
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Install single deep-leg deflection tracks and anchor to building structure.
 - 2. Install double deep-leg deflection tracks and anchor outer track to building structure.
 - 3. Connect vertical deflection clips to [bypassing] [infill] studs and anchor to building structure.
 - 4. Connect drift clips to cold formed metal framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.

1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within [12 inches (305 mm)] [18 inches (450 mm)] of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
 - a. Install solid blocking at [96-inch (2440-mm) centers] [centers indicated] [centers indicated on Shop Drawings].
 2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 4. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 JOIST INSTALLATION

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
 1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm).
 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.
- C. Space joists not more than 2 inches (51 mm) from abutting walls, and as follows:
 1. Joist Spacing: [12 inches (305 mm)] [16 inches (406 mm)] [19.2 inches (488 mm)] [24 inches (610 mm)] [As indicated].
 2. Joist Spacing: [300 mm] [400 mm] [480 mm] [600 mm] [As indicated].
- D. Frame openings with built-up joist headers consisting of joist and joist track, or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated [on Shop Drawings].
 1. Install web stiffeners to transfer axial loads of walls above.

- F. Install bridging at intervals indicated[**on Shop Drawings**]. Fasten bridging at each joint intersection as follows:
 - 1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
 - 2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
- G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.7 FIELD QUALITY CONTROL

- A. Testing: [**Owner will**] Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and DEN Project Manager.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement will be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the lump sum contract price.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Steel framing and supports for ceiling-hung toilet compartments.
2. Steel framing and supports for operable partitions.
3. Steel framing and supports for overhead **[doors] [and] [grilles]**.
4. Steel framing and supports for countertops.
5. Steel framing and supports for mechanical and electrical equipment.
6. Steel framing and supports for applications where framing and supports are not specified in other Sections.
7. Steel framing and supports (outriggers) for window-washing equipment including **[mounting brackets] [and] [anchorages]**.
8. **[Mounting brackets] [and] [anchorages]** for window-washing equipment.
9. Elevator machine beams[, **hoist beams,**] **[and] [divider beams]**.
10. Steel shapes for supporting elevator doorsills.
11. Steel girders for supporting wood frame construction.
12. Steel pipe columns for supporting wood frame construction.
13. Steel handrails and guardrails that are not part of or associated with steel stairs.
14. Overhead supports and bracing for toilet partitions and other suspended work.
15. Equipment supports.
16. Equipment screen framing.
17. Formed steel channel support (unistrut) framing.
18. Prefabricated building columns.
19. Shelf angles.
20. Metal ladders.
21. Ladder safety cages.
22. Alternating tread devices.
23. Metal **[ships ladders] and [pipe crossovers]**.
24. Metal floor plate[**and supports]**.
25. Structural-steel door frames.
26. Miscellaneous steel trim including **[steel angle corner guards] [steel edgings] [and] [loading-dock edge angles]**.
27. Metal bollards.
28. **[Pipe] [Downspout]** guards.
29. Abrasive metal **[nosings] [treads] [and] [thresholds]**.

30. Cast-iron wheel guards.
31. Metal downspout boots.
32. Loose bearing and leveling plates for applications where they are not specified in other Sections.
33. Other miscellaneous, non-structural framing as shown on the drawings or required for the bracing or support of the work of other Sections.
34. Anchors, fasteners, and related hardware or accessories required for the installation of work specified herein.

B. Products furnished, but not installed, under this Section:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Sections:

1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
3. Section 050510 "Welding" for general welding requirements.
4. Section 051200 "Structural Steel Framing."
5. Section 055100 "Metal Stairs."
6. Section 055213 "Pipe and Tube Railings."
7. Section 055300 "Metal Gratings."
8. Section 057000 "Decorative Metal."
9. Section 057300 "Decorative Metal Railings."
10. Section 059990 "Welding".
11. Section 329300 "Plants" for tree grates.

D. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design ladders, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance of Aluminum Ladders: Aluminum ladders[, **including landings,**] shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

- C. Structural Performance of Alternating Tread Devices: Alternating tread devices shall withstand the effects of loads and stresses within limits and under conditions specified in ICC's International Building Code.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Formed steel channel support (unistrut) framing.
 - 2. Nonslip aggregates and nonslip-aggregate surface finishes.
 - 3. Prefabricated building columns.
 - 4. Metal nosings and treads.
 - 5. Paint products.
 - 6. Grout.
 - 7. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Laboratory Test Reports for Credit IEQ 4: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Show fabrication and installation details for metal fabrications.
 - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- D. Samples for Verification: For each type and finish of extruded **[nosing] [and] [tread] [insert product]**.
- E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.
- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6, "Structural Welding Code - Stainless Steel."
- C. Handrails and Guardrails: Rails must be capable of resisting a uniform lateral load of 50 plf applied horizontally to the top rail, plus a concentrated load of 200 lbs applied at any point in any direction, and comply with all requirements of current applicable building codes.
- D. Structural Design: Provide the services of a professional engineer registered in the State of Colorado to design all handrails and guardrails.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.9 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

- B. Coordinate installation of anchorages[**and steel weld plates and angles for casting into concrete**]. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Storage: Store materials and fabrications in protected areas. Protect from rusting or other damage.
- B. Identification: Properly identify all items or components, including bolts or other loose materials and accessories. Leave manufacturer's labels or tags intact on manufactured products.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Fasteners, General:
 - 1. Use same material and finish as parts being joined, except use stainless steel between dissimilar metals and non-corrosive fasteners at exterior connections or joints.
 - 2. Provide fasteners of sufficient strength to support connected members and loads, and to develop full strength of parts fastened or connected.

2.2 FERROUS METALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25] <Insert number> percent.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, [Type 304] [Type 316L].

- D. Stainless-Steel Bars and Shapes: ASTM A 276, **[Type 304] [Type 316L]**.
- E. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- F. Rolled-Stainless-Steel Floor Plate: ASTM A 793.
- G. Abrasive-Surface Floor Plate: Steel plate **[with abrasive granules rolled into surface] [or] [with abrasive material metallically bonded to steel]**.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. IKG Industries, a division of Harsco Corporation; Mebac.
 - b. SlipNOT Metal Safety Flooring, a W. S. Molnar company; SlipNOT.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
- H. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- I. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.
- J. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
1. Size of Channels: **[1-5/8 by 1-5/8 inches (41 by 41 mm)] [As indicated] <Insert size>**.
 2. Material: Galvanized steel, ASTM A 653/A 653M, **[commercial steel, Type B] [structural steel, Grade 33 (Grade 230)]**, with **G90 (Z275)** coating; **[0.108-inch (2.8-mm)] [0.079-inch (2-mm)] [0.064-inch (1.6-mm)]** nominal thickness.
 3. Material: Cold-rolled steel, ASTM A 1008/A 1008M, **[commercial steel, Type B] [structural steel, Grade 33 (Grade 230)]**; **[0.0966-inch (2.5-mm)] [0.0677-inch (1.7-mm)] [0.0528-inch (1.35-mm)]** minimum thickness; **[unfinished] [coated with rust-inhibitive, baked-on, acrylic enamel] [hot-dip galvanized after fabrication]**.
- K. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- 2.3 NONFERROUS METALS
- A. Aluminum Plate and Sheet: **ASTM B 209** (ASTM B 209M), Alloy 6061-T6.
- B. Aluminum Extrusions: **ASTM B 221** (ASTM B 221M), Alloy 6063-T6.
- C. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- D. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

- E. Bronze Plate, Sheet, Strip, and Bars: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper).
- F. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (extruded architectural bronze).
- G. Bronze Castings: ASTM B 584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).
- H. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500.
- I. Nickel Silver Castings: ASTM B 584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

2.4 FASTENERS

- A. General: Unless otherwise indicated, provide **[Type 304]** **[Type 316]** stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or **ASTM F 1941** (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
 - 2. Provide stainless-steel fasteners for fastening stainless steel.
 - 3. Provide stainless-steel fasteners for fastening nickel silver.
 - 4. Provide bronze fasteners for fastening bronze.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, **ASTM A 307, Grade A** (ASTM F 568M, Property Class 4.6); with hex nuts, **ASTM A 563** (ASTM A 563M); and, where indicated, flat washers.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, **ASTM A 325, Type 3** (ASTM A 325M, Type 3); with hex nuts, **ASTM A 563, Grade C3** (ASTM A 563M, Class 8S3); and, where indicated, flat washers.
- D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, **ASTM F 593** (ASTM F 738M); with hex nuts, **ASTM F 594** (ASTM F 836M); and, where indicated, flat washers; Alloy **[Group 1 (A1)]** **[Group 2 (A4)]**.
- E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Eyebolts: ASTM A 489.
- G. Machine Screws: **ASME B18.6.3** (ASME B18.6.7M).
- H. Lag Screws: **ASME B18.2.1** (ASME B18.2.3.8M).

- I. Wood Screws: Flat head, ASME B18.6.1.
- J. Plain Washers: Round, [ASME B18.22.1](#) (ASME B18.22M).
- K. Lock Washers: Helical, spring type, [ASME B18.21.1](#) (ASME B18.21.2M).
- L. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- M. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- N. Post-Installed Anchors: **[Torque-controlled expansion anchors] [or] [chemical anchors]**.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or [ASTM F 1941](#) (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy **[Group 1 (A1)] [Group 2 (A4)]** stainless-steel bolts, [ASTM F 593](#) (ASTM F 738M), and nuts, [ASTM F 594](#) (ASTM F 836M).
- O. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, [1-5/8 by 7/8 inches](#) (41 by 22 mm) by length indicated with anchor straps or studs not less than [3 inches](#) (75 mm) long at not more than [8 inches](#) (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Primers: Provide primers that comply with **[Section 099113 "Exterior Painting." [Section 099123 Interior Painting.] [Section 099600 "High-Performance Coatings." [Section 099113 "Exterior Painting," Section 099123 Interior Painting,"and Section 099600 "High-Performance Coatings."]**
- D. Universal Shop Primer for Metal Fabrications: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. ICI/Devoe "Devshield 4130".
 - b. Tnemec Series 10 Primers.
 - c. **<Insert manufacturer's name>**
 - d. or approved equal.
- E. Epoxy Zinc-Rich Primer for Metal Fabrications Receiving High Performance Finish Coatings: Complying with MPI#20 and compatible with topcoat.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ICI/Devoe #310 "Catha-Coat".
 - b. Tnemec 90-97 "Tneme-Zinc".
 - c. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - d. or approved equal.
- F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it, liquid organic zinc compound containing not less than 95% pure zinc metal.
1. Subject to compliance with requirements, provide one of the following:
 - a. ZRC Products Co. "Z.R.C. Cold Galvanizing Compound".
 - b. **<Insert manufacturer's name>**
 - c. or approved equal.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- H. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.
- I. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- J. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of **3000 psi (20 MPa)**.
- 2.6 FABRICATION, GENERAL
- A. Reference Section 050510 "Welding" for general welding requirements.
 - B. Fabricate work to sizes, shapes, and profiles shown, and in accordance with approved

- shop drawings. Verify all dimensions prior to fabrication.
- C. Fabricate equipment supports and other items penetrating through roof from square, rectangular, or round tubing; angle, channel, or H-shapes will not be permitted.
 - D. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
 - E. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately $1/32$ inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
 - F. Do all punching, shearing, cutting, and forming so as to produce clean, true lines, and surfaces with a constant width on each face. Form straight and true edge arises and uniform contours as detailed. Make stampings and perforations with uniformly spaced and sized openings in alignment in both directions. Dress all cuts smooth; make corners square and joints tight.
 - G. Uniformly space and align members. Provide sleeves, inserts, anchors, and other built-in and auxiliary work. Provide welded connections at all joints and intersections; use continuous welds and grind smooth.
 - H. Cut, drill, and tap units to receive hardware. Provide all necessary brackets, anchors, fasteners, and other accessory items required for complete installation.
 - I. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
 - J. Exposed-to-Public-View Members:
 - 1. Fabricate items that will be exposed to public view with smooth, flat surfaces, free from embedded scale, marks, gouges, or other irregularities.
 - 2. Form exposed work with accurate angles and surfaces and straight edges.
 - 3. Fill depressions with weld metal of same composition as parent metal. Grind welds and raised marks flush with adjacent surfaces. Fill small pit marks with metallic compound and grind smooth.
 - K. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing[**and contour of welded surface matches that of adjacent surface**].
 - L. Form exposed connections with hairline joints, flush and smooth, using concealed

fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

- M. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- N. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- O. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
 - 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, **1/8 by 1-1/2 inches** (3.2 by 38 mm), with a minimum **6-inch** (150-mm) embedment and **2-inch** (50-mm) hook, not less than **8 inches** (200 mm) from ends and corners of units and **24 inches** (600 mm) o.c., unless otherwise indicated.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes **[indicated] [recommended by partition manufacturer]** with attached bearing plates, anchors, and braces as **[indicated] [recommended by partition manufacturer]**. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.
- D. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.
 - 1. Provide bearing plates welded to beams where indicated.
 - 2. Drill or punch girders and plates for field-bolted connections where indicated.
 - 3. Where wood nailers are attached to girders with bolts or lag screws, drill or punch holes at **24 inches** (600 mm) o.c.
- E. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.

- F. Unless otherwise indicated, fabricate from Schedule 40 steel pipe.
 - 1. Unless otherwise indicated, provide **1/2-inch** (12.7-mm) baseplates with four **5/8-inch** (16-mm) anchor bolts and **1/4-inch** (6.4-mm) top plates.
- G. Galvanize miscellaneous framing and supports where indicated.
- H. Prime miscellaneous framing and supports with [**zinc-rich primer**] [**primer specified in Section 099600 "High-Performance Coatings"**] where indicated.

2.8 MANUFACTURED PRODUCTS

- A. Formed Steel Channel Support Framing System:
 - 1. Manufactured system consisting of roll-formed steel channels fabricated from structural grade steel complying with ASTM A653, Grade 33, minimum 12 gage, weighing 190 lbs per 100 lineal feet. Provide channels with manufacturer's finish consisting of thermally-cured, rust inhibiting acrylic enamel applied by electrodeposition after cleaning and phosphating, per Federal Standard 595a.
 - 2. Unless otherwise indicated, provide channels with dimensions of 1-5/8" x 1-5/8", with 7/8" clear opening between lip returns.
 - 3. Provide all required fittings, anchors, and accessories or incidental materials
 - 4. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Unistrut, with Permagreen II finish, color No. 14109.
 - b. **<Insert manufacturer's name>**
 - c. or approved equal.

2.9 PREFABRICATED BUILDING COLUMNS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Black Rock Column, Inc.
 - 2. Dean, George H., Inc.
 - 3. Fire-Trol Division; Dean Lally L. P.
 - 4. **<Insert manufacturer's name>**.
 - 5. or approved equal.
- B. General: Provide prefabricated building columns consisting of load-bearing structural-steel members protected by concrete fireproofing encased in an outer non-load-bearing steel shell. Fabricate connections to comply with details shown or as needed to suit type of structure indicated.
- C. Fire-Resistance Ratings: Provide prefabricated building columns listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for ratings indicated, based on testing according to ASTM E 119.

1. Fire-Resistance Rating: **[4 hours] [3 hours] [2 hours] [As indicated]**.

2.10 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive **3/4-inch (19-mm)** bolts, spaced not more than **6 inches (150 mm)** from ends and **24 inches (600 mm)** o.c., unless otherwise indicated.
 1. Provide mitered and welded units at corners.
 2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately **2 inches (50 mm)** larger than expansion or control joint.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Hot-dip galvanize shelf angles located in exterior walls.
- D. Prime shelf angles located in interior walls with **[zinc-rich primer.] [primer specified in Section 099600 "High-Performance Coatings."]**
- E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.11 METAL LADDERS

- A. General:
 1. Comply with ANSI A14.3 unless otherwise indicated.
 2. For elevator pit ladders, comply with ASME A17.1.
- B. Steel Ladders:
 1. Space siderails **[16 inches (406 mm)] [18 inches (457 mm)]** apart unless otherwise indicated.
 2. Space siderails of elevator pit ladders **12 inches (300 mm)** apart.
 3. Siderails: Continuous, **3/8-by-2-1/2-inch (9.5-by-64-mm)** steel flat bars, with eased edges.
 4. Rungs: **1-inch- (25-mm-) square]** steel bars.
 5. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
 - a. Rungs shall be capable of carrying a load of 1000 pounds each without failing or permanently deforming. Side rails shall be capable of carrying the load of a single rung.
 6. Bolt or weld all anchors and connections; grind welds smooth.
 7. Ladder shall not deflect horizontally or vertically more than 1/240 of its span between anchorage points.
 8. Provide nonslip surfaces on top of each rung, either by coating rung with

- aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
9. Provide nonslip surfaces on top of each rung by coating with abrasive material metallurgically bonded to rung.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) IKG Industries, a division of Harsco Corporation; Mebac.
 - 2) SlipNOT Metal Safety Flooring, a W. S. Molnar company; SlipNOT.
 - 3) **<Insert manufacturer's name; product name or designation>**.
 - 4) or approved equal.
 10. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than **1/2 inch (12 mm)** [**3/4 inch (19 mm)**] in least dimension.
 11. Support each ladder[**at top and bottom and not more than 60 inches** (1500 mm) **o.c.**] with welded or bolted steel brackets.
 12. Hot-dip galvanize [**exterior**] ladders, including brackets and fasteners.
 13. Prime interior ladders, including brackets and fasteners, with [**zinc-rich primer.**] [**primer specified in Section 099600 "High-Performance Coatings."**]

C. Aluminum Ladders:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACL Industries, Inc.
 - b. Alco-Lite Industrial Products.
 - c. Halliday Products.
 - d. O'Keeffe's Inc.
 - e. Precision Ladders, LLC.
 - f. Royalite Manufacturing, Inc.
 - g. Thompson Fabricating, LLC.
 - h. **<Insert manufacturer's name>**.
2. Space siderails [**16 inches (406 mm)**] [**18 inches (457 mm)**] apart unless otherwise indicated.
3. Siderails: Continuous extruded-aluminum channels or tubes, not less than **2-1/2 inches** (64 mm) deep, **3/4 inch** (19 mm) wide, and **1/8 inch** (3.2 mm) thick.
4. Rungs: Extruded-aluminum tubes, not less than **3/4 inch** (19 mm) deep and not less than **1/8 inch** (3.2 mm) thick, with ribbed tread surfaces.
5. Fit rungs in centerline of siderails; fasten by welding or with stainless-steel fasteners or brackets and aluminum rivets.
6. Provide platforms as indicated fabricated from [**pressure-locked aluminum bar grating**] [**or**] [**extruded-aluminum plank grating**], supported by extruded-aluminum framing. Limit openings in gratings to no more than **1/2 inch (12 mm)** [**3/4 inch (19 mm)**] in least dimension.
7. Support each ladder[**at top and bottom and not more than 60 inches** (1500 mm) **o.c.**] with welded or bolted aluminum brackets.

8. Provide minimum **72-inch-** (1830-mm-) high, hinged security door with padlock hasp at foot of ladder to prevent unauthorized ladder use.

2.12 LADDER SAFETY CAGES

A. General:

1. Fabricate ladder safety cages to comply with ANSI A14.3. Assemble by welding or with stainless-steel fasteners.
2. Provide primary hoops at tops and bottoms of cages and spaced not more than **20 feet** (6 m) o.c. Provide secondary intermediate hoops spaced not more than **48 inches** (1200 mm) o.c. between primary hoops.
3. Fasten assembled safety cage to ladder rails and adjacent construction by welding or with stainless-steel fasteners unless otherwise indicated.

B. Steel Ladder Safety Cages:

1. Primary Hoops: **1/4-by-4-inch** (6.4-by-100-mm) flat bar hoops.
2. Secondary Intermediate Hoops: **1/4-by-2-inch** (6.4-by-50-mm) flat bar hoops.
3. Vertical Bars: **3/16-by-1-1/2-inch** (4.8-by-38-mm) flat bars secured to each hoop.
4. Hot-dip galvanize ladder safety cages, including brackets and fasteners.
5. Prime interior ladder safety cages, including brackets and fasteners, with **[zinc-rich primer.] [primer specified in Section 099600 "High-Performance Coatings."]**

C. Aluminum Ladder Safety Cages:

1. Primary Hoops: **1/4-by-4-inch** (6.4-by-100-mm) flat bar hoops.
2. Secondary Intermediate Hoops: **1/4-by-2-inch** (6.4-by-50-mm) flat bar hoops.
3. Vertical Bars: **1/4-by-2-inch** (6.4-by-50-mm) flat bars secured to each hoop.

2.13 ALTERNATING TREAD DEVICES

A. Alternating Tread Devices: Fabricate alternating tread devices to comply with ICC's International Building Code. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lapeyre Stair Inc.
 - b. Schmidt Structural Products; a subsidiary of Penco Products, Inc.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.
2. Fabricate from **[steel] [stainless steel] [aluminum]** and assemble by welding or with stainless-steel fasteners.

3. Comply with applicable railing requirements in Section 055213 "Pipe and Tube Railings."
- B. Hot-dip galvanize exterior steel alternating tread devices, including treads, railings, brackets, and fasteners.
- C. Prime interior steel alternating tread devices, including treads, railings, brackets, and fasteners, with **[zinc-rich primer.] [primer specified in Section 099600 "High-Performance Coatings."]**

2.14 METAL [SHIPS' LADDERS] [AND] [PIPE CROSSOVERS]

- A. Provide metal **[ships' ladders] [and] [pipe crossovers]** where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.
 1. Fabricate **[ships' ladders] [and] [pipe crossovers]**, including railings from **[steel] [stainless steel] [aluminum]**.
 2. Fabricate treads **[and platforms]** from **[welded or pressure-locked steel bar grating] [pressure-locked stainless-steel bar grating] [pressure-locked aluminum bar grating] [extruded-aluminum plank grating]**. Limit openings in gratings to no more than **[1/2 inch (12 mm)] [3/4 inch (19 mm)]** in least dimension.
 3. Fabricate treads **[and platforms]** from **[rolled-steel floor plate] [rolled-stainless-steel floor plate] [rolled-aluminum-alloy tread plate] [abrasive-surface floor plate]**.
 4. Comply with applicable railing requirements in Section 055213 "Pipe and Tube Railings."
- B. Hot-dip galvanize **[exterior]** steel **[ships' ladders] [and] [pipe crossovers]**, including treads, railings, brackets, and fasteners.
- C. Prime interior steel **[ships' ladders] [and] [pipe crossovers]**, including treads, railings, brackets, and fasteners, with **[zinc-rich primer.] [primer specified in Section 099600 "High-Performance Coatings."]**

2.15 METAL FLOOR PLATE

- A. Fabricate from **[rolled-steel floor] [rolled-stainless-steel floor] [rolled-aluminum-alloy tread] [abrasive-surface floor]** plate of thickness indicated below:
 1. Thickness: **[1/8 inch (3.2 mm)] [3/16 inch (4.8 mm)] [1/4 inch (6.4 mm)] [5/16 inch (8 mm)] [3/8 inch (9.5 mm)] [As indicated]**.
- B. Provide grating sections where indicated fabricated from **[welded or pressure-locked steel bar grating] [pressure-locked stainless steel bar grating] [pressure-locked aluminum bar grating] [extruded-aluminum plank grating]**. Limit openings in gratings to no more than **[1/2 inch (12 mm)] [3/4 inch (19 mm)] [1 inch (25 mm)]** in least dimension.

- C. Provide **[steel]** **[stainless-steel]** **[aluminum]** angle supports as indicated.
- D. Include **[steel]** **[stainless-steel]** **[aluminum]** angle stiffeners, and fixed and removable sections as indicated.
- E. Provide flush **[steel]** **[stainless-steel]** **[aluminum]** bar drop handles for lifting removable sections, one at each end of each section.

2.16 STRUCTURAL-STEEL DOOR FRAMES

- A. Fabricate structural-steel doorframes from steel shapes, plates, and bars of size and to dimensions indicated, fully welded together, with **5/8-by-1-1/2-inch** (16-by-38-mm) steel channel stops, unless otherwise indicated. Plug-weld built-up members and continuously weld exposed joints. Secure removable stops to frame with countersunk machine screws, uniformly spaced at not more than **10 inches** (250 mm) o.c. Reinforce frames and drill and tap as necessary to accept finish hardware.
 - 1. Provide with integrally welded steel strap anchors for securing doorframes into adjoining concrete or masonry.
- B. Extend bottom of frames to floor elevation indicated with steel angle clips welded to frames for anchoring frame to floor with expansion shields and bolts.
- C. Hot-dip galvanize exterior steel frames.
- D. Prime interior steel frames with **[zinc-rich primer.] [primer specified in Section 099600 "High-Performance Coatings."]**

2.17 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Hot-dip galvanize exterior miscellaneous steel trim.
- D. Prime interior miscellaneous steel trim with **[zinc-rich primer.] [primer specified in Section 099600 "High-Performance Coatings."]**

2.18 METAL BOLLARDS

- A. Fabricate metal bollards from **[Schedule 40 steel pipe]** **[Schedule 80 steel pipe]**

[1/4-inch (6.4-mm) wall-thickness rectangular steel tubing] [steel shapes, as indicated].

1. Cap bollards with 1/4-inch- (6.4-mm-) thick steel plate.
 2. Where bollards are indicated to receive controls for door operators, provide necessary cutouts for controls and holes for wire.
 3. Where bollards are indicated to receive light fixtures, provide necessary cutouts for fixtures and holes for wire.
- B. Fabricate bollards with 3/8-inch- (9.5-mm-) thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch (19-mm) anchor bolts.
1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
- C. Fabricate sleeves for bollard anchorage from steel **[pipe] [or] [tubing]** with 1/4-inch- (6.4-mm-) thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) larger than OD of bollard.
- D. Fabricate internal sleeves for removable bollards from Schedule 40 steel pipe or 1/4-inch (6.4-mm) wall-thickness steel tubing with an OD approximately 1/16 inch (1.5 mm) less than ID of bollards. Match drill sleeve and bollard for 3/4 inch (19 mm) steel machine bolt.
- E. Prime bollards with **[zinc-rich primer.] [primer specified in Section 099600 "High-Performance Coatings."]**

2.19 **[PIPE] [DOWNSPOUT] GUARDS**

- A. Fabricate **[pipe] [downspout]** guards from 3/8-inch- (9.5-mm-) thick by 12-inch- (300-mm-) wide steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with 2-inch (50-mm) clearance between pipe and pipe guard. Drill each end for two 3/4-inch (19-mm) anchor bolts.
- B. Galvanize **[pipe] [downspout]** guards.
- C. Prime **[pipe] [downspout]** guards with **[zinc-rich primer.] [primer specified in Section 099600 "High-Performance Coatings."]**

2.20 **ABRASIVE METAL [NOSINGS] [TREADS] [AND] [THRESHOLDS]**

- A. Cast-Metal Units: Cast **[iron] [aluminum] [bronze (lead red or semired brass)] [nickel silver (lead nickel bronze)]**, with an integral-abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Safety Tread Co., Inc.
 - b. Balco Inc.
 - c. Barry Pattern & Foundry Co., Inc.
 - d. Granite State Casting Co.
 - e. Safe-T-Metal Company, Inc.
 - f. Wooster Products Inc.
 - g. <Insert manufacturer's name>.
 - h. or approved equal.
2. Nosings: Cross-hatched units, 4 inches (100 mm) wide with [1/4-inch (6-mm)] [1-inch (25-mm)] lip, for casting into concrete steps.
 3. Nosings: Cross-hatched units, 1-1/2 by 1-1/2 inches (38 by 38 mm), for casting into concrete curbs.
 4. Treads: Cross-hatched units, full depth of tread with 3/4-by-3/4-inch (19-by-19-mm) nosing, for application over bent plate treads or existing stairs.
 5. Thresholds: Fluted-saddle-type units, 5 inches (125 mm) wide by 1/2 inch (12 mm) high, with tapered edges.
 6. Thresholds: Fluted-interlocking- (hook-strip-) type units, 5 inches (125 mm) wide by 5/8 inch (16 mm) high, with tapered edge.
 7. Thresholds: Plain-stepped- (stop-) type units, 5 inches (125 mm) wide by 1/2 inch (12 mm) high, with 1/2-inch (12-mm) step.
- B. Extruded Units: [Aluminum] [Bronze], with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACL Industries, Inc.
 - b. American Safety Tread Co., Inc.
 - c. Amstep Products.
 - d. Armstrong Products, Inc.
 - e. Balco Inc.
 - f. Granite State Casting Co.
 - g. Wooster Products Inc.
 - h. <Insert manufacturer's name>.
 - i. or approved equal.
 2. Provide ribbed units, with abrasive filler strips projecting 1/16 inch (1.5 mm) above aluminum extrusion.
 3. Provide solid-abrasive-type units without ribs.
 4. Nosings: Square-back units, [1-7/8 inches (48 mm)] [3 inches (75 mm)] [4 inches (100 mm)] wide, for casting into concrete steps.
 5. Nosings: Beveled-back units, [3 inches (75 mm)] [4 inches (100 mm)] wide with 1-3/8-inch (35-mm) lip, for surface mounting on existing stairs.
 6. Nosings: Two-piece units, 3 inches (75 mm) wide, with subchannel for casting into concrete steps.
 7. Treads: [Square] [Beveled]-back units, full depth of tread with 1-3/8-inch (35-mm) lip, for application over existing stairs.

- C. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
- D. Drill for mechanical anchors and countersink. Locate holes not more than **4 inches** (100 mm) from ends and not more than **12 inches** (300 mm) o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by manufacturer.
 - 1. Provide two rows of holes for units more than **5 inches** (125 mm) wide, with two holes aligned at ends and intermediate holes staggered.
- E. Apply bituminous paint to concealed surfaces of cast-metal units.
- F. Apply clear lacquer to concealed surfaces of extruded units.

2.21 CAST-IRON WHEEL GUARDS

- A. Provide wheel guards made from cast iron, **3/4 inch** (19 mm) thick, hollow-core construction, of size and shape indicated. Provide holes for countersunk anchor bolts and grouting.
- B. Prime cast iron wheel guards with **[zinc-rich primer.] [primer specified in Section 099600 "High-Performance Coatings."]**

2.22 METAL DOWNSPOUT BOOTS

- A. Provide downspout boots made from **[cast iron] [cast aluminum]** in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.
 - 1. Outlet: **[Vertical, to discharge into pipe] [Horizontal, to discharge into pipe] [At 35 degrees from horizontal, to discharge onto splash block or pavement].**
- B. Prime cast iron downspout boots with **[zinc-rich primer.] [primer specified in Section 099600 "High-Performance Coatings."]**

2.23 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Hot-dip galvanize plates.
- C. Prime plates with **[zinc-rich primer.] [primer specified in Section 099600 "High-Performance Coatings."]**

2.24 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Refer to Structural Drawings for lintel schedules and sizes.
- C. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches (200 mm) unless otherwise indicated.
- D. Hot-dip galvanize loose steel lintels located in exterior walls.
- E. Prime loose steel lintels located in interior walls with **[zinc-rich primer.] [primer specified in Section 099600 "High-Performance Coatings."]**

2.25 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.26 EMBEDMENTS

- A. Provide miscellaneous weld plates and anchor plates as indicated or required for embedding in concrete or building into masonry for attachment of the work of other trades.

2.27 HANDRAILS AND GUARDRAILS

- A. Unless otherwise indicated, fabricate handrails and guardrails from 1-1/2" outside diameter smooth steel pipe or round tubing as indicated. Uniformly space posts and rails as shown, and provide rounded safety caps at all exposed rail terminations.
 - 1. Weld all connections.
- B. Fabricate intermediate guardrail pickets from steel bars of size and configuration indicated on the Drawings. Space intermediate rails or pickets with clear dimension not exceeding 3-15/16", as required by UBC or applicable local code.
- C. Provide all necessary brackets, escutcheons or cover plates, and anchors required for anchoring to substrates indicated.

2.28 SCREEN FRAMING

- A. Provide welded steel frames in accordance with detailed drawings.
- B. Fabricate from angles and tubular or bar shapes as indicated. Punch or drill for bolts and other attachments, and provide any additional internal bracing required to resist wind or other imposed loads.
- C. Provide minimum 12 gauge steel flashing collars at all members penetrating roof; furnish collars loose for field welding after erection.

2.29 EQUIPMENT SUPPORTS

- A. Provide welded steel supports in accordance with Detailed Drawings. Verify dimensions and sizes with manufacturer of equipment to be supported.
- B. Fabricate from angles, tubes, or shapes as indicated. Punch or drill for bolts or other attachment, and provide all required internal bracing to prevent deflection or racking under load.
- C. Provide minimum 12 gauge steel flashing collars at all members penetrating roof; furnish collars loose for field welding after erection.

2.30 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.31 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Shop prime iron and steel items[**not indicated to be galvanized**] unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with [**universal shop primer**] [**primers specified in Section 099113 "Exterior Painting"**] [**primers specified in Section 099123 "Interior Painting"**]

unless [zinc-rich primer is] [primers specified in Section 099600 "High-Performance Coatings" are] indicated.

- C. Preparation for Shop Priming: Prepare surfaces to comply with [SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."] [SSPC-SP 3, "Power Tool Cleaning."] [requirements indicated below:]
1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 4. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.32 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).
- C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine areas and conditions under which the work of this Section will be performed.
- B. Do not proceed with the work until unsatisfactory conditions have been corrected. Commencement of work implies acceptance of all areas and conditions

3.2 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

- B. Install metal fabrications in accordance with approved shop drawings.
 - C. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
 - D. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
 - 5. Reference Section 050510 "Welding" for general welding requirements.
 - E. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
 - F. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction. Remove all temporary braces or erection clips when no longer needed and restore affected surface finishes.
 - G. Insulate between dissimilar metals at connections.
 - H. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - 1. Cast Aluminum: Heavy coat of bituminous paint.
 - 2. Extruded Aluminum: Two coats of clear lacquer.
 - I. Install flashing collars at members penetrating roofing. Coordinate installation with roofing trades.
- 3.3 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS
- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
 - B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.

1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.4 INSTALLING PREFABRICATED BUILDING COLUMNS

A. Install prefabricated building columns to comply with AISC's "Specification for Structural Steel Buildings" and with requirements applicable to listing and labeling for fire-resistance rating indicated.

3.5 INSTALLING METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

1. Do not fill removable bollards with concrete.

B. Anchor bollards to existing construction with **[expansion anchors] [anchor bolts] [through bolts]**. Provide four **3/4-inch** (19-mm) bolts at each bollard unless otherwise indicated.

1. Embed anchor bolts at least **4 inches** (100 mm) in concrete.

C. Anchor bollards in concrete **[with pipe sleeves preset and anchored into concrete] [in formed or core-drilled holes not less than 8 inches** (200 mm) **deep and 3/4 inch** (19 mm) **larger than OD of bollard]**. Fill annular space around bollard solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately **1/8 inch** (3 mm) toward bollard.

D. Anchor bollards in place with concrete footings. Center and align bollards in holes **3 inches** (75 mm) above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

E. Anchor internal sleeves for removable bollards in **[concrete by inserting into pipe sleeves preset into concrete] [formed or core-drilled holes not less than 8 inches** (200 mm) **deep and 3/4 inch** (19 mm) **larger than OD of sleeve]**. Fill annular space around internal sleeves solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately **1/8 inch** (3 mm) toward internal sleeve.

- F. Anchor internal sleeves for removable bollards in place with concrete footings. Center and align sleeves in holes **3 inches** (75 mm) above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace sleeves in position until concrete has cured.
- G. Place removable bollards over internal sleeves and secure with **3/4-inch** (19-mm) machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner will furnish padlocks.
- H. Fill bollards solidly with concrete, mounding top surface to shed water.
 - 1. Do not fill removable bollards with concrete.

3.6 INSTALLING PIPE GUARDS

- A. Provide pipe guards at exposed vertical pipes in parking garage where not protected by curbs or other barriers. Install by bolting to wall or column with expansion anchors. Provide four **3/4-inch** (19-mm) bolts at each pipe guard. Mount pipe guards with top edge **26 inches** (660 mm) above driving surface.

3.7 INSTALLING NOSINGS, TREADS, AND THRESHOLDS

- A. Center nosings on tread widths unless otherwise indicated.
- B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.
- C. Seal thresholds exposed to exterior with elastomeric sealant complying with Section 079200 "Joint Sealants" to provide a watertight installation.

3.8 INSTALLING CAST-IRON WHEEL GUARDS

- A. Anchor wheel guards to concrete or masonry construction to comply with manufacturer's written instructions. Fill cores solidly with concrete.

3.9 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 - 1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations

unless otherwise indicated.

2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.10 FIELD QUALITY CONTROL

- A. Visual Inspection: The testing and inspection agency will visually inspect shop and field welding and bolting of handrails, ladders, and other items requiring structural connections. Welds or bolts that do not pass visual inspection will be tested as specified herein at the Contractor's expense.
- B. Welding Materials and Procedures
 1. Verify that electrodes used for manual shielded metal-arc welding conform to requirements of the Contract Documents, and that welding procedures and welding sequences are followed without deviation.
 2. Verify certification of welding operators under AWS qualification procedures within previous twelve (12) months.
 3. Verify that fit up, joint preparation, size, contour, extent of reinforcement, and length and location of welds conform to specified requirements.
 4. Inspect and test field welds as follows:
 - a. Visually inspect all (100%) welds.
 - b. If more than 10% of the tested welds of any type are rejected, an additional 10% of all such welds will be re-tested using the same test method. This 10% additional testing procedure will be continued until the rejection rate drops below 10%.
 - c. In addition, the DEN Project Manager reserves the right to require additional ultrasonic or magnetic testing of uninspected welds of the same type.
 - 1) All costs of additional testing shall be borne by the Contractor.
 - d. Radiographic (X-ray) testing (ASTM E94 and E390) may be substituted for ultrasonic testing at the option of the testing agency and with the approval of the DEN Project Manager.
 5. Authority for Rejection: The testing and inspections agency is authorized to reject welding materials and procedures. Rejection may be based on visual inspection if, in the opinion of the inspector, the weld would not pass a more detailed investigation.

3.11 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Apply by brush or spray to provide a minimum **2.0-mil** (0.05-mm) dry film

thickness.

- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in [**Section 099113 "Exterior Painting."**] [**Section 099123 "Interior Painting."**]
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.12 PROTECTION

- A. Protection of Work in Place: Protect all work in place, and replace damaged finished work without cost to Owner.
- B. Touch-up and Repair of Galvanized Coating:
 - 1. Welds: Wire brush to remove slag residue, weld splatter, and similar deleterious materials. If surface is oily, clean with phosphoric acid base compound as recommended by galvanizing repair compound manufacturer. Apply galvanizing repair compound in accordance with manufacturer's instructions.
 - 2. Scratches and Other Surface Damage: Thoroughly wash damaged area with water or mild detergent to remove any zinc oxides that may have formed. Apply galvanizing repair compound in accordance with manufacturer's instructions.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 055000

SECTION 055100 - METAL STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Preassembled steel stairs with [**concrete-filled**] [**precast concrete**] [**epoxy-resin-filled**] [**and**] [**abrasive-coating-finished formed-metal**] treads.
2. Industrial-type stairs with steel [**floor plate**] [**grating**] treads.
3. Ornamental steel-framed stairs.
4. [**Steel tube**] railings attached to metal stairs.
5. [**Steel tube**] handrails attached to walls adjacent to metal stairs.
6. Railing gates at the level of exit discharge.

B. Related Sections:

1. Section 033000 "Cast-in-Place Concrete" for concrete fill for stair treads and platforms.
2. Section 050510 "Welding" for general welding requirements.
3. Section 055000 "Metal Fabrications" for [**metal treads and nosings installed at locations other than in metal stairs**] [**and**] [**alternating tread devices**].
4. Section 055213 "Pipe and Tube Railings" for pipe and tube railings[**not attached to metal stairs or to walls adjacent to metal stairs**].
5. Section 057113 "Fabricated Metal Spiral Stairs."
6. Section 057300 "Decorative Metal Railings" for ornamental metal railings.
7. [**Section 061000 "Rough Carpentry"**] [**Section 061053 "Miscellaneous Rough Carpentry"**] for wood blocking for anchoring railings.
8. Section 092216 "Non-Structural Metal Framing" for metal backing for anchoring railings.
9. Section 093000 "Tiling" for ceramic-tile treads and landings[**for ornamental steel-framed stairs**].
10. Section 096340 "Stone Flooring" for stone treads and landings[**for ornamental steel-framed stairs**].
11. Section 096400 "Wood Flooring" for wood treads and landings[**for ornamental steel-framed stairs**].
12. [**Section 096613 "Portland Cement Terrazzo Flooring"**] [**Section 096623 "Resinous Matrix Terrazzo Flooring"**] for terrazzo treads and landings[**for ornamental steel-framed stairs**].

13. Section 102213 "Wire Mesh Partitions" for wire mesh security partitions and doors.

C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to [L/240] [L/360] <Insert deflection ratio> or 1/4 inch (6.4 mm), whichever is less.

C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Handrails and Top Rails of Guards:

- a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
- b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
- c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

- a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
- b. Infill load and other loads need not be assumed to act concurrently.

D. Seismic Performance: Metal stairs shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7] <Insert requirement>.

1. Component Importance Factor is 1.5.

1.4 ACTION SUBMITTALS

A. Product Data: For metal stairs and the following:

1. Prefilled metal-pan stair treads.
2. Precast concrete treads.

3. Epoxy-resin-filled stair treads.
4. Nonslip aggregates and nonslip-aggregate finishes.
5. Abrasive nosings.
6. Metal floor plate treads.
7. Paint products.
8. Grout.
9. Photoluminescent exit pathway markings.
10. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Laboratory Test Reports for Credit IEQ 4: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

D. Samples for Initial Selection: For products involving selection of color, texture, or design.

E. Samples for Verification: For the following products, in manufacturer's standard sizes:

1. Precast concrete treads.
2. Epoxy-resin-filled stair treads.
3. Stair treads with nonslip-aggregate surface finish.
4. Metal floor plate treads.
5. Grating treads.
6. Abrasive nosings.

F. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified [**professional engineer**] [**testing agency**].
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for **[stairs] [and] [railings]**.

1. Test railings according ASTM E 894 and ASTM E 935.

1.6 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.
1. Preassembled Stairs: Commercial class.
 2. Industrial-Type Stairs: Industrial class.
 3. Ornamental Stairs: Architectural class.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.8 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25] <Insert number>** percent.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Tubing: **[ASTM A 500 (cold formed)] [or] [ASTM A 513]**.
- D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- E. Abrasive-Surface Floor Plate: Steel plate **[with abrasive granules rolled into surface] [or] [with abrasive material metallically bonded to steel]**.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. IKG Industries, a division of Harsco Corporation; Mebac.
 - b. SlipNOT Metal Safety Flooring, a W. S. Molnar company; SlipNOT.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
- F. Steel Bars for Grating Treads: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.
- G. Wire Rod for Grating Crossbars: **ASTM A 510** (ASTM A 510M).
- H. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- I. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, **[either commercial steel, Type B, or] structural steel, Grade 25** (Grade 170), unless another grade is required by design loads; exposed.

- J. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, [**either commercial steel, Type B, or**] structural steel, **Grade 30** (Grade 205), unless another grade is required by design loads.
- K. Galvanized-Steel Sheet: ASTM A 653/A 653M, **G90** (Z275) coating, [**either commercial steel, Type B, or**] structural steel, **Grade 33** (Grade 230), unless another grade is required by design loads.
- L. Expanded-Metal, Carbon Steel: ASTM F 1267, [**Type I (expanded)**] [**Type II (expanded and flattened)**], Class 1 (uncoated).
1. Style Designation: [**3/4 number 13**] [**1-1/2 number 10**] <Insert designation>.
- M. Perforated Metal: Cold-rolled steel sheet, ASTM A 1008/A 1008M, or hot-rolled steel sheet, ASTM A 1011/A 1011M, commercial steel Type B, [**0.060 inch** (1.52 mm)] <Insert thickness> thick, [**with 1/4-inch** (6.4-mm) **holes 3/8 inch** (9.5 mm) **o.c. in staggered rows**] [**with 1/8-by-1-inch** (3.2-by-25.4-mm) **round end slotted holes in staggered rows**] <Insert description>.
- N. Perforated Metal: Galvanized-steel sheet, ASTM A 653/A 653M, **G90** (Z275) coating, commercial steel Type B, [**0.064 inch** (1.63 mm)] <Insert thickness> thick, [**with 1/4-inch** (6.4-mm) **holes 3/8 inch** (9.5 mm) **o.c. in staggered rows**] <Insert description>.
- O. Woven-Wire Mesh: Intermediate-crimp, [**diamond**] [**square**] pattern, **2-inch** (50-mm) woven-wire mesh, made from **0.135-inch** (3.5-mm) nominal diameter wire complying with **ASTM A 510** (ASTM A 510M).

2.3 NONFERROUS METALS

- A. Aluminum Extrusions: **ASTM B 221** (ASTM B 221M), Alloy 6063-T6.
- B. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.
- C. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (extruded architectural bronze).
- D. Bronze Castings: ASTM B 584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).
- E. Nickel Silver Castings: ASTM B 584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

2.4 ABRASIVE NOSINGS

- A. Cast-Metal Units: Cast [**iron**] [**aluminum**] [**bronze**] [**nickel silver**], with an integral abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Safety Tread Co., Inc.
 - b. Balco Inc.
 - c. Barry Pattern & Foundry Co., Inc.
 - d. Granite State Casting Co.
 - e. Safe-T-Metal Company, Inc.
 - f. Wooster Products Inc.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
 2. Configuration: Cross-hatched units, [3 inches (75 mm)] [4 inches (100 mm)] wide without lip.
 3. Configuration: Cross-hatched angle-shaped units, same depth as bar-grating treads and 1 to 1-1/2 inches (25 to 38 mm) wide.
- B. Extruded Units: **[Aluminum]** **[Bronze]** units with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACL Industries, Inc.
 - b. American Safety Tread Co., Inc.
 - c. Amstep Products.
 - d. Armstrong Products, Inc.
 - e. Balco Inc.
 - f. Granite State Casting Co.
 - g. Wooster Products Inc.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.
 2. Provide ribbed units, with abrasive filler strips projecting 1/16 inch (1.5 mm) above aluminum extrusion.
 3. Provide solid-abrasive-type units without ribs.
 4. Nosings: Square-back units, [1-7/8 inches (48 mm)] [3 inches (75 mm)] [4 inches (100 mm)] wide, without lip.
 5. Nosings: Two-piece units, 3 inches (75 mm) wide, with subchannel for casting into concrete.
- C. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
- D. Apply bituminous paint to concealed surfaces of cast-metal units set into concrete.
- E. Apply clear lacquer to concealed surfaces of extruded units set into concrete.

2.5 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or [ASTM F 1941](#) (ASTM F 1941M), Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, [ASTM A 307, Grade A](#) (ASTM F 568M, Property Class 4.6); with hex nuts, [ASTM A 563](#) (ASTM A 563M); and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, [ASTM A 563](#) (ASTM A 563M); and, where indicated, flat washers.
1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for **[exterior stairs] [stairs indicated to be galvanized] [stairs indicated to be shop primed with zinc-rich primer]**.
- D. Machine Screws: [ASME B18.6.3](#) (ASME B18.6.7M).
- E. Lag Screws: [ASME B18.2.1](#) (ASME B18.2.3.8M).
- F. Plain Washers: Round, [ASME B18.22.1](#) (ASME B18.22M).
- G. Lock Washers: Helical, spring type, [ASME B18.21.1](#) (ASME B18.21.2M).
- H. Post-Installed Anchors: **[Torque-controlled expansion anchors] [or] [chemical anchors]** capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or [ASTM F 1941](#) (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
 2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy **[Group 1 (A1)] [Group 2 (A4)]** stainless-steel bolts, [ASTM F 593](#) (ASTM F 738M), and nuts, [ASTM F 594](#) (ASTM F 836M).

2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Primers: Provide primers that comply with **[Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."]** **[Section 099600 "High-Performance**

Coatings.]" [Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."]

- D. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- E. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.
- F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- H. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- I. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of **3000 psi** (20 MPa) unless otherwise indicated.
- J. Nonslip-Aggregate Concrete Finish: Factory-packaged abrasive aggregate made from fused, aluminum-oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.
- K. Welded Wire Fabric: ASTM A 185/A 185M, **6 by 6 inches** (152 by 152 mm), W1.4 by W1.4, unless otherwise indicated.

2.7 PRECAST CONCRETE TREADS

- A. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, ready-mixed concrete with a minimum 28-day compressive strength of **5000 psi** (35 MPa) and a total air content of not less than 4 percent or more than 6 percent.
- B. Reinforcing Wire Fabric: Galvanized, welded wire fabric, **2 by 2 inches** (50 by 50 mm) by **0.062-inch-** (1.6-mm-) diameter wire; comply with ASTM A 185/A 185M and ASTM A 82/A 82M, except for minimum wire size.

2.8 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, [**railings,**] clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
1. Join components by welding unless otherwise indicated.
 2. Use connections that maintain structural value of joined pieces.
 3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.
- B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately **1/32 inch** (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Weld exposed corners and seams continuously unless otherwise indicated.
 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for [**Type 1 welds: no evidence of a welded joint**] [**Type 2 welds: completely sanded joint, some undercutting and pinholes okay**] [**Type 3 welds: partially dressed weld with spatter removed**] [**Type 4 welds: good quality, uniform undressed weld with minimal splatter**].
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.
- H. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.9 STEEL-FRAMED STAIRS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alfab, Inc.
 2. American Stair, Inc.
 3. Sharon Companies Ltd. (The).
 4. **<Insert manufacturer's name>**.
 5. or approved equal.
- B. Stair Framing:
1. Fabricate stringers of steel **[plates] [channels] [plates or channels] [tubes]**.
 - a. Provide closures for exposed ends of **[channel] [tube]** stringers.
 2. Construct platforms of steel **[plate] [channel] [plate or channel] [tube]** headers and miscellaneous framing members as **[needed to comply with performance requirements] [indicated]**.
 3. Weld **[or bolt]** stringers to headers; weld **[or bolt]** framing members to stringers and headers. **[If using bolts, fabricate and join so bolts are not exposed on finished surfaces.]**
 4. Where stairs are enclosed by gypsum board **[shaft-wall]** assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.
 5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- C. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness **[needed to comply with performance requirements but not less than 0.067 inch (1.7 mm)] [indicated]**.
1. Steel Sheet: Uncoated **[cold] [hot]**-rolled steel sheet **[unless otherwise indicated]**.
 2. Steel Sheet: Galvanized-steel sheet **[, where indicated]**.
 3. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
 4. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
 5. Shape metal pans to include nosing integral with riser.
 6. Attach abrasive nosings to risers.
 7. At Contractor's option, provide stair assemblies with metal-pan subtreads filled with reinforced concrete during fabrication.
 8. Provide epoxy-resin-filled treads, reinforced with glass fibers, with slip-resistant, abrasive surface.
 9. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.
 - a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

- D. Abrasive-Coating-Finished, Formed-Metal Stairs: Form risers, treads, and platforms to configurations shown from steel sheet of thickness **[needed to comply with performance requirements but not less than 0.097 inch (2.5 mm)] [indicated]**.
1. Steel Sheet: Uncoated hot-rolled steel sheet unless otherwise indicated.
 2. Directly weld risers and treads to stringers; locate welds on underside of stairs.
 3. Provide platforms of configuration indicated or, if not indicated, the same as treads. Weld platforms to platform framing.
 4. Finish tread and platform surfaces with manufacturer's standard epoxy-bonded abrasive finish.
- E. Metal Floor Plate Stairs: Form treads and platforms to configurations shown from **[rolled-steel] [abrasive-surface]** floor plate of thickness **[needed to comply with performance requirements, but not less than 1/4 inch (6.4 mm)] [needed to comply with performance requirements, but not less than 3/16 inch (4.8 mm)] [needed to comply with performance requirements, but not less than 1/8 inch (3.2 mm)] [indicated]**.
1. Form treads with integral nosing and back edge stiffener. Form risers of same material as treads.
 2. Form treads with integral nosing and back edge stiffener. Form risers from steel sheet not less than **0.097 inch (2.5 mm)** thick, welded to tread nosings and stiffeners and to platforms.
 3. Form treads with integral nosing and back edge stiffener, and with open risers.
 4. Weld steel supporting brackets to stringers and weld treads to brackets.
 5. Fabricate platforms with integral nosings matching treads and weld to platform framing.
- F. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."
1. Fabricate treads and platforms from **[welded] [or] [pressure-locked]** steel grating with **[1-1/4-by-3/16-inch (32-by-5-mm) bearing bars at 15/16 inch (24 mm) o.c.] [1-by-3/16-inch (25-by-5-mm) bearing bars at 11/16 inch (17 mm) o.c.] [1-by-1/8-inch (25-by-3-mm) bearing bars at 7/16 inch (11 mm) o.c.]** and crossbars at **4 inches (100 mm) o.c.**
 2. Fabricate treads and platforms from **[welded] [or] [pressure-locked]** steel grating with openings in gratings no more than **[5/16 inch (8 mm)] [1/2 inch (12 mm)] [3/4 inch (19 mm)]** in least dimension.
 3. Surface: **[Plain] [Serrated]**.
 4. Finish: **[Shop primed] [Painted] [Galvanized]**.
 5. Fabricate grating treads with **[rolled-steel floor plate] [cast abrasive]** nosing and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.
 6. Fabricate grating platforms with nosing matching that on grating treads. Provide toeplates at open-sided edges of grating platforms. Weld grating to platform framing.

2.10 STAIR RAILINGS

- A. Comply with applicable requirements in **[Section 055213 "Pipe and Tube Railings]** **[Section 057300 "Decorative Metal Railings]."**
1. Fabricate newels of square steel tubing and provide newel caps of **[pressed steel]** **[gray-iron castings]**, as shown.
 2. Rails may be bent at corners, rail returns, and wall returns, instead of using prefabricated fittings.
 3. Connect posts to stair framing by direct welding unless otherwise indicated.
- B. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.
1. Rails and Posts: **[1-5/8-inch- (41-mm-) diameter]** **[1-1/2-inch- (38-mm-) square]** top and bottom rails and **1-1/2-inch- (38-mm-) square** posts.
 2. Picket Infill: **1/2-inch- (13-mm-) square** pickets spaced less than **4 inches (100 mm)** clear.
 3. Expanded-Metal Infill: Expanded-metal panels edged with U-shaped channels made from steel sheet not less than **0.043 inch (1.1 mm)** thick. Orient expanded metal with long dimension of diamonds **[parallel to top rail]** **[perpendicular to top rail]** **[vertical]**.
 4. Perforated-Metal Infill: Perforated-metal panels edged with U-shaped channels made from metal sheet, of same metal as perforated metal and not less than **0.043 inch (1.1 mm)** thick. Orient perforated metal with pattern **[parallel to top rail]** **[perpendicular to top rail]** **[horizontal]** **[vertical]** **[as indicated on Drawings]**.
 5. Mesh Infill: Woven wire mesh crimped into **1-by-1/2-by-1/8-inch (25-by-13-by-3-mm)** steel channel frames. Orient wire mesh with **[diamonds vertical]** **[wires perpendicular and parallel to top rail]** **[wires horizontal and vertical]**.
 6. Intermediate Rails Infill: **[1-5/8-inch- (41-mm-) diameter]** **[1-1/2-inch- (38-mm-) square]** intermediate rails spaced less than **[12 inches (305 mm)]** **[21 inches (533 mm)]** clear.
 7. Gates: Form gates from steel tube of same size and shape as top rails, with infill to match guards. Provide with **[cam-type, self-closing]** **[spring]** hinges for fastening to wall and overlapping stop with rubber bumper to prevent gate from opening in direction opposite egress.
- C. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
1. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for **[Type 1 welds: no evidence of a welded joint]** **[Type 2 welds: completely sanded joint, some undercutting and pinholes okay]** **[Type 3 welds: partially dressed weld with spatter removed]** **[Type 4 welds: good quality, uniform undressed weld with minimal splatter]**.

- D. Form changes in direction of railings as follows:
1. As detailed.
 2. By bending[**or by inserting prefabricated elbow fittings**].
 3. By flush bends[**or by inserting prefabricated flush-elbow fittings**].
 4. By radius bends of radius indicated[**or by inserting prefabricated elbow fittings of radius indicated**].
 5. By inserting prefabricated [**elbow fittings**] [**flush-elbow fittings**] [**elbow fittings of radius indicated**].
- E. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- F. Close exposed ends of railing members with prefabricated end fittings.
- G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is **1/4 inch** (6 mm) or less.
- H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
1. Connect posts to stair framing by direct welding unless otherwise indicated.
 2. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
 3. For nongalvanized railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
- I. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.11 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal stairs after assembly.
- C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
 2. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- D. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with **[SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning. "] [SSPC-SP 3, "Power Tool Cleaning. "] [minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed products:]**
1. Exterior Stairs: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 2. Interior Stairs: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 3. Interior Stairs: SSPC-SP 3, "Power Tool Cleaning."
- E. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article. Reference Section 050510 "Welding" for general welding requirements.

- G. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."
 - 1. Install abrasive nosings with anchors fully embedded in concrete. Center nosings on tread width.
- H. Install precast concrete treads with adhesive supplied by manufacturer.

3.2 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.
- B. Set steel stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 - 1. Use nonmetallic, nonshrink grout unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 INSTALLING RAILINGS

- A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
 - 1. Anchor posts to steel by welding directly to steel supporting members.
 - 2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.
- B. Attach handrails to wall with wall brackets. Use type of bracket [**with flange tapped for concealed anchorage to threaded hanger bolt**] [**with predrilled hole for exposed bolt anchorage**]. Provide bracket with **1-1/2-inch** (38-mm) clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction [**as required to comply with performance requirements.**] [**as follows:**]
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.
 - 3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
 - 4. For steel-framed partitions, use hanger or lag bolts set into [**fire-retardant-treated**] wood backing between studs. Coordinate with stud installation to locate backing members.

5. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
6. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Apply by brush or spray to provide a minimum **2.0-mil** (0.05-mm) dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in [**Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."**] [**Section 099600 "High-Performance Coatings."**] [**Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."**]
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 055100

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Steel **[pipe] [and] [tube]** railings.
2. Aluminum **[pipe] [and] [tube]** railings.
3. Stainless-steel **[pipe] [and] [tube]** railings.

- B. Related Sections:

1. Section 050510 "Welding" for general welding requirements.
2. Section 055100 "Metal Stairs" for steel tube railings associated with metal stairs.
3. Section 057300 "Decorative Metal Railings" for ornamental railings fabricated from pipes and tubes.
4. **[Section 061000 "Rough Carpentry"] [Section 061053 "Miscellaneous Rough Carpentry"]** for wood blocking for anchoring railings.
5. Section 092216 "Non-Structural Metal Framing" for metal backing for anchoring railings.
6. Section 096900 "Access Flooring" for railings included with access flooring.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
1. Steel: 72 percent of minimum yield strength.
 2. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.
 3. Stainless Steel: 60 percent of minimum yield strength.

- C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Handrails and Top Rails of Guards:
 - a. Uniform load of 100 lbf/ ft. (1.46 kN/m) applied in any direction.
 - b. Concentrated load of 300 lbf (1.34 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 2. Infill of Guards: Capable of withstanding a horizontal concentrated load at any point in the system including panels, intermediate rails balusters, or other elements composing the infill area.
 - a. Concentrated load of 200 lbf (0.88 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
1. Manufacturer's product lines of mechanically connected railings.
 2. Railing brackets.
 3. Grout, anchoring cement, and paint products.
 4. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 2. Laboratory Test Reports for Credit IEQ 4: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- D. Samples for Initial Selection: For products involving selection of color, texture, or design[, **including mechanical finishes on stainless steel**].
- E. Samples for Verification: For each type of exposed finish required.
 - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 - 2. Fittings and brackets.
 - 3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
 - a. Show method of **[finishing]** **[connecting]** members at intersections.
- F. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified **[professional engineer]** **[testing agency]**.
- B. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.6 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

- C. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.9 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Steel Pipe and Tube Railings:
 - a. Pisor Industries, Inc.
 - b. Wagner, R & B, Inc.; a division of the Wagner Companies.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.

2. Aluminum Pipe and Tube Railings:
 - a. ATR Technologies, Inc.
 - b. Blum, Julius & Co., Inc.
 - c. Braun, J. G., Company; a division of the Wagner Companies.
 - d. CraneVeyor Corp.
 - e. Hollaender Manufacturing Company.
 - f. Kee Industrial Products, Inc.
 - g. Moultrie Manufacturing Company.
 - h. Pisor Industries, Inc.
 - i. Sterling Dula Architectural Products, Inc.; Div. of Kane Manufacturing.
 - j. Superior Aluminum Products, Inc.
 - k. Thompson Fabricating, LLC.
 - l. Tri Tech, Inc.
 - m. Tubular Specialties Manufacturing, Inc.
 - n. Tuttle Railing Systems; Div. of Tuttle Aluminum & Bronze, Inc.
 - o. Wagner, R & B, Inc.; a division of the Wagner Companies.
 - p. **<Insert manufacturer's name>**.
 - q. or approved equal.

3. Stainless-Steel Pipe and Tube Railings:
 - a. Blum, Julius & Co., Inc.
 - b. Paragon Aquatics; Division of Pentair, Inc.
 - c. Pisor Industries, Inc.
 - d. Stainless Fabricators, Inc.
 - e. Sterling Dula Architectural Products, Inc.; Div. of Kane Manufacturing.
 - f. Tri Tech, Inc.
 - g. Tubular Specialties Manufacturing, Inc.
 - h. Tuttle Railing Systems; Div. of Tuttle Aluminum & Bronze, Inc.
 - i. Wagner, R & B, Inc.; a division of the Wagner Companies.
 - j. **<Insert manufacturer's name>**.
 - k. or approved equal.

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.3 STEEL AND IRON

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25] **<Insert number>** percent.
- B. Tubing: **[ASTM A 500 (cold formed)] [or] [ASTM A 513]**.

- C. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
1. Provide galvanized finish for exterior installations and where indicated.
- D. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- E. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- F. Expanded Metal: ASTM F 1267, **[Type I (expanded)] [Type II (expanded and flattened)]**, Class 1 (uncoated).
1. Style Designation: **[3/4 number 13] [1-1/2 number 10] <Insert designation>**.
- G. Perforated Metal: Cold-rolled steel sheet, ASTM A 1008/A 1008M, or hot-rolled steel sheet, ASTM A 1011/A 1011M, commercial steel Type B, **[0.060 inch (1.52 mm)] <Insert thickness> thick, [with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows] <Insert description>**.
- H. Perforated Metal: Galvanized-steel sheet, ASTM A 653/A 653M, **G90 (Z275)** coating, commercial steel Type B, **[0.064 inch (1.63 mm)] <Insert thickness> thick, [with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows] [with 1/8-by-1-inch (3.2-by-25.4-mm) round end slotted holes in staggered rows] <Insert description>**.
- I. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. **<Insert manufacturer's name; product name or designation>**.
 2. or approved equal.
- J. Woven-Wire Mesh: Intermediate-crimp, **[diamond] [square]** pattern, **2-inch (50-mm)** woven-wire mesh, made from **0.135-inch (3.5-mm)** nominal diameter wire complying with **ASTM A 510 (ASTM A 510M)**.

2.4 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- B. Extruded **[Bars] [and] [Tubing]**: **ASTM B 221 (ASTM B 221M)**, Alloy 6063-T5/T52.
- C. Extruded Structural **[Pipe] [and] [Round Tubing]**: **ASTM B 429/B 429M**, Alloy 6063-T6.
1. Provide Standard Weight (Schedule 40) pipe, unless otherwise indicated.
- D. Drawn Seamless Tubing: **ASTM B 210 (ASTM B 210M)**, Alloy 6063-T832.

- E. Plate and Sheet: **ASTM B 209** (ASTM B 209M), Alloy 6061-T6.
- F. Die and Hand Forgings: **ASTM B 247** (ASTM B 247M), Alloy 6061-T6.
- G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.
- H. Perforated Metal: Aluminum sheet, **ASTM B 209** (ASTM B 209M), Alloy 6061-T6, [**0.063 inch (1.60 mm)**] <Insert thickness> thick, [with **1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows**] <Insert description>.
- I. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. <Insert manufacturer's name; product name or designation>.
 - 2. or approved equal.
- J. Woven-Wire Mesh: Intermediate-crimp, [**diamond**] [**square**] pattern, **2-inch (50-mm)** woven-wire mesh, made from **0.162-inch (4.1-mm)** nominal diameter wire complying with **ASTM B 211** (ASTM B 211M), Alloy 6061-T94.

2.5 STAINLESS STEEL

- A. Tubing: ASTM A 554, [**Grade MT 304**] [**Grade MT 316L**].
- B. Pipe: ASTM A 312/A 312M, [**Grade TP 304**] [**Grade TP 316L**].
- C. Castings: ASTM A 743/A 743M, [**Grade CF 8 or CF 20**] [**Grade CF 8M or CF 3M**].
- D. Plate and Sheet: ASTM A 240/A 240M or ASTM A 666, [**Type 304**] [**Type 316L**].
- E. Expanded Metal: ASTM F 1267, [**Type I (expanded)**] [**Type II (expanded and flattened)**], Class 3 (corrosion-resistant steel), made from stainless-steel sheet, ASTM A 240/A 240M or ASTM A 666, [**Type 304**] [**Type 316**].
 - 1. Style Designation: [**3/4 number 13**] [**1-1/2 number 10**] <Insert designation>.
- F. Perforated Metal: Stainless-steel sheet, ASTM A 240/A 240M or ASTM A 666, [**Type 304**] [**Type 316L**], [**0.062 inch (1.59 mm)**] <Insert thickness> thick, [with **1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows**] <Insert description>.
- G. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. <Insert manufacturer's name; product name or designation>.
 - 2. or approved equal.
- H. Woven-Wire Mesh: Intermediate-crimp, [**diamond**] [**square**] pattern, **2-inch (50-mm)** woven-wire mesh, made from **0.135-inch (3.5-mm)** nominal diameter wire complying with ASTM A 580/A 580M, [**Type 304**] [**Type 316**].

2.6 FASTENERS

A. General: Provide the following:

1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or [ASTM F 1941](#) (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.
2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
3. Aluminum Railings: **[Type 304]** **[Type 316]** stainless-steel fasteners.
4. Stainless-Steel Railings: **[Type 304]** **[Type 316]** stainless-steel fasteners.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated **[and capable of withstanding design loads]**.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
3. Provide **[Phillips]** **[tamper-resistant]** **[square or hex socket]** flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: **[Torque-controlled expansion anchors]** **[or]** **[chemical anchors]** capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or [ASTM F 1941](#) (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy **[Group 1 (A1)]** **[Group 2 (A4)]** stainless-steel bolts, [ASTM F 593](#) (ASTM F 738M), and nuts, [ASTM F 594](#) (ASTM F 836M).

2.7 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For **[aluminum]** **[and]** **[stainless-steel]** railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

- B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Shop Primers: Provide primers that comply with [Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."] [Section 099600 "High-Performance Coatings."] [Section 099113 "Exterior Painting,"Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."]
- F. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- G. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. <Insert, in separate subparagraphs, manufacturer's name; product name or designation>.
 - b. or approved equal.
- H. Shop Primer for Galvanized Steel: [Cementitious galvanized metal primer complying with MPI#26] [Vinyl wash primer complying with MPI#80] [Water based galvanized metal primer complying with MPI#134].
- I. Intermediate Coats and Topcoats: Provide products that comply with [Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."] [Section 099600 "High-Performance Coatings."] [Section 099113 "Exterior Painting,"Section 099123 "Interior Painting,"and Section 099600 "High-Performance Coatings."]
- J. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. <Insert, in separate subparagraphs, manufacturer's name; product name or designation>.
 - b. or approved equal.
- K. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.
1. Products: Subject to compliance with requirements, provide one of the following:

- a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
 - b. or approved equal.
- L. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- M. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- N. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
1. Water-Resistant Product: **[At exterior locations] [and] [where indicated]** provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.8 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage[, **but not less than that required to support structural loads**].
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately **1/32 inch** (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with **[welded] [nonwelded] [either welded or nonwelded]** connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings. Reference Section 050510 "Welding" for general welding requirements.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove flux immediately.
 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- J. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- K. Form changes in direction as follows:
1. As detailed.
 2. **[By bending] [or] [by inserting prefabricated elbow fittings].**
 3. **[By flush bends] [or] [by inserting prefabricated flush-elbow fittings].**
 4. **[By radius bends of radius indicated] [or] [by inserting prefabricated elbow fittings of radius indicated].**
- L. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- M. Close exposed ends of railing members with prefabricated end fittings.
- N. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is **1/4 inch** (6 mm) or less.
- O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

- Q. For railing posts set in concrete, provide **[steel] [stainless-steel]** sleeves not less than **6 inches** (150 mm) long with inside dimensions not less than **1/2 inch** (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.
- R. For removable railing posts, fabricate slip-fit sockets from **[steel] [stainless-steel]** tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.
1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.
- S. Expanded-Metal Infill Panels: Fabricate infill panels from expanded metal made from same metal as railings in which they are installed.
1. Edge panels with U-shaped channels made from metal sheet, of same metal as expanded metal and not less than **0.043 inch** (1.1 mm) thick.
 2. Orient expanded metal with long dimension of diamonds **[parallel to top rail] [perpendicular to top rail] [horizontal] [vertical]**.
- T. Perforated-Metal Infill Panels: Fabricate infill panels from perforated metal made from **[steel] [galvanized steel] [aluminum] [stainless steel] [same metal as railings in which they are installed]**.
1. Edge panels with U-shaped channels made from metal sheet, of same metal as perforated metal and not less than **0.043 inch** (1.1 mm) thick.
 2. Orient perforated metal with pattern **[parallel to top rail] [perpendicular to top rail] [horizontal] [vertical] [as indicated on Drawings]**.
- U. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into **1-by-1/2-by-1/8-inch** (25-by-13-by-3-mm) metal channel frames. Make wire mesh and frames from same metal as railings in which they are installed.
1. Orient wire mesh with **[diamonds vertical] [wires perpendicular and parallel to top rail] [wires horizontal and vertical]**.
- V. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.
- 2.9 FINISHES, GENERAL
- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples.

Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.10 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize[**exterior**] steel and iron railings, including hardware, after fabrication.
2. Hot-dip galvanize indicated steel and iron railings, including hardware, after fabrication.
3. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
4. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
5. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
6. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

- D. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.

- E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with **[SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning.]" [SSPC-SP 3, "Power Tool Cleaning.]" [requirements indicated below:]**

1. Exterior Railings: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Railings Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Railings Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Railings: SSPC-SP 3, "Power Tool Cleaning."

- F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with **[universal shop primer] [primers specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting"]** unless **[zinc-rich primer is] [primers specified in Section 099600 "High-Performance Coatings" are]** indicated.
 2. Do not apply primer to galvanized surfaces.
- G. Shop-Painted Finish: Comply with **[Section 099113 "Exterior Painting."]** **[Section 099600 "High-Performance Coatings."]**
1. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range].**
- H. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.
1. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range].**

2.11 ALUMINUM FINISHES

- A. Mechanical Finish: AA-M12 (Mechanical Finish: nonspecular as fabricated).
- B. Clear Anodic Finish: AAMA 611, **[AA-M12C22A41, Class I, 0.018 mm] [AA-M12C22A31, Class II, 0.010 mm]** or thicker.
- C. Color Anodic Finish: AAMA 611, **[AA-M12C22A42/A44, Class I, 0.018 mm] [AA-M12C22A32/A34, Class II, 0.010 mm]** or thicker.
1. Color: **[Light bronze] [Medium bronze] [Dark bronze] [Black].**
 2. Color: **[Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors and color densities].**
- D. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils** (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>.**
- E. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with **[AAMA 2604] [AAMA 2605]** and containing not less than **[50] [70]** percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>.**

- F. High-Performance Organic Finish: **[Three] [Four]**-coat fluoropolymer finish complying with AAMA 2605 and containing not less than **[50] [70]** percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>.**

2.12 STAINLESS-STEEL FINISHES

- A. Remove tool and die marks and stretch lines, or blend into finish.
- B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- C. 180-Grit Polished Finish: Oil-ground, uniform, directionally textured finish.
- D. 320-Grit Polished Finish: Oil-ground, uniform, fine, directionally textured finish.
- E. Polished and Buffed Finish: Oil-ground, 180-grit finish followed by buffing.
- F. Directional Satin Finish: No. 4.
- G. Dull Satin Finish: No. 6.
- H. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.

- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of **1/16 inch in 3 feet** (2 mm in 1 m).
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed **1/4 inch in 12 feet** (5 mm in 3 m).
- C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field. Reference Section 050510 "Welding" for general welding requirements.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending **2 inches** (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within **6 inches** (150 mm) of post.

3.4 ANCHORING POSTS

- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with **[nonshrink, nonmetallic grout] [or] [anchoring cement]**, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core-drill holes not less than **5 inches** (125 mm) deep and **3/4 inch** (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with **[nonshrink,**

nonmetallic grout] [or] [**anchoring cement**], mixed and placed to comply with anchoring material manufacturer's written instructions.

- C. Cover anchorage joint with flange of same metal as post, [**welded to post after placing anchoring material**] [**attached to post with set screws**].
- D. Leave anchorage joint exposed with [**1/8-inch (3-mm) buildup, sloped away from post**] [**anchoring material flush with adjacent surface**].
- E. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For aluminum pipe railings, attach posts using fittings designed and engineered for this purpose.
 - 2. For stainless-steel pipe railings, weld flanges to post and bolt to supporting surfaces.
 - 3. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.
- F. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ATTACHING RAILINGS

- A. Anchor railing ends at walls with round flanges anchored to wall construction and [**welded to railing ends**] [or] [**connected to railing ends using nonwelded connections**].
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and [**welded to railing ends**] [or] [**connected to railing ends using nonwelded connections**].
- C. Attach railings to wall with wall brackets[, **except where end flanges are used**]. Provide brackets with **1-1/2-inch (38-mm)** clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
 - 1. Use type of bracket with [**flange tapped for concealed anchorage to threaded hanger bolt**] [**predrilled hole for exposed bolt anchorage**].
 - 2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets and railing end flanges to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.
 - 3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.

4. For steel-framed partitions, use hanger or lag bolts set into **[fire-retardant-treated]**wood backing between studs. Coordinate with stud installation to locate backing members.
5. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
6. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.6 ADJUSTING AND CLEANING

- A. Clean **[aluminum] [and] [stainless steel]** by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Apply by brush or spray to provide a minimum **2.0-mil** (0.05-mm) dry film thickness.
- C. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in **[Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."]** **[Section 099600 "High-Performance Coatings."]** **[Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."]**
- D. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.7 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 055213

SECTION 055300 - METAL GRATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Metal bar gratings.
2. Expanded-metal gratings.
3. Formed-metal plank gratings.
4. Extruded-aluminum plank gratings.
5. Glass-fiber-reinforced plastic gratings.
6. Metal frames and supports for gratings.

- B. Related Sections:

1. Section 050510 "Welding" for general welding requirements.
2. Section 051200 "Structural Steel Framing" for structural-steel framing system components.
3. Section 055100 "Metal Stairs" for grating treads and landings of steel-framed stairs.
4. Section 055213 "Pipe and Tube Railings" for metal pipe and tube handrails and railings.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design gratings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
 1. Floors: Uniform load of **125 lbf/sq. ft.** (6.00 kN/sq. m) or concentrated load of **2000 lbf** (8.90 kN), whichever produces the greater stress.

2. Floors: Uniform load of **250 lbf/sq. ft.** (11.97 kN/sq. m) or concentrated load of **3000 lbf** (13.40 kN), whichever produces the greater stress.
3. Walkways and Elevated Platforms Other Than Exits: Uniform load of **60 lbf/sq. ft.** (2.87 kN/sq. m).
4. Walkways and Elevated Platforms Used as Exits: Uniform load of **100 lbf/sq. ft.** (4.79 kN/sq. m).
5. Sidewalks and Vehicular Driveways, Subject to Trucking: Uniform load of **250 lbf/sq. ft.** (11.97 kN/sq. m) or concentrated load of **8000 lbf** (35.60 kN), whichever produces the greater stress.
6. Limit deflection to **[L/240] [L/360] <Insert deflection ratio>** or **1/4 inch** (6.4 mm), whichever is less.

- C. Seismic Performance: Provide gratings capable of withstanding the effects of earthquake motions determined according to **[ASCE/SEI 7] <Insert requirement>**.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:

1. Formed-metal plank gratings.
2. Extruded-aluminum plank gratings.
3. Glass-fiber-reinforced plastic gratings.
4. Clips and anchorage devices for gratings.
5. Paint products.
6. Include data substantiating that materials comply with requirements.

- B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Laboratory Test Reports for Credit IEQ 4: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Shop Drawings: Include plans, sections, details, and attachments to other work.

- D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.

- B. Mill Certificates: Signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.
- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Metal Bar Grating Standards: Comply with **[NAAMM MBG 531, "Metal Bar Grating Manual]" and [NAAMM MBG 532, "Heavy-Duty Metal Bar Grating Manual]."**
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.3, "Structural Welding Code - Sheet Steel."
 - 4. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

1.9 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 FERROUS METALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25] <Insert number> percent.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Bars for Bar Gratings: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.
- D. Wire Rod for Bar Grating Crossbars: [ASTM A 510](#) (ASTM A 510M).
- E. Uncoated Steel Sheet: ASTM A 1011/A 1011M, structural steel, [Grade 30](#) (Grade 205).
- F. Galvanized-Steel Sheet: ASTM A 653/A 653M, structural quality, [Grade 33](#) (Grade 230), with [G90](#) (Z275) coating.
- G. Expanded-Metal Carbon Steel: ASTM F 1267, Class 1.
- H. Expanded-Metal Galvanized Steel: ASTM F 1267, Class 2, Grade A.
- I. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, [**Type 304**] [**Type 316**].
- J. Stainless-Steel Bars and Shapes: ASTM A 276, [**Type 304**] [**Type 316**].
- K. Expanded-Metal Stainless Steel: ASTM F 1267, Class 3, made from stainless-steel sheet, ASTM A 666, [**Type 304**] [**Type 316**].

2.2 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer for type of use indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- B. Extruded Bars and Shapes: [ASTM B 221](#) (ASTM B 221M), alloys as follows:
 - 1. 6061-T6 or 6063-T6, for bearing bars of gratings and shapes.
 - 2. 6061-T1, for grating crossbars.

- C. Aluminum Sheet: [ASTM B 209](#) (ASTM B 209M), Alloy 5052-H32.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide [**Type 304**] [**Type 316**] stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or [ASTM F 1941](#) (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless steel fasteners for fastening stainless steel.

- B. Steel Bolts and Nuts: Regular hexagon-head bolts, [ASTM A 307, Grade A](#) (ASTM F 568M, Property Class 4.6); with hex nuts, [ASTM A 563](#) (ASTM A 563M); and, where indicated, flat washers.

- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; [ASTM F 593](#) (ASTM F 738M) for bolts and [ASTM F 594](#) (ASTM F 836M) for nuts, Alloy [**Group 1 (A1)**] [**Group 2 (A4)**].

- D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, [ASTM A 563](#) (ASTM A 563M); and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

- E. Plain Washers: Round, [ASME B18.22.1](#) (ASME B18.22M).

- F. Lock Washers: Helical, spring type, [ASME B18.21.1](#) (ASME B18.21.2M).

- G. Post-Installed Anchors: [**Torque-controlled expansion anchors**] [**or**] [**chemical anchors**] capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or [ASTM F 1941](#) (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy [**Group 1 (A1)**] [**Group 2 (A4)**] stainless-steel bolts, [ASTM F 593](#) (ASTM F 738M), and nuts, [ASTM F 594](#) (ASTM F 836M).

2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy that is welded.

- B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Primers: Provide primers that comply with [**Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."**] [**Section 099600 "High-Performance Coatings."**] [**Section 099113 "Exterior Painting" and Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."**]
- D. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- E. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
 - b. or approved equal.
- F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 FABRICATION

- A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately **1/32 inch** (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.
- D. Fit exposed connections accurately together to form hairline joints.
- E. Welding: Reference Section 050510 "Welding" for general welding requirements. Comply with AWS recommendations and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

1. Fabricate toeplates to fit grating units and weld to units in shop unless otherwise indicated.
2. Fabricate toeplates for attaching in the field.
3. Toeplate Height: **4 inches** (100 mm) unless otherwise indicated.

2.6 METAL BAR GRATINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alabama Metal Industries Corporation; a Gibraltar Industries company.
2. All American Grating.
3. BarnettBates Corporation.
4. Borden Metal Products (Canada) Limited.
5. Fisher & Ludlow; Division of Harris Steel Limited.
6. Grating Pacific, Inc.
7. Grupo Metelmex, S.A. de C.V.
8. IKG Industries; a division of Harsco Corporation.
9. Marwas Steel Co.; Laurel Steel Products Division.
10. Ohio Gratings, Inc.
11. Seidelhuber Metal Products; Division of Brodhead Steel Products.
12. **<Insert manufacturer's name>**.
13. or approved equal.

B. Welded Steel Grating [**MBG-#>**]:

1. Bearing Bar Spacing: [**7/16 or 1/2 inch** (11 or 13 mm)] [**11/16 inch** (17 mm)] [**15/16 inch** (24 mm)] [**1-3/16 inches** (30 mm)] [**1-3/8 inches** (35 mm)] [**1-7/8 inches** (48 mm)] [**2-3/8 inches** (60 mm)] **<Insert dimension(s)> o.c.**
2. Bearing Bar Depth: [**3/4 inch** (19 mm)] [**1 inch** (25 mm)] [**1-1/4 inches** (32 mm)] [**1-1/2 inches** (38 mm)] [**1-3/4 inches** (44 mm)] [**2 inches** (51 mm)] [**2-1/4 inches** (57 mm)] [**2-1/2 inches** (64 mm)] [**3 inches** (76 mm)] [**3-1/2 inches** (89 mm)] [**4 inches** (102 mm)] [**4-1/2 inches** (114 mm)] [**5 inches** (127 mm)] [**As required to comply with structural performance requirements**].
3. Bearing Bar Thickness: [**1/8 inch** (3.2 mm)] [**3/16 inch** (4.8 mm)] [**1/4 inch** (6.4 mm)] [**3/8 inch** (9.5 mm)] [**As required to comply with structural performance requirements**].
4. Crossbar Spacing: [**2 inches** (51 mm)] [**4 inches** (102 mm)] o.c.
5. Grating Mark W-11-4 (1 x 3/16) STEEL: **1-by-3/16-inch** (25-by-4.8-mm) bearing bars at **11/16 inch** (18 mm) o.c., and crossbars at **4 inches** (102 mm) o.c.
6. Grating Mark W-15-4 (1 x 1/8) STEEL: **1-by-1/8-inch** (25-by-3.2-mm) bearing bars at **15/16 inch** (24 mm) o.c., and crossbars at **4 inches** (102 mm) o.c.

7. Grating Mark W-19-4 (1-1/4 x 3/16) STEEL: 1-1/4-by-3/16-inch (32-by-4.8-mm) bearing bars at 1-3/16 inches (30 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
 8. Grating Mark W-19-4 (1-1/2 x 3/16) STEEL: 1-1/2-by-3/16-inch (38-by-4.8-mm) bearing bars at 1-3/16 inches (30 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
 9. Grating Mark W-19-4 (2 x 1/4) STEEL: 2-by-1/4-inch (51-by-6.4-mm) bearing bars at 1-3/16 inches (30 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
 10. Grating Mark W-30-4 (5 x 3/8) STEEL: 5-by-3/8-inch (127-by-9.5-mm) bearing bars at 1-7/8 inches (60 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
 11. Grating Mark: As indicated.
 12. Traffic Surface: **[Plain] [Serrated] [Knurled] [Applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive] [As indicated]**.
 13. Steel Finish: **[Shop primed] [Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. (550 g/sq. m) of coated surface]**.
- C. Pressure-Locked Steel Grating **[MBG-<#>]**: Fabricated by **[pressing rectangular flush-top crossbars into slotted bearing bars] [or] [swaging crossbars between bearing bars]**.
1. Bearing Bar Spacing: **[7/16 or 1/2 inch (11 or 13 mm)] [11/16 inch (17 mm)] [15/16 inch (24 mm)] [1-3/16 inches (30 mm)] <Insert dimension(s)> o.c.**
 2. Bearing Bar Depth: **[3/4 inch (19 mm)] [1 inch (25 mm)] [1-1/4 inches (32 mm)] [1-1/2 inches (38 mm)] [1-3/4 inches (44 mm)] [2 inches (51 mm)] [2-1/4 inches (57 mm)] [2-1/2 inches (64 mm)] [As required to comply with structural performance requirements] <Insert depth>.**
 3. Bearing Bar Thickness: **[1/8 inch (3.2 mm)] [3/16 inch (4.8 mm)] [As required to comply with structural performance requirements] <Insert thickness>.**
 4. Crossbar Spacing: **[2 inches (51 mm)] [4 inches (102 mm)] o.c.**
 5. Grating Mark P-11-4 (1 x 3/16) STEEL: 1-by-3/16-inch (25-by-4.8-mm) bearing bars at 11/16 inch (18 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
 6. Grating Mark P-15-4 (1-1/4 x 1/8) STEEL: 1-1/4-by-1/8-inch (32-by-3.2-mm) bearing bars at 15/16 inch (24 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
 7. Grating Mark P-19-4 (1-1/2 x 3/16) STEEL: 1-1/2-by-3/16-inch (38-by-4.8-mm) bearing bars at 1-3/16 inches (30 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
 8. Grating Mark: As indicated.
 9. Traffic Surface: **[Plain] [Serrated] [Knurled] [Applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive] [As indicated]**.
 10. Steel Finish: **[Shop primed] [Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. (550 g/sq. m) of coated surface]**.
- D. Riveted Steel Grating **[MBG-<#>]**:
1. Bearing Bar Spacing: **[3/4 inch (19 mm)] [1-1/8 inches (29 mm)] [2-5/16 inches (59 mm)] <Insert dimension>, clear.**
 2. Bearing Bar Depth: **[3/4 inch (19 mm)] [1 inch (25 mm)] [1-1/4 inches (32 mm)] [1-1/2 inches (38 mm)] [1-3/4 inches (44 mm)] [2 inches (51 mm)] [2-1/4 inches (57**

- mm)] [2-1/2 inches (64 mm)] [3 inches (76 mm)] [3-1/2 inches (89 mm)] [4 inches (102 mm)] [4-1/2 inches (114 mm)] [5 inches (127 mm)] [As required to comply with structural performance requirements].
3. Bearing Bar Thickness: [1/8 inch (3.2 mm)] [3/16 inch (4.8 mm)] [1/4 inch (6.4 mm)] [3/8 inch (9.5 mm)] [As required to comply with structural performance requirements].
 4. Rivet Spacing: [3-1/2 inches (89 mm)] [5 inches (127 mm)] [7 inches (178 mm)] o.c. along bearing bar.
 5. Grating Mark R-12-3-1/2 (1 x 1/8) STEEL: 1-by-1/8-inch (25-by-3.2-mm) bearing bars with 3/4-inch (19-mm) clear space between bearing bars, and rivets at 3-1/2 inches (89 mm) o.c. along bearing bar.
 6. Grating Mark R-18-7 (1-1/2 x 3/16) STEEL: 1-1/2-by-3/16-inch (38-by-4.8-mm) bearing bars with 1-1/8-inch (29-mm) clear space between bearing bars, and rivets at 7 inches (178 mm) o.c. along bearing bar.
 7. Grating Mark R-37-5 (4 x 1/4) STEEL: 4-by-1/4-inch (102-by-6.4-mm) bearing bars with 2-5/16-inch (59-mm) clear space between bearing bars, and rivets at 5 inches (127 mm) o.c. along bearing bar.
 8. Grating Mark R-37-5 (5 x 3/8) STEEL: 5-by-3/8-inch (127-by-9.5-mm) bearing bars with 2-5/16-inch (59-mm) clear space between bearing bars, and rivets at 5 inches (127 mm) o.c. along bearing bar.
 9. Grating Mark: As indicated.
 10. Traffic Surface: [Plain] [Serrated] [Knurled] [Applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive] [As indicated].
 11. Steel Finish: [Shop primed] [Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. (550 g/sq. m) of coated surface].
- E. Pressure-Locked, Stainless-Steel Grating [MBG-<#>]: Fabricated by [pressing rectangular flush-top crossbars into slotted bearing bars] [or] [swaging crossbars between bearing bars].
1. Bearing Bar Spacing: [7/16 or 1/2 inch (11 or 13 mm)] [11/16 inch (17 mm)] [15/16 inch (24 mm)] [1-3/16 inches (30 mm)] [1-3/8 inches (35 mm)] [1-7/8 inches (48 mm)] [2-3/8 inches (60 mm)] <Insert dimension(s)> o.c.
 2. Bearing Bar Depth: [3/4 inch (19 mm)] [1 inch (25 mm)] [1-1/4 inches (32 mm)] [1-1/2 inches (38 mm)] [1-3/4 inches (44 mm)] [2 inches (51 mm)] [2-1/4 inches (57 mm)] [2-1/2 inches (64 mm)] [3 inches (76 mm)] [3-1/2 inches (89 mm)] [4 inches (102 mm)] [4-1/2 inches (114 mm)] [5 inches (127 mm)] [As required to comply with structural performance requirements].
 3. Bearing Bar Thickness: [1/8 inch (3.2 mm)] [3/16 inch (4.8 mm)] [1/4 inch (6.4 mm)] [3/8 inch (9.5 mm)] [As required to comply with structural performance requirements].
 4. Crossbar Spacing: [2 inches (51 mm)] [4 inches (102 mm)] o.c.
 5. Grating Mark P-11-4 (1 x 3/16) STAINLESS STEEL: 1-by-3/16-inch (25-by-4.8-mm) bearing bars at 11/16 inch (18 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
 6. Grating Mark P-15-2 (1 x 1/8) STAINLESS STEEL: 1-by-1/8-inch (25-by-3.2-mm) bearing bars at 15/16 inch (24 mm) o.c., and crossbars at 2 inches (51 mm) o.c.

7. Grating Mark P-19-4 (1-1/2 x 3/16) STAINLESS STEEL: 1-1/2-by-3/16-inch (38-by-4.8-mm) bearing bars at 1-3/16 inches (30 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
 8. Grating Mark P-30-4 (3 x 3/8) STAINLESS STEEL: 3-by-3/8-inch (76-by-9.5-mm) bearing bars at 1-7/8 inches (48 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
 9. Grating Mark: As indicated.
 10. Traffic Surface: **[Plain] [Serrated] [Knurled] [Applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive] [As indicated].**
 11. Finish: **[Mill finish] [Abrasive blasted] [Electropolished].**
- F. Pressure-Locked, Rectangular Bar Aluminum Grating **[MBG-<#>]**: Fabricated by **[pressing rectangular flush-top crossbars into slotted bearing bars] [or] [swaging crossbars between bearing bars].**
1. Bearing Bar Spacing: **[7/16 or 1/2 inch (11 or 13 mm)] [11/16 inch (17.5 mm)] [15/16 inch (24 mm)] [1-3/16 inches (30 mm)] <Insert dimension(s)> o.c.**
 2. Bearing Bar Depth: **[1 inch (25 mm)] [1-1/4 inches (32 mm)] [1-1/2 inches (38 mm)] [1-3/4 inches (44 mm)] [2 inches (51 mm)] [2-1/4 inches (57 mm)] [2-1/2 inches (64 mm)] [As required to comply with structural performance requirements].**
 3. Bearing Bar Thickness: **[1/8 inch (3.2 mm)] [3/16 inch (4.8 mm)] [1/4 inch (6.4 mm)] [As required to comply with structural performance requirements].**
 4. Crossbar Spacing: **[2 inches (51 mm)] [4 inches (102 mm)] o.c.**
 5. Grating Mark P-7-4 (1 x 1/8) ALUMINUM: 1-by-1/8-inch (25-by-3.2-mm) bearing bars at 7/16 inch (11 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
 6. Grating Mark P-11-4 (1 x 3/16) ALUMINUM: 1-by-3/16-inch (25-by-4.8-mm) bearing bars at 11/16 inch (18 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
 7. Grating Mark P-15-4 (1-1/2 x 3/16) ALUMINUM: 1-1/2-by-3/16-inch (38-by-4.8-mm) bearing bars at 15/16 inch (24 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
 8. Grating Mark P-19-4 (2 x 3/16) ALUMINUM: 2-by-3/16-inch (51-by-4.8-mm) bearing bars at 1-3/16 inches (30 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
 9. Grating Mark: As indicated.
 10. Traffic Surface: **[Plain] [Applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive] [As indicated].**
 11. Aluminum Finish: **[Mill finish] [Class I, clear, anodized finish].**
- G. Pressure-Locked, Aluminum I-Bar Grating **[MBG-<#>]**: Fabricated by swaging crossbars between bearing bars.
1. Bearing Bar Spacing: **[7/16 or 1/2 inch (11 or 13 mm)] [11/16 inch (17 mm)] [15/16 inch (24 mm)] [1-3/16 inches (30 mm)] <Insert dimension(s)> o.c.**
 2. Bearing Bar Depth: **[1 inch (25 mm)] [1-1/4 inches (32 mm)] [1-1/2 inches (38 mm)] [1-3/4 inches (44 mm)] [2 inches (51 mm)] [2-1/4 inches (57 mm)] [2-1/2 inches (64 mm)] [As required to comply with structural performance requirements].**
 3. Bearing Bar Flange Width: **1/4 inch (6.4 mm).**
 4. Crossbar Spacing: **[2 inches (51 mm)] [4 inches (102 mm)] o.c.**
 5. Grating Mark P-11-4 (1 I-Bar) ALUMINUM: 1-inch (25-mm) I-bar bearing bars at 11/16 inch (18 mm) o.c., and crossbars at 4 inches (102 mm) o.c.

6. Grating Mark P-15-2 (1 I-Bar) ALUMINUM: **1-inch** (25-mm) I-bar bearing bars at **15/16 inch** (24 mm) o.c., and crossbars at **2 inches** (51 mm) o.c.
 7. Grating Mark P-19-4 (1-1/2 I-Bar) ALUMINUM: **1-1/2-inch** (38-mm) I-bar bearing bars at **1-3/16 inches** (30 mm) o.c., and crossbars at **4 inches** (102 mm) o.c.
 8. Grating Mark: As indicated.
 9. Traffic Surface: **[Plain] [Grooved] [Applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive] [As indicated]**.
 10. Aluminum Finish: **[Mill finish] [Class I, clear, anodized finish]**.
- H. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.
1. Provide no fewer than four weld lugs for each heavy-duty grating section, with each lug shop welded to two bearing bars.
 2. Provide no fewer than four saddle clips for each grating section composed of rectangular bearing bars **3/16 inch** (4.8 mm) or less in thickness and spaced **15/16 inch** (24 mm) or more o.c., with each clip designed and fabricated to fit over two bearing bars.
 3. Provide no fewer than four weld lugs for each grating section composed of rectangular bearing bars **3/16 inch** (4.8 mm) or less in thickness and spaced less than **15/16 inch** (24 mm) o.c., with each lug shop welded to three or more bearing bars. Interrupt intermediate bearing bars as necessary for fasteners securing grating to supports.
 4. Provide no fewer than four flange blocks for each section of aluminum I-bar grating, with block designed to fit over lower flange of I-shaped bearing bars.
 5. Furnish threaded bolts with nuts and washers for securing grating to supports.
 6. Furnish self-drilling fasteners with washers for securing grating to supports.
 7. Furnish galvanized malleable-iron flange clamp with galvanized bolt for securing grating to supports. Furnish as a system designed to be installed from above grating by one person.
- a. Products: Subject to compliance with requirements, provide one of the following:
- 1) Kee Industrial Products, Inc.; Grating Clip.
 - 2) Lindapter North America, Inc.; Grate-Fast.
 - 3) **<Insert manufacturer's name; product name or designation>**.
 - 4) or approved equal.
- I. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.
1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.
- J. Do not notch bearing bars at supports to maintain elevation.

2.7 EXPANDED-METAL GRATINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Alabama Metal Industries Corporation; a Gibraltar Industries company.
 2. All American Grating.
 3. Central Expanded Metal, Inc.
 4. Fisher & Ludlow; Division of Harris Steel Limited.
 5. Grating Pacific, Inc.
 6. **<Insert manufacturer's name>**.
 7. or approved equal.
- B. Provide expanded-metal gratings in material, finish, style, size, thickness, weight, and type indicated or, if not indicated, as recommended by manufacturer for indicated applications and as needed to support indicated loads.
1. Material: [**Steel**] [**Stainless steel**] [**Aluminum**].
 2. Steel Finish: [**Unfinished, oiled**] [**Shop primed**] [**Galvanized**].
 3. Stainless-Steel Finish: Mill finish, as fabricated.
 4. Aluminum Finish: Mill finish, as fabricated.
 5. Style Designation: [**4.27 lb**] [**3/4 number 9**].
 6. Style Designation: [**1-1/2 number 9**] [**3/4 number 9**].
 7. Size: [**2 lb**] [**3/4 0.188**] [**1-1/2 0.125**].
 8. Type: [**I, expanded**] [**II, expanded and flattened**].
- C. Fabricate cutouts in grating sections for penetrations of sizes and at locations indicated. Cut openings neatly and accurately to size. Edge-band openings with bars having a thickness not less than overall grating thickness at contact points.
- D. Where gratings are pierced by pipes, ducts, and structural members, cut openings neatly and accurately to size and weld a strap collar not less than **1/8 inch** (3 mm) thick to the cut ends. Divide panels into sections only to extent required for installation where grating platforms and runways are to be placed around previously installed pipe, ducts, and structural members.

2.8 FORMED-METAL PLANK GRATINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Alabama Metal Industries Corporation; a Gibraltar Industries company.
 2. Fisher & Ludlow; Division of Harris Steel Limited.
 3. Grating Pacific, Inc.
 4. GS Metals Corp.
 5. IKG Industries; a division of Harsco Corporation.
 6. Morton Manufacturing Company.
 7. Unistrut.
 8. **<Insert manufacturer's name>**.

9. or approved equal.
- B. C-shaped channels rolled from heavy sheet metal of thickness indicated, and punched in serrated diamond shape to produce raised slip-resistant surface and drainage holes.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Alabama Metal Industries Corporation, a Gibraltar Industries company; Diamond Grip.
 - b. Fisher & Ludlow, Division of Harris Steel Limited; Grip Span.
 - c. GS Metals Corp.; Grip Strut.
 - d. IKG Industries, a division of Harsco Corporation; Deck Span.
 - e. Morton Manufacturing Company; Grip-Tac.
 - f. **<Insert manufacturer's name; product name or designation>**.
 - g. or approved equal.
 2. Channel Width: [4-3/4 inches (121 mm)] [7 inches (178 mm)] [9-1/2 inches (241 mm)] [11-3/4 inches (298 mm)] [18-3/4 inches (476 mm)] [24 inches (610 mm)] [**As indicated**] [**As required to comply with structural performance requirements**].
 3. Channel Depth: [1-1/2 inches (38 mm)] [2 inches (51 mm)] [2-1/2 inches (64 mm)] [3 inches (76 mm)] [**As indicated**] [**As required to comply with structural performance requirements**].
 4. Material: [0.074-inch- (1.9-mm-) **thick steel sheet, shop primed**] [0.104-inch- (2.65-mm-) **thick steel sheet, shop primed**] [0.079-inch- (2.0-mm-) **thick, hot-dip galvanized-steel sheet**] [0.108-inch- (2.8-mm-) **thick, hot-dip galvanized-steel sheet**] [0.074-inch- (1.9-mm-) **thick steel sheet, hot-dip galvanized after fabrication**] [0.104-inch- (2.65-mm-) **thick steel sheet, hot-dip galvanized after fabrication**] [0.062-inch- (1.6-mm-) **thick, stainless-steel sheet**] [0.078-inch- (2.0-mm-) **thick, stainless-steel sheet**] [0.080-inch- (2.0-mm-) **thick aluminum sheet**] [0.100-inch- (2.5-mm-) **thick aluminum sheet**].
- C. Fabricate cutouts in grating sections for penetrations of sizes and at locations indicated. Cut openings neatly and accurately to size. Edge-band openings with metal sheet or bars having a thickness not less than grating material.
- D. Where gratings are pierced by pipes, ducts, and structural members, cut openings neatly and accurately to size and weld a strap collar not less than 1/8 inch (3 mm) thick to the cut ends. Divide panels into sections only to extent required for installation where grating platforms and runways are to be placed around previously installed pipe, ducts, and structural members.
- ## 2.9 EXTRUDED-ALUMINUM PLANK GRATINGS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Alabama Metal Industries Corporation; a Gibraltar Industries company.
 2. IKG Industries; a division of Harsco Corporation.

3. Ohio Gratings, Inc.
 4. Seidelhuber Metal Products; Division of Brodhead Steel Products.
 5. **<Insert manufacturer's name>**.
 6. or approved equal.
- B. Provide extruded-aluminum plank gratings in type, size, and finish indicated or, if not indicated, as recommended by manufacturer for indicated applications and as needed to support indicated loads.
1. Type: Extruded-aluminum planks approximately **6 inches** (152 mm) wide with multiple flanges approximately **1.2 inches** (30 mm) o.c., acting as bearing bars connected by a web that serves as a walking surface. Top surface has raised ribs to increase slip resistance.
 2. Depth: [**1 inch** (25 mm)] [**1-1/2 inches** (38 mm)] [**2 inches** (51 mm)] [**As required to comply with structural performance requirements**].
 3. Perforations: [**None**] [**Rectangular, 19/32 by 3 inches** (15 by 76 mm), **with adjacent rows staggered**] [**19/32 inch** (15 mm) **square, with adjacent rows aligned**].
 4. Finish: Mill finish, as fabricated.
- C. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

2.10 GLASS-FIBER-REINFORCED PLASTIC GRATINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Grating, LLC.
 2. Creative Pultrusions, Inc.
 3. Enduro Systems Inc.; Composite Products Division.
 4. Fibergrate Composite Structures Inc.
 5. Fisher & Ludlow; Division of Harris Steel Limited.
 6. Grating Pacific, Inc.
 7. Seasafe, Inc.; a Gibraltar Industries company.
 8. Strongwell Corporation.
 9. **<Insert manufacturer's name>**.
 10. or approved equal.
- B. Molded Glass-Fiber-Reinforced Gratings: Bar gratings made by placing glass-fiber strands that have been saturated with thermosetting plastic resin in molds in alternating directions to form interlocking bars without voids and with a high resin content.
1. Configuration: [**1-1/2-inch-** (38-mm-) **square mesh, 1 inch** (25 mm) **thick**] [**1-1/2-inch-** (38-mm-) **square mesh, 1-1/4 inches** (32 mm) **thick**] [**1-1/2-inch-** (38-mm-) **square mesh, 1-1/2 inches** (38 mm) **thick**] [**2-inch-** (51-mm-) **square mesh, 2 inches** (51 mm) **thick**] [**1-1/2-inch-** (38-mm-) **square mesh, thickness as required to comply with structural performance requirements**] [**As required**]

to comply with structural performance requirements] <Insert configuration>.

2. Weight: [2.5 lb/sq. ft. (12.2 kg/sq. m)] [2.7 lb/sq. ft. (13.2 kg/sq. m)] [3.2 lb/sq. ft. (15.6 kg/sq. m)] [3.5 lb/sq. ft. (17.1 kg/sq. m)] [3.7 lb/sq. ft. (18.1 kg/sq. m)] [4.1 lb/sq. ft. (20.0 kg/sq. m)] [5.0 lb/sq. ft. (24.4 kg/sq. m)] <Insert value>.
3. Resin: [Polyester] [Vinylester] <Insert description>.
 - a. Flame-Spread Index: 25 or less when tested according to ASTM E 84.
 - b. U.S.D.A. Acceptance: Accepted for food-processing applications.
4. Color: [Beige] [Gray] [Green] [Orange] [Yellow] [Manufacturer's standard].
5. Traffic Surface: [Plain, meniscus] [Applied abrasive finish] [As indicated].

C. Pultruded Glass-Fiber-Reinforced Gratings: Bar gratings assembled from components made by simultaneously pulling glass fibers and extruding thermosetting plastic resin through a heated die under pressure to produce a product without voids and with a high glass-fiber content.

1. Configuration: [I4010; 1-inch (25-mm) I-bars spaced 1 inch (25 mm) o.c. (40 percent open)] [I6010; 1-inch (25-mm) I-bars spaced 1-1/2 inches (38 mm) o.c. (60 percent open)] [I4015; 1-1/2-inch (38-mm) I-bars spaced 1 inch (25 mm) o.c. (40 percent open)] [I6015; 1-1/2-inch (38-mm) I-bars spaced 1-1/2 inches (38 mm) o.c. (60 percent open)] [T3320; 2-inch (51-mm) T-bars spaced 1-1/2 inches (38 mm) o.c. (33 percent open)] [T5020; 2-inch (51-mm) T-bars spaced 2 inches (51 mm) o.c. (50 percent open)] [As required to comply with structural performance requirements] <Insert configuration>.
2. Weight: [2.35 lb/sq. ft. (11.5 kg/sq. m)] [2.83 lb/sq. ft. (13.8 kg/sq. m)] [3.10 lb/sq. ft. (15.1 kg/sq. m)] [3.41 lb/sq. ft. (16.6 kg/sq. m)] [4.10 lb/sq. ft. (20.0 kg/sq. m)] [4.13 lb/sq. ft. (20.2 kg/sq. m)] <Insert value>.
3. Resin Type: [Polyester] [Vinylester] <Insert description>.
 - a. Flame-Spread Index: 25 or less when tested according to ASTM E 84.
 - b. U.S.D.A. Acceptance: Accepted for food processing applications.
4. Color: [Beige] [Gray] [Green] [Orange] [Yellow] [Manufacturer's standard].
5. Traffic Surface: [Plain, grooved] [Applied abrasive finish] [As indicated].

D. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

2.11 GRATING FRAMES AND SUPPORTS

A. Frames and Supports for Metal Gratings: Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

1. Unless otherwise indicated, fabricate from same basic metal as gratings.

2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors **24 inches** (600 mm) o.c. and provide minimum anchor units in the form of steel straps **1-1/4 inches** (32 mm) wide by **1/4 inch** (6 mm) thick by **8 inches** (200 mm) long.
- B. Frames and Supports for Glass-Fiber-Reinforced Plastic Gratings: Fabricate from glass-fiber-reinforced plastic shapes of sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
1. Unless otherwise indicated, use shapes made from same resin as gratings.
 2. Equip units indicated to be cast into concrete or built into masonry with integral anchors.
- C. Galvanize steel frames and supports in the following locations:
1. Exterior.
 2. Interior[, **where indicated**].

2.12 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

2.13 STEEL FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish gratings, frames, and supports after assembly.
- C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- D. Shop prime gratings, frames and supports[**not indicated to be galvanized**] unless otherwise indicated.
1. Shop prime with [**universal shop primer**] [**primers specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting"**] unless [**zinc-rich primer is**] [**primers specified in Section 099600 "High-Performance Coatings" are**] indicated.

- E. Preparation for Shop Priming: Prepare surfaces to comply with [**SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."**] [**SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."**] [requirements indicated below:]
1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 4. Other Items: SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
- F. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.
- D. Fit exposed connections accurately together to form hairline joints.
1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- E. Attach toeplates to gratings by welding at locations indicated.
- F. Field Welding: Reference Section 050510 "Welding" for general welding requirements. Comply with the following requirements:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.

- G. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.2 INSTALLING METAL BAR GRATINGS

- A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
- B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.
- C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.3 INSTALLING EXPANDED-METAL GRATINGS

- A. General: Comply with manufacturer's written instructions for installing gratings.
- B. Place units with straight edge of bond up and with long direction of diamond-shaped openings parallel to direction of span.
- C. Attach removable units to supporting members by bolting at **6-inch** (150-mm) intervals.
- D. Attach nonremovable units to supporting members by welding unless otherwise indicated. Space welds at **6-inch** (150-mm) intervals.
- E. Attach aluminum units to steel supporting members by bolting at **6-inch** (150-mm) intervals.
- F. Butt edges parallel to long direction of diamond-shaped openings and weld at every second bond point. Place individual grating sections so diamonds of one piece are aligned with those of adjacent sections.

3.4 INSTALLING METAL PLANK GRATINGS

- A. General: Comply with manufacturer's written instructions for installing gratings. Use manufacturer's standard anchor clips and hold-down devices for bolted connections.
- B. Attach removable units to supporting members by bolting at every point of contact.
- C. Attach nonremovable units to supporting members by welding unless otherwise indicated. Comply with manufacturer's written instructions for size and spacing of welds.

- D. Attach aluminum units to steel supporting members by bolting at side channels at every point of contact and by bolting intermediate planks at each end on alternate sides. Bolt adjacent planks together at midspan.

3.5 INSTALLING GLASS-FIBER-REINFORCED PLASTIC GRATINGS

- A. Comply with manufacturer's written instructions for installing gratings. Use manufacturer's standard stainless-steel anchor clips and hold-down devices for bolted connections.

3.6 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

- 1. Apply by brush or spray to provide a minimum **2.0-mil** (0.05-mm) dry film thickness.

- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 055300

SECTION 055813 - COLUMN COVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes [**spackled-seam**] [**and**] [**snap-together**] metal column covers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product, including finishing materials.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For [**adhesives**] [**and**] [**sealants**], documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit IEQ 4.1: For [**adhesives**] [**and**] [**sealants**], documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - 3. Laboratory Test Reports for Credit IEQ 4.2: For paints and coatings, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Shop Drawings: Show fabrication and installation details for column covers.
- D. Samples for Initial Selection: For products involving selection of color, texture, or design[, **including mechanical finishes**].
- E. Samples for Verification: For each type of exposed finish required, prepared on **6-inch-**
(150-mm-) square Samples of metal of same thickness and material indicated for the Work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[fabricator] [organic-coating applicator] [anodic finisher] [and] [powder-coating applicator]**.
- B. Mill Certificates: Signed by stainless-steel manufacturers certifying that products furnished comply with requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For **[mirrorlike stainless-steel finish] [and] [statuary conversion coating copper-alloy finish]** to include in maintenance manuals.

1.6 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing column covers similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Organic-Coating Applicator Qualifications: A firm experienced in successfully applying organic coatings of type indicated to metals of types indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.
- C. Anodic Finisher Qualifications: A firm experienced in successfully applying anodic finishes of type indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.
- D. Powder-Coating Applicator Qualifications: A firm experienced in successfully applying powder coatings of type indicated to metals of types indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.
- E. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Build mockups of typical column covers.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver column covers wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 SPACKLED-SEAM COLUMN COVERS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
- [Fry Reglet Corporation.](#)
 - [MM Systems Corporation.](#)
 - [Pittcon Industries.](#)
 - <Insert manufacturer's name>.**
 - or approved equal.
- B. Form column covers from **0.125-inch (3.2-mm)** aluminum sheet complying with **ASTM B 209 (ASTM B 209M)**, with not less than strength and durability properties of Alloy 5005-H32; rolled to radii indicated. Taper edges of adjoining pieces of column covers, for taping and spackling, to **0.094-inch (2.4-mm)** thickness in approximately **1 inch (25 mm)** of width. Punch tapered edges for gypsum board screws at **1/2 inch (12 mm)** o.c., and mill grooves in tapered edge to improve bond with joint compound.
- Support Framing: At vertical joints, provide **1-1/2-by-3-5/8-inch (38-by-89-mm)** steel channel support posts formed from **0.040-inch (1.0-mm)** galvanized steel.
 - Joint Treatment Materials: Provide joint treatment compounds and reinforcing tape complying with requirements in Section 092900 "Gypsum Board."

2.2 SNAP-TOGETHER COLUMN COVERS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
- [ATAS International, Inc.](#)
 - [Ceilings Plus.](#)
 - [Construction Services, Inc.](#)
 - [Firestone Metal Products, LLC; Una-Clad.](#)
 - [Fry Reglet Corporation.](#)

6. [Hi-Tech Metals, Inc.](#)
7. [Industrial Louvers Inc.](#)
8. [Kanalco Ltd.](#)
9. [Leed Himmel Industries, Inc.](#)
10. [Metal Sales & Service, Inc.; Metalwerks Division.](#)
11. [MM Systems Corporation.](#)
12. [Pittcon Industries.](#)
13. [Protean Construction Products, Inc.](#)
14. [Southwest Metalsmiths.](#)
15. <Insert manufacturer's name>.
16. or approved equal.

B. Form column covers to shapes indicated from metal of type and minimum thickness indicated below. Return vertical edges and bend to form hook that engages continuous mounting clips.

1. Aluminum Sheet: [ASTM B 209](#) (ASTM B 209M), with not less than strength and durability properties of Alloy 5005-H32, [[0.063 inch](#) (1.60 mm)] <Insert dimension> thick.
 - a. Finish: [**Baked enamel or powder coat**] [**Siliconized polyester**] [**High-performance organic coating**] [**Mill**] [**Clear anodic**] [**Color anodic**].
2. Steel Sheet: Uncoated, cold-rolled, ASTM A 1008/A 1008M, commercial steel, exposed, [[0.060 inch](#) (1.52 mm)] <Insert dimension> thick.
 - a. Finish: [**Factory primed**] [**Baked enamel**] [**Powder coat**].
3. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, [**Type 304**] [**Type 316**], [[0.050 inch](#) (1.27 mm)] <Insert dimension> thick.
 - a. Finish: [**No. 2B**] [**No. 4**] [**No. 6**] [**No. 7**] [**No. 8**].
4. Bronze Sheet: ASTM B 36/B 36M, Alloy UNS C28000 (muntz metal, 60 percent copper) or Alloy UNS C23000 (red brass, 85 percent copper), [[0.051 inch](#) (1.29 mm)] <Insert dimension> thick.
 - a. Finish: [**Buffed finish, lacquered**] [**Hand-rubbed finish, lacquered**] [**Statuary conversion coating over satin finish**].
5. Brass Sheet: ASTM B 36/B 36M, Alloy UNS C26000 (cartridge brass, 70 percent copper), [[0.051 inch](#) (1.29 mm)] <Insert dimension> thick.
 - a. Finish: [**Buffed**] [**Hand-rubbed**] finish, lacquered.
6. Column covers may be fabricated from prefinished metal sheet in lieu of finishing after fabrication provided unfinished edges are concealed from view.
7. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide flat surfaces where indicated.

8. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
9. Form returns at vertical joints to provide hairline V-joints.
10. Form returns at vertical joints to provide [1/2-inch- (12-mm-)] [3/4-inch- (18-mm-)] wide reveal at joints. Provide snap-in metal filler strips at reveals that leave reveals [1/2 inch (12 mm) **deep**] [**flush**].
11. Form returns at vertical joints to accommodate backer rod and sealant.
12. Fabricate column covers with hairline horizontal V-joints produced by forming returns on mating ends of column cover sections. Locate horizontal joints as indicated.
13. Fabricate column covers without horizontal joints.
14. Fabricate column covers with horizontal butt joints, tightly fitted and backed with a sleeve for field splicing with adhesive.
15. Fabricate column covers with [1/2-inch- (12-mm-) **wide**] reveals at horizontal joints produced by forming returns on mating ends of column cover sections. Provide snap-in metal filler strips at reveals matching reveals at vertical joints. Locate horizontal joints as indicated.
16. Fabricate [**base**] [**ceiling**] ring to [**match**] [**contrast with**] column covers.
17. Fabricate with calk stop/stiffener ring.
18. Apply manufacturer's recommended sound-deadening [**insulation**] [**mastic**] to backs of column covers.

2.3 MISCELLANEOUS MATERIALS

- A. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated. Do not use metals that are incompatible with materials joined.
 1. Provide concealed fasteners for interconnecting column covers and for attaching them to other work unless[**otherwise indicated**][**exposed fasteners are unavoidable or are the standard fastening method**].
 2. Provide [**Phillips**] [**tamper-resistant**] [**square or hex socket**] flat-head machine screws for exposed fasteners unless otherwise indicated.
- B. Sound-Deadening Materials:
 1. Insulation: Unfaced, mineral-fiber blanket insulation complying with ASTM C 665, Type I, and passing ASTM E 136 test.
 2. Mastic: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- C. Backing Materials: Provided or recommended by column cover manufacturer.

2.4 PAINTS AND COATINGS

- A. Low-Emitting Materials: Paints and coatings applied to interior decorative formed metal items shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

- B. Lacquer for Copper Alloys: Clear, acrylic lacquer specially developed for coating copper-alloy products.
- C. Shop Primers: Comply with [**Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."**] [**Section 099600 "High-Performance Coatings."**]
- D. Universal Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

2.5 FABRICATION, GENERAL

- A. Coordinate dimensions and attachment methods of column covers with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.
- B. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends.

2.6 GENERAL FINISH REQUIREMENTS

- A. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.
- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
- B. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.

1. Color: [**Champagne**] [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] <Insert color>.
 2. Color: [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**].
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils** (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.
- D. Siliconized Polyester Finish: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than **0.2 mil** (0.005 mm) for primer and **0.8 mil** (0.02 mm) for topcoat.
1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.
- E. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with [**AAMA 2604**] [**AAMA 2605**] and containing not less than [**50**] [**70**] percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.
- F. High-Performance Organic Finish: [**Three**] [**Four**]-coat fluoropolymer finish complying with AAMA 2605 and containing not less than [**50**] [**70**] percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.
- 2.8 STEEL SHEET FINISHES
- A. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."
 - B. Pretreatment: Immediately after cleaning, apply a conversion coating of type suited to organic coating applied over it.

- C. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply shop primer to prepared surfaces of items unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
- D. Baked-Enamel Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of **2 mils** (0.05 mm).
 - 1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>**.
- E. Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than **1.5 mils** (0.04 mm). Prepare, treat, and coat metal to comply with resin manufacturer's written instructions.
 - 1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>**.

2.9 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- C. Bright, Cold-Rolled, Unpolished Finish: No. 2B.
- D. Directional Satin Finish: No. 4.
- E. Dull Satin Finish: No. 6.
- F. Satin, Reflective, Directional Polish: No. 7.
- G. Mirrorlike Reflective, Nondirectional Polish: No. 8 finish.

2.10 COPPER-ALLOY FINISHES

- A. Buffed Finish, Lacquered: M21-O6x (Mechanical Finish: buffed, smooth specular; Coating: clear, organic, air dried, as specified below).

1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).
- B. Hand-Rubbed Finish, Lacquered: M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear, organic, air dried, as specified below).
 1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).
- C. Statuary Conversion Coating over Satin Finish: M31-C55 (Mechanical Finish: directionally textured, fine satin; Chemical Finish: conversion coating, sulfide)[, **with color matching DEN Project Manager's sample**].

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of column covers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Locate and place column covers plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install column covers.
 1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
- B. Use concealed anchorages where possible.
- C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.
- D. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.
- E. Apply joint treatment at joints of spackled-seam metal column covers. Comply with requirements in Section 092900 "Gypsum Board."

3.3 ADJUSTING AND CLEANING

- A. Clean copper alloys according to metal finisher's written instructions in a manner that leaves an undamaged and uniform finish matching approved Sample.
- B. Touchup Painting: Immediately after erection, clean abraded areas of shop paint and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum **2.0-mil (0.05-mm)** dry film thickness.
- C. Touchup Painting: Cleaning and touchup painting of shop paint are specified in **[Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."]** **[Section 099600 "High-Performance Coatings."]** **[Section 099113 "Exterior Painting" Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."]**
- D. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.4 PROTECTION

- A. Protect finishes from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 055813

SECTION 057300 - DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Aluminum decorative railings[**with stainless-steel, wire-rope guard infill**].
2. Copper-alloy decorative railings.
3. Stainless-steel decorative railings[**with stainless-steel, wire-rope guard infill**].
4. Steel and iron decorative railings[**with stainless-steel, wire-rope guard infill**].
5. Glass- and plastic-supported railings.
6. Post-supported railings with glass infill.
7. Illuminated decorative railings.

B. Related Sections:

1. Section 055100 "Metal Stairs" for steel tube railings included with metal stairs.
2. Section 055213 "Pipe and Tube Railings" for railings fabricated from pipe and tube components.
3. Section 057500 "Decorative Formed Metal" for other decorative formed metal items.
4. **[Section 061000 "Rough Carpentry"] [Section 061053 "Miscellaneous Rough Carpentry"]** for wood blocking for anchoring railings.
5. **[Section 062013 "Exterior Finish Carpentry"] [Section 062023 "Interior Finish Carpentry"] [Section 064023 "Interior Architectural Woodwork"]** for wood railings.
6. Section 092216 "Non-Structural Metal Framing" for metal backing for anchoring railings.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 DEFINITIONS

- A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas, pedestrian guidance and support, visual separation, or wall protection.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
1. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.
 2. Copper Alloys: 60 percent of minimum yield strength.
 3. Stainless Steel: 60 percent of minimum yield strength.
 4. Steel: 72 percent of minimum yield strength.
 5. Glass: 25 percent of mean modulus of rupture (50 percent probability of breakage), as listed in "Mechanical Properties" in AAMA's Aluminum Curtain Wall Series No. 12, "Structural Properties of Glass."
- C. Structural Performance: Design, engineer, fabricate, and install handrails and railing systems to withstand the following structural loads without exceeding the allowable design working stress of the materials for handrails, railing systems, anchors, and connections. Apply each load to produce the maximum stress in each of the respective components comprising handrails and railing systems. Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Handrails and Top Rails of Guards:
 - a. Uniform load of 100 **lbf/ft.** (1.46 kN/m) applied in any direction.
 - b. Concentrated load of 300 **lbf** (1.34 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 2. Infill of Guards: Capable of withstanding a horizontal concentrated load at any point in the system including panels, intermediate rails balusters, or other elements composing the infill area.
 - a. Concentrated load of 200 **lbf** (0.88 kN) applied horizontally on an area of 1 **sq. ft.** (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.
 3. Glass-Supported Railings: Support each section of top rail by a minimum of three glass panels or by other means so top rail will remain in place if any one panel fails.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

- E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: **[Owner will engage] [Engage]** a qualified testing agency to perform preconstruction testing on laboratory mockups. Payment for these services will be made **[by Owner] [from the testing and inspecting allowance, as authorized by Change Orders] [by Contractor]**. Retesting of products that fail to meet specified requirements shall be done at Contractor's expense.

1. Build laboratory mockups at testing agency facility; use personnel, materials, and methods of construction that will be used at Project site.
2. Test railings according to ASTM E 894 and ASTM E 935.
3. Notify DEN Project Manager **[seven] <Insert number>** days in advance of the dates and times when laboratory mockups will be tested.

1.6 ACTION SUBMITTALS

- A. Product Data: For the following:

1. Manufacturer's product lines of railings assembled from standard components.
2. Grout, anchoring cement, and paint products.
3. Finishing materials and methods, and detailed sequence of installation.
4. Include data substantiating that materials comply with requirements.

- B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Certificates for **[Credit MR 6] [Credit MR 7]**: Chain-of-custody certificates indicating that wood rails comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
3. Laboratory Test Reports for Credit IEQ 4: For paints and coatings on interior decorative metal items, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Indicate materials, profiles of each ornamental metalwork member and fitting, joinery, finishes, fasteners, anchorages and accessory items.
 - 1. Include setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed as unit of Work of other sections.
 - 2. For illuminated railings, include wiring diagrams and roughing-in details.
- D. Samples for Initial Selection: For products involving selection of color, texture, or design[, **including mechanical finishes**].
- E. Samples for Verification: For each type of exposed finish required.
 - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 - 2. Each type of glass required.
 - 3. Fittings and brackets.
 - 4. Welded connections.
 - 5. Brazed connections.
 - 6. Assembled Samples of entire section of each type of railing system, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections.
- F. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified [**professional engineer**] [**testing agency**].
- B. Qualification data for firms and persons specified "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project name, addresses, names of Owners, plus other information specified.
- C. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- D. Installer certificates signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" article.
- E. Welding certificates.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.
- G. Preconstruction test reports.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: Firm experienced in successfully producing ornamental metalwork similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the Work.
- B. Installer Qualifications: Arrange for installation of ornamental work specified in this section by same firm that fabricated them.
- C. Testing for recertification is Contractor's responsibility.
- D. Engineer Qualifications: Professional engineer licensed to practice in jurisdiction where project is located and experienced in providing engineering services of the kind indicated which has resulted in the successful installation of assemblies similar in material, design, and extent to that indicated for this Project.
- E. Field Test: Field test mock-up per structural requirements indicated. DEN Project Manager to be present during testing.
- F. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- G. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including structural analysis, preconstruction testing, field testing, and in-service performance.
 - 1. Do not modify intended aesthetic effects, as judged solely by DEN Project Manager, except with DEN Project Manager's approval. If modifications are proposed, submit comprehensive explanatory data to DEN Project Manager for review.
- H. Product Options: Drawings indicate size, profiles, and dimensional requirements of railings and are based on the specific system indicated. Refer to Section 016000 "Product Requirements."
 - 1. Do not modify intended aesthetic effects, as judged solely by DEN Project Manager, except with DEN Project Manager's approval. If modifications are proposed, submit comprehensive explanatory data to DEN Project Manager for review.
- I. Welding Qualifications: Certify that each welder employed in unit of Work of this section has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification. Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 3. AWS D1.6, "Structural Welding Code - Stainless Steel."
- J. Safety Glazing Labeling: Permanently mark glass with certification label of **[the SGCC]** **[the SGCC or another certification agency acceptable to authorities having jurisdiction]** **[or]** **[manufacturer]**. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- K. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- L. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockups as shown on Drawings.
 2. Build mockups for each form and finish of railing consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than **24 inches** (600 mm) in length.
 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- M. Preinstallation Conference: Conduct conference at **[Project site]** **[location and time as determined by DEN Project Manager]** **<Insert location>**

1.9 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.
1. Do not delay job progress; allow for adjustments and fitting where taking of field measurements before fabrication might delay Work.

1.10 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not suit structural performance requirements.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Store components and materials in clean, dry location, away from uncured concrete and masonry. Cover with waterproof paper, tarpaulin, or polyethylene sheeting in a manner that permits air circulation within covering.
- B. Handle ornamental work on site to a minimum; exercise care to avoid damaging metal finishes.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 METALS

- A. General: Provide ornamental work composed of forms and types which comply with requirements of referenced standards and which are free from surface blemishes where exposed to view in the finished unit. Exposed to view surfaces exhibiting pitting, seam marks, roller marks, "oil canning," stains, discolorations or other imperfections on finished units are not acceptable.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Aluminum Decorative Railings:
 - a. Architectural Metal Works.
 - b. Architectural Railings & Grilles, Inc.
 - c. ATR Technologies, Inc.
 - d. Blum, Julius & Co., Inc.
 - e. Blumcraft of Pittsburgh.
 - f. Braun, J. G., Company; a division of the Wagner Companies.
 - g. CraneVeyor Corp.
 - h. Laurence, C. R. Co., Inc.
 - i. Livers Bronze Co.
 - j. Newman Brothers, Inc.
 - k. Pisor Industries, Inc.
 - l. Platers Polishing Company; a division of Rippel Architectural Metals.
 - m. Poma Corporation.
 - n. Sterling Dula Architectural Products, Inc.; Div. of Kane Manufacturing.
 - o. Superior Aluminum Products, Inc.

- p. Wagner, R & B, Inc.; a division of the Wagner Companies.
 - q. Wylie Systems.
 - r. **<Insert manufacturer's name>**.
 - s. or approved equal.
2. Copper-Alloy Decorative Railings:
- a. Architectural Metal Works.
 - b. Blum, Julius & Co., Inc.
 - c. Blumcraft of Pittsburgh.
 - d. Braun, J. G., Company; a division of the Wagner Companies.
 - e. CraneVeyor Corp.
 - f. Lavi Industries.
 - g. Livers Bronze Co.
 - h. Newman Brothers, Inc.
 - i. Platers Polishing Company; a division of Rippel Architectural Metals.
 - j. Tri Tech, Inc.
 - k. Wagner, R & B, Inc.; a division of the Wagner Companies.
 - l. Wylie Systems.
 - m. **<Insert manufacturer's name>**.
 - n. or approved equal.
3. Stainless-Steel Decorative Railings:
- a. Architectural Metal Works.
 - b. Architectural Railings & Grilles, Inc.
 - c. Atlantis Rail Systems; Division of Suncor Stainless.
 - d. Blum, Julius & Co., Inc.
 - e. Blumcraft of Pittsburgh.
 - f. CraneVeyor Corp.
 - g. Livers Bronze Co.
 - h. Newman Brothers, Inc.
 - i. P & P Artec.
 - j. Pisor Industries, Inc.
 - k. Platers Polishing Company; a division of Rippel Architectural Metals.
 - l. Tri Tech, Inc.
 - m. Wagner, R & B, Inc.; a division of the Wagner Companies.
 - n. Wylie Systems.
 - o. **<Insert manufacturer's name>**.
 - p. or approved equal.
4. Stainless-Steel and Glass Decorative Railings:
- a. Architectural Arts Mfg., Inc.
 - b. Julius Blum & Co., Inc.
 - c. Downey Architectural Systems
 - d. Zephyr Metal Craft, Inc.
 - e. Tri-Tech, Inc.
 - f. Rippel Architectural Metals, Inc.
 - g. Newman Brothers, Inc.

- h. Livers Bronse Co., Inc.
 - i. Lavi Industries
 - j. York Metal Fabricators, Inc.
 - k. Custom Enclosures, Inc.
 - l. Clover Glazing Corp., Clear View Rail
 - m. Clearail, Inc.
 - n. **<Insert manufacturer>**
 - o. or approved equal.
5. Steel and Iron Decorative Railings:
- a. Architectural Iron Designs, Inc.
 - b. Artezzi.
 - c. Bavarian Iron Works Co.; TT Triebenbacher.
 - d. Blum, Julius & Co., Inc.
 - e. Braun, J. G., Company; a division of the Wagner Companies.
 - f. Indital USA; a division of Ind.i.a. SPA.
 - g. Lawler Foundry Corporation.
 - h. Livers Bronze Co.
 - i. Olin Wrought Iron.
 - j. Regency Railings.
 - k. Wagner, R & B, Inc.; a division of the Wagner Companies.
 - l. Wiemann Ironworks.
 - m. **<Insert manufacturer's name>**.
 - n. or approved equal.
6. Glass- and Plastic-Supported Railings:
- a. Architectural Metal Works.
 - b. Blum, Julius & Co., Inc.
 - c. Blumcraft of Pittsburgh.
 - d. Clearail, Inc.
 - e. CraneVeyor Corp.
 - f. Livers Bronze Co.
 - g. Newman Brothers, Inc.
 - h. Platers Polishing Company; a division of Rippel Architectural Metals.
 - i. TACO Metals Inc.
 - j. Tri Tech, Inc.
 - k. **<Insert manufacturer's name>**.
 - l. or approved equal.
7. Illuminated Decorative Railings:
- a. Blumcraft of Pittsburgh.
 - b. Cole, C. W., & Company, Inc.
 - c. L & J Specialty Corp.; Lumirail Division.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.

2.3 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.
 - 1. Provide cast-metal brackets with flange tapped for concealed anchorage to threaded hanger bolt.
 - 2. Provide either formed- or cast-metal brackets with predrilled hole for exposed bolt anchorage.
 - 3. Provide formed-steel brackets with predrilled hole for bolted anchorage and with snap-on cover that matches rail finish and conceals bracket base and bolt head.
 - 4. Provide extruded-aluminum brackets with interlocking pieces that conceal anchorage. Locate set screws on bottom of bracket.

2.4 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.
- B. Extruded Bars and Shapes[, **Including Extruded Tubing**]: [ASTM B 221](#) (ASTM B 221M), Alloy 6063-T5/T52.
- C. Extruded Structural [**Pipe**] [**and**] [**Round Tubing**]: ASTM B 429/B 429M, Alloy 6063-T6.
 - 1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.
- D. Drawn Seamless Tubing: [ASTM B 210](#) (ASTM B 210M), Alloy 6063-T832.
- E. Plate and Sheet: [ASTM B 209](#) (ASTM B 209M), [**Alloy 5005-H32**] [**Alloy 6061-T6**].
- F. Die and Hand Forgings: [ASTM B 247](#) (ASTM B 247M), Alloy 6061-T6.
- G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.
- H. Perforated Metal: Aluminum sheet, [ASTM B 209](#) (ASTM B 209M), Alloy 6061-T6, [**0.063 inch** (1.60 mm)] **<Insert thickness>** thick, [**with 1/4-inch** (6.4-mm) **holes 3/8 inch** (9.5 mm) **o.c. in staggered rows**] **<Insert description>**.
 - 1. Basis-of-Design Product: Provide product with perforations matching **<Insert manufacturer's name; product name or designation>**.
- I. Woven-Wire Mesh: Intermediate-crimp, [**diamond**] [**square**] pattern, **2-inch** (50-mm) woven-wire mesh, made from **0.162-inch** (4.1-mm) nominal diameter wire complying with [ASTM B 211](#) (ASTM B 211M), Alloy 6061-T94.

2.5 COPPER ALLOYS

- A. Copper and Copper Alloys, General: Provide alloys indicated and with temper to suit application and forming methods, but with strength and stiffness not less than Temper H01 (quarter hard) for plate, sheet, strip, and bars and Temper H55 (light drawn) for tube and pipe.
- B. Extruded Shapes, Bronze: ASTM B 455, Alloy UNS No. C38500 (architectural bronze).
- C. Extruded Shapes, Brass: ASTM B 249/B 249M, Alloy UNS No. C36000 (free-cutting brass).
- D. Extruded Shapes, Nickel Silver: ASTM B 249/B 249M, Alloy UNS No. C79600.
- E. Seamless Pipe, Bronze: ASTM B 43, Alloy UNS No. C23000 (red brass, 85 percent copper).
- F. Seamless Tube, Bronze: [ASTM B 135](#) (ASTM B 135M), Alloy UNS No. C23000 (red brass, 85 percent copper).
- G. Seamless Tube, Brass: [ASTM B 135](#) (ASTM B 135M), Alloy UNS No. C26000 (cartridge brass, 70 percent copper).
- H. Seamless Tube, Copper: [ASTM B 75](#) (ASTM B 75M), Alloy UNS No. C12200 (phosphorous deoxidized, high residual phosphorous copper).
- I. Castings, Bronze: [**Composition bronze castings complying with ASTM B 62, Alloy UNS No. C83600 (85-5-5-5 or No. 1 composition commercial red brass)**] [or] [**sand castings complying with ASTM B 584, Alloy UNS No. C86500 (No. 1 manganese bronze)**].
- J. Castings, Brass: Sand castings complying with ASTM B 584, Alloy UNS No. C85200 (high-copper yellow brass).
- K. Castings, Copper: ASTM B 824, with a minimum of 99.9 percent copper.
- L. Castings, Nickel Silver: ASTM B 584, Alloy UNS No. C97300 (12 percent leaded nickel silver).
- M. Plate, Sheet, Strip, and Bars; Bronze: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper).
- N. Plate, Sheet, Strip, and Bars; Brass: ASTM B 36/B 36M, Alloy UNS No. C26000 (cartridge brass, 70 percent copper).
- O. Plate, Sheet, Strip, and Bars; Copper: ASTM B 152/B 152M, Alloy UNS No. C11000 (electrolytic tough pitch copper) or Alloy UNS No. C12200 (phosphorous deoxidized, high-residual phosphorous copper).

2.6 STAINLESS STEEL

- A. Tubing: ASTM A 554, [**Grade MT 304**] [**Grade MT 316**] [**Grade MT 316L**].
- B. Pipe: ASTM A 312/A 312M, [**Grade TP 304**] [**Grade TP 316**] [**Grade TP 316L**].
- C. Castings: ASTM A 743/A 743M, [**Grade CF 8 or CF 20**] [**Grade CF 8M or CF 3M**].
- D. Sheet, Strip, Plate, and Flat Bar: ASTM A 666, [**Type 304**] [**Type 316**] [**Type 316L**].
- E. Bars and Shapes: ASTM A 276, [**Type 304**] [**Type 316**] [**Type 316L**].
- F. Wire Rope and Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cable Connection (The).
 - b. Carl Stahl DecorCable, Inc.
 - c. Esmet, Inc.
 - d. Feeney Wire Rope & Rigging.
 - e. Hayn Enterprises, LLC.
 - f. Johnson, C. Sherman, Co., Inc.
 - g. Loos & Co., Inc.; Cableware Division.
 - h. Ronstan International Inc.
 - i. Secosouth, Inc.
 - j. **<Insert manufacturer's name>**.
 - k. or approved equal.
 - 2. Wire Rope: [**1-by-19**] [**7-by-7**] [**7-by-19**] **<Insert configuration>** wire rope made from wire complying with ASTM A 492, Type 316.
 - 3. Wire-Rope Fittings: Connectors of types indicated, fabricated from stainless steel, and with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
- G. Expanded Metal: ASTM F 1267, [**Type I (expanded)**] [**Type II (expanded and flattened)**], Class 3 (corrosion-resisting steel), made from stainless-steel sheet complying with ASTM A 666, [**Type 304**] [**Type 316**].
 - 1. Style Designation: [**3/4 number 13**] [**1-1/2 number 10**] **<Insert designation>**.
- H. Perforated Metal: Stainless-steel sheet, ASTM A 240/A 240M or ASTM A 666, [**Type 304**] [**Type 316L**], [**0.062 inch** (1.59 mm)] **<Insert thickness>** thick, [**with 1/4-inch** (6.4-mm) **holes 3/8 inch** (9.5 mm) **o.c. in staggered rows**] **<Insert description>**.
 - 1. Basis-of-Design Product: Provide product with perforations matching **<Insert manufacturer's name; product name or designation>**.
- I. Woven-Wire Mesh: Intermediate-crimp, [**diamond**] [**square**] pattern, **2-inch** (50-mm) woven-wire mesh, made from **0.135-inch** (3.5-mm) nominal diameter wire complying with ASTM A 580/A 580M, [**Type 304**] [**Type 316**].

2.7 STEEL AND IRON

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25]** **<Insert number>** percent.
- B. Tubing: **[ASTM A 500 (cold formed)] [or] [ASTM A 513]**.
- C. Bars: Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.
- D. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- E. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- F. Expanded Metal: ASTM F 1267, **[Type I (expanded)] [Type II (expanded and flattened)]**, Class 1 (uncoated).
 - 1. Style Designation: **[3/4 number 13] [1-1/2 number 10]** **<Insert designation>**.
- G. Perforated Metal: Cold-rolled steel sheet, ASTM A 1008/A 1008M, or hot-rolled steel sheet, ASTM A 1011/A 1011M, commercial steel Type B, **[0.060 inch (1.52 mm)] <Insert thickness>** thick, **[with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows]** **<Insert description>**.
- H. Perforated Metal: Galvanized-steel sheet, ASTM A 653/A 653M, **G90 (Z275)** coating, commercial steel Type B, **[0.064 inch (1.63 mm)] <Insert thickness>** thick, **[with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows]** **[with 1/8-by-1-inch (3.2-by-25.4-mm) round end slotted holes in staggered rows]** **<Insert description>**.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.
- I. Woven-Wire Mesh: Intermediate-crimp, **[diamond] [square]** pattern, **2-inch (50-mm)** woven-wire mesh, made from **0.135-inch (3.5-mm)** nominal diameter wire complying with **ASTM A 510 (ASTM A 510M)**.

2.8 GLASS AND GLAZING MATERIALS

- A. Tempered Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated), Type 1 (transparent flat glass), Quality-Q3. Provide products that have been tested for surface and edge compression according to ASTM C 1048 and for impact strength according to 16 CFR 1201 for Category II materials.
 - 1. Glass Color: **[Clear] [Blue] [Blue-green] [Bronze] [Green] [Gray]** **<Insert color>**.
 - 2. Thickness for Structural Glass Balusters: **[12.0] [19.0]** mm.

3. Thickness for Structural Glass Balusters: As required by structural loads, but not less than **[12.0] [19.0]** mm.
 4. Thickness for Glass Infill Panels: **[6.0] [10.0]** mm.
 5. Thickness for Glass Infill Panels: As required by structural loads, but not less than **[6.0] [10.0]** mm.
 6. Thickness: As indicated on Drawings.
- B. Laminated Glass: ASTM C 1172, Condition A (uncoated), Type I (transparent flat glass), Quality-Q3 with two plies of glass and polyvinyl butyral interlayer not less than **0.060 inch** (1.52 mm) thick.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.
 2. Kind: **[LA (laminated annealed)] [LHS (laminated heat strengthened)] [LT (laminated tempered)] [As indicated]**.
 3. Glass Color: **[Clear] [Blue] [Blue-green] [Bronze] [Green] [Gray]** **<Insert color>**.
 4. Interlayer Color: **[Clear] [Blue-green] [Bronze light] [Gray]** **<Insert color>**.
 5. Interlayer Color and Pattern: **[As selected by DEN Project Manager from manufacturer's full range] [Match] [Provide]** **<Insert manufacturer's color and pattern designation>**.
 6. Glass Plies for Structural Glass Balusters: **[6.0] [8.0] [10.0]** mm thick, each.
 7. Glass Plies for Structural Glass Balusters: Thickness required by structural loads, but not less than **[6.0] [8.0]** mm thick, each.
 8. Glass Plies for Glass Infill Panels: **[3.0] [4.0] [5.0]** mm thick, each.
 9. Glass Plies for Glass Infill Panels: Thickness required by structural loads, but not less than **[3.0] [4.0] [5.0]** mm, each.
- C. Ceramic-Coated Glass: Heat-treated float glass, Condition C; with ceramic enamel applied by silk-screened process; complying with Specification No. 95-1-31 in GANA's "Engineering Standards Manual" and with other requirements specified.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.
 2. Glass Color: **[Clear] [Blue] [Blue-green] [Bronze] [Green] [Gray]** **<Insert color>**.
 3. Ceramic Coating Color and Pattern: **[As selected by DEN Project Manager from manufacturer's full range] [Match] [Provide]** **<Insert manufacturer's color and pattern designation>**.

- D. Plastic Structural Glazing: Uncoated, transparent, monolithic acrylic sheet complying with ASTM D 4802, Category A-1 or A-2 (cell cast or continuous cast), Finish 1 (smooth or polished), and as follows:
1. Color: [**Colorless (clear)**] [**Blue**] [**Blue-green**] [**Bronze**] [**Gray**] [**Green**] [**Match glass**] <Insert color>.
 2. Thickness: [**12.0 mm**] [**Match glass thickness**].
- E. Glazing Cement and Accessories for Structural Glazing: Glazing cement, setting blocks, shims, and related accessories as recommended or supplied by railing manufacturer for installing structural glazing in metal subrails.
1. Glazing Cement: Nonshrinking organic cement designed for curing by passing an electric current through metal subrail holding glass panel, as standard with manufacturer.
- F. Glazing Gaskets for Glass Infill Panels: Glazing gaskets and related accessories recommended or supplied by railing manufacturer for installing glass infill panels in post-supported railings.

2.9 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
1. Aluminum Components: [**Type 304**] [**Type 316**] stainless-steel fasteners.
 2. Copper-Alloy (Bronze) Components: Silicon bronze (Alloy 651 or Alloy 655) fasteners[**where concealed; muntz metal (Alloy 280) fasteners where exposed**].
 3. Copper-Alloy (Brass) Components: Silicon bronze (Alloy 651 or Alloy 655) fasteners[**where concealed; brass (Alloy 260 or Alloy 360) fasteners where exposed**].
 4. Stainless-Steel Components: [**Type 304**] [**Type 316**] stainless-steel fasteners.
 5. Uncoated Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed; Type 304 stainless-steel fasteners where exposed.
 6. Galvanized-Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.
 7. Dissimilar Metals: [**Type 304**] [**Type 316**] stainless-steel fasteners.
- B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated[**and capable of withstanding design loads**].
- C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless [**otherwise indicated**] [**exposed fasteners are unavoidable**] [**exposed fasteners are the standard fastening method for railings indicated**].

1. Provide **[Phillips] [tamper-resistant] [square or hex socket]** flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- E. Post-Installed Anchors: **[Torque-controlled expansion anchors] [or] [chemical anchors]**.
 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or **ASTM F 1941** (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy **[Group 1 (A1)] [Group 2 (A4)]** stainless-steel bolts, **ASTM F 593** (ASTM F 738M), and nuts, **ASTM F 594** (ASTM F 836M).

2.10 MISCELLANEOUS MATERIALS

- A. Wood Rails: Clear, straight-grained hardwood rails secured to **[recessed] [exposed]** metal subrail.
 1. Species: **[Ash] [Cherry] [Red oak] [Walnut] [White oak] <Insert species>**.
 2. Finish: **[Manufacturer's standard] [Transparent polyurethane] [Penetrating oil] [Acrylic impregnated]**.
 3. Staining: **[None] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert description or manufacturer's name and product designation>**.
 4. Profile: **[Square, 1-3/4 by 1-3/4 inches (45 by 45 mm) with edges eased to 1/4-inch (6-mm) radius] [Rectangular, 1-3/4 by 5 inches (45 by 127 mm) with edges eased to 1/4-inch (6-mm) radius] [Round, 2-inch (50-mm) diameter] [As indicated] <Insert description>**.
 5. Certified Wood: Fabricate wood rails from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- B. Wood Rails: Hardwood rails complying with Section 064023 "Interior Architectural Woodwork."
- C. Electrical Components: Provide internal, fluorescent light fixtures and electrical components, required as part of illuminated railings, that comply with NFPA 70 and that are listed and labeled by UL.
- D. Plastic Handrail Caps: Thermoplastic rail covering, color as indicated or, if not indicated, as selected by DEN Project Manager from manufacturer's standard colors.
- E. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For aluminum railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- F. Brazing Rods: For copper-alloy railings, provide type and alloy as recommended by producer of metal to be brazed and as required for color match, strength, and compatibility in fabricated items.
- G. Low-Emitting Paints and Coatings: Paints and coatings applied to interior decorative metal railings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- H. Lacquer for Copper Alloys: Clear acrylic lacquer specially developed for coating copper-alloy products.
- I. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- J. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- K. Shop Primers: Provide primers that comply with **[Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."]** **[Section 099600 "High-Performance Coatings."]** **[Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."]**
- L. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- M. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- N. Shop Primer for Galvanized Steel: **[Cementitious galvanized metal primer complying with MPI#26]** **[Vinyl wash primer complying with MPI#80]** **[Water-based galvanized metal primer complying with MPI#134].**
- O. Intermediate Coats and Topcoats: Provide products that comply with **[Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."]** **[Section 099600 "High-Performance Coatings."]** **[Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."]**
- P. Epoxy Intermediate Coat: Complying with MPI#77 and compatible with primer and topcoat.
- Q. Polyurethane Topcoat: Complying with MPI#72 and compatible with undercoat.
- R. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

- S. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- T. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - 1. Water-Resistant Product: **[At exterior locations] [and] [where indicated]** provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.11 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage[, **but not less than that required to support structural loads**].
- B. Form ornamental work to required shapes and sizes, with true curves, lines, and angles. Provide components in sizes and profiles indicated, but not less than required to comply with requirements indicated for structural performance.
- C. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature, in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening up of joints and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.
 - 1. Temperature Change (Range): 100 deg F (55.5 deg C).
- D. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- E. Make up wire-rope assemblies in the shop to field-measured dimensions with fittings machine swaged. Minimize amount of turnbuckle take-up used for dimensional adjustment so maximum amount is available for tensioning wire ropes. Tag wire-rope assemblies and fittings to identify installation locations and orientations for coordinated installation.
- F. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately **1/32 inch** (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- G. Form work true to line and level with accurate angles and surfaces.
- H. Provide necessary rebates, lugs, and brackets for assembly of units. Use concealed fasteners wherever possible.

- I. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- J. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- K. Connections: Fabricate railings with **[welded]** **[or]** **[nonwelded]** connections unless otherwise indicated.
- L. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Comply with AWS for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded joints of all welding flux, and dress on all exposed and contact surfaces.
 - 2. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 3. Obtain fusion without undercut or overlap.
 - 4. Remove flux immediately.
 - 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.
- M. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- N. Brazed Connections: Connect copper-alloy railings by brazing. Cope components at connections to provide close fit, or use fittings designed for this purpose. Braze corners and seams continuously.
 - 1. Use materials and methods that match color of base metal, minimize distortion, and develop maximum strength and corrosion resistance.
 - 2. Remove flux immediately.
 - 3. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and brazed surface matches contours of adjoining surfaces.
- O. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 - 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- P. Form changes in direction as follows:
 - 1. As detailed.
 - 2. **[By bending]** **[or]** **[by inserting prefabricated elbow fittings]**.

3. **[By flush bends] [or] [by inserting prefabricated flush-elbow fittings].**
 4. **[By radius bends of radius indicated] [or] [by inserting prefabricated elbow fittings of radius indicated].**
 5. By bending to smallest radius that will not result in distortion of railing member.
- Q. Mill joints to a tight, hairline fit. Cope or miter corner joints. Form joints exposed to weather to exclude water penetration.
- R. Finish exposed surfaces to smooth, sharp, well defined lines and arrises.
- S. Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- T. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- U. Close exposed ends of hollow railing members with prefabricated end fittings.
- V. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is **1/4 inch** (6 mm) or less.
- W. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- X. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- Y. For railing posts set in concrete, provide **[steel] [stainless-steel]** sleeves not less than **6 inches** (150 mm) long with inside dimensions not less than **1/2 inch** (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.
- Z. For removable railing posts, fabricate slip-fit sockets from **[steel] [stainless-steel]** tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.
1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.
- AA. Expanded-Metal Infill Panels: Fabricate infill panels from **[stainless-steel] [steel]** expanded metal[**unless otherwise indicated**].

1. Edge panels with U-shaped channels made from same metal as infill; not less than **0.043 inch** (1.1 mm) thick.
 2. Orient expanded metal with long dimension of diamonds [**parallel to top rail**] [**perpendicular to top rail**] [**horizontal**] [**vertical**].
- BB. Perforated-Metal Infill Panels: Fabricate infill panels from perforated metal made from [**steel**] [**galvanized steel**] [**aluminum**] [**stainless steel**] [**same metal as railings in which they are installed**].
1. Edge panels with U-shaped channels made from metal sheet, of same metal as perforated metal and not less than **0.043 inch** (1.1 mm) thick.
 2. Orient perforated metal with pattern [**parallel to top rail**] [**perpendicular to top rail**] [**horizontal**] [**vertical**] [**as indicated on Drawings**].
- CC. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into **1-by-1/2-by-1/8-inch** (25-by-13-by-3-mm) metal channel frames.
1. Make wire mesh and frames from [**aluminum**] [**stainless steel**] [**steel**] [**unless otherwise indicated**].
 2. Orient wire mesh with [**diamonds vertical**] [**wires perpendicular and parallel to top rail**] [**wires horizontal and vertical**].
- DD. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.12 GLAZING PANEL FABRICATION

- A. General: Fabricate to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.
1. Clean-cut or flat-grind edges at butt-glazed sealant joints to produce square edges with slight chamfers at junctions of edges and faces
 2. Grind smooth exposed edges, including those at open joints, to produce square edges with slight chamfers at junctions of edges and faces.
- B. Structural Glass Balusters: Factory-bond glass to aluminum base and top-rail channels in railing manufacturer's plant using glazing cement to comply with manufacturer's written specifications[, **unless field glazing is standard with manufacturer**].
- C. Structural Balusters: Provide [**tempered**] [**laminated, heat-strengthened**] [**laminated, tempered**] glass panels[**for both straight and curved sections**].
- D. Structural Balusters: Provide thermoformed, curved, plastic glazing panels for curved sections and [**tempered**] [**laminated, heat-strengthened**] [**laminated, tempered**] glass panels for straight sections.
- E. Infill Panels: Provide [**tempered**] [**laminated, annealed**] [**laminated, heat-strengthened**] [**laminated, tempered**] glass panels[**for both straight and curved sections**].

2.13 ILLUMINATED RAILINGS

- A. General: Comply with requirements in this Section for aluminum railings with welded connections.
- B. Illuminated Units: Provide internal illumination using concealed, internally wired, fluorescent-strip fixture system to illuminate walking surfaces adjacent to railings without light leaks. Make provisions for servicing and for concealed connection to electric service. Coordinate electrical characteristics with those of the power supply provided.
 - 1. Fluorescent Tubes: Provide number of tubes indicated or required by railing length.
 - 2. Diffusers: UV-stabilized acrylic diffusers matching profile of railings.
 - 3. Ballasts: Energy-saving, high power factor, Class P, electromagnetic type; designed for use with high-output lamps, and with automatic-reset thermal protection. Ballasts comply with ANSI C82.1, bear Certified Ballast Manufacturer Certification labels, and are rated for [0 deg F (minus 17 deg C)] [minus 20 deg F (minus 29 deg C)] starting temperature.

2.14 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.15 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Mechanical Finish: AA-M3x (Mechanical Finish: as specified); sand top rails, handrails, and intermediate rails in one direction only, parallel to length of railing, with 120- and 320-grit abrasive. After installation, polish railings with No. 0 steel wool immersed in paste wax, then rub to a luster with a soft dry cloth.
- C. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.

- D. Color Anodic Finish: AAMA 611, **[AA-M12C22A42/A44, Class I, 0.018 mm]** **[AA-M12C22A32/A34, Class II, 0.010 mm]** or thicker.
1. Color: **[Champagne]** **[Light bronze]** **[Medium bronze]** **[Dark bronze]** **[Black]** **<Insert color>**.
 2. Color: **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from full range of industry colors and color densities]**.
- E. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils** (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
1. Color and Gloss: **[As indicated by manufacturer's designations]** **[Match DEN Project Manger's sample]** **[As selected by DEN Project manager from manufacturer's full range]** **<Insert color and gloss>**.
- F. Siliconized Polyester Finish: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than **0.2 mil** (0.005 mm) for primer and **0.8 mil** (0.02 mm) for topcoat.
1. Color and Gloss: **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from manufacturer's full range]** **<Insert color and gloss>**.
- G. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with **[AAMA 2604]** **[AAMA 2605]** and containing not less than **[50]** **[70]** percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from manufacturer's full range]** **<Insert color and gloss>**.
- H. High-Performance Organic Finish: **[Three]** **[Four]**-coat fluoropolymer finish complying with AAMA 2605 and containing not less than **[50]** **[70]** percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from manufacturer's full range]** **<Insert color and gloss>**.

2.16 COPPER-ALLOY FINISHES

- A. Finish designations for copper alloys comply with the system for designating copper-alloy finish systems defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products."
- B. Buffed Finish: M21 (Mechanical Finish: buffed, smooth specular).

- C. Hand-Rubbed Finish: M31-M34 (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed).
 - D. Medium-Satin Finish: M32 (Mechanical Finish: directionally textured, medium satin).
 - E. Fine-Matte Finish: M42 (Mechanical Finish: nondirectional finish, fine matte).
 - F. Buffed Finish, Lacquered: M21-O6x (Mechanical Finish: buffed, smooth specular; Coating: clear organic, air drying, as specified below).
 - 1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).
 - G. Hand-Rubbed Finish, Lacquered: M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear organic, air drying, as specified below).
 - 1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).
 - H. Medium-Satin Finish, Lacquered: M32-O6x (Mechanical Finish: directionally textured, medium satin; Coating: clear organic, air drying, as specified below).
 - 1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).
 - I. Fine-Matte Finish, Lacquered: M42-O6x (Mechanical Finish: nondirectional finish, fine matte; Coating: clear organic, air drying, as specified below).
 - 1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).
 - J. Statuary Conversion Coating over Satin Finish: M31-C55 (Mechanical Finish: directionally textured, fine satin; Chemical Finish: conversion coating, sulfide)[, **with color matching DEN Project Manager's sample**].
 - K. Patina Conversion Coating: M36-C12-C52 (Mechanical Finish: directionally textured, uniform; Chemical Finish: nonetched cleaned, degreased; Chemical Finish: conversion coating, ammonium sulfate)[, **with color matching DEN Project Manager's sample**].
- 2.17 STAINLESS-STEEL FINISHES
- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 - B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
- C. Directional Satin Finish: No. 4.
- D. Dull Satin Finish: No. 6.
- E. Satin, Reflective, Directional Polish: No. 7.
- F. Mirrorlike Reflective, Nondirectional Polish: No. 8.
- G. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- H. Sputter-Coated Finish: Titanium nitride coating deposited by magnetic sputter-coating process over indicated mechanical finish.

2.18 STEEL AND IRON FINISHES

- A. Galvanized Railings:
 1. Hot-dip galvanize[**exterior**] steel and iron railings, including hardware, after fabrication.
 2. Hot-dip galvanize indicated steel and iron railings, including hardware, after fabrication.
 3. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
 4. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
 5. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
 6. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.
- E. Preparing Nongalvanized Items for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with [**SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."**] [**SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."**] [**requirements indicated below:**]
 1. Exterior Railings: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 2. Railings Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

3. Railings Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 4. Other Railings: SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
- F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
1. Shop prime uncoated railings with **[universal shop primer] [primers specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting"]** unless **[zinc-rich primer is] [primers specified in Section 099600 "High-Performance Coatings" are]** indicated.
 2. Do not apply primer to galvanized surfaces.
- G. Shop-Painted Finish: Comply with **[Section 099113 "Exterior Painting."]** **[Section 099600 "High-Performance Coatings."]**
1. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range].**
- H. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.
1. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range].**
- I. Powder-Coat Finish: Prepare, treat, and coat nongalvanized ferrous metal to comply with resin manufacturer's written instructions and as follows:
1. Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 2. Treat prepared metal with iron-phosphate pretreatment, rinse, and seal surfaces.
 3. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than **1.5 mils (0.04 mm)**.
 4. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range].**
- J. Powder-Coat Finish: Prepare, treat, and coat galvanized metal to comply with resin manufacturer's written instructions and as follows:
1. Prepare galvanized metal by thoroughly removing grease, dirt, oil, flux, and other foreign matter.

2. Treat prepared metal with zinc-phosphate pretreatment, rinse, and seal surfaces.
3. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than **1.5 mils** (0.04 mm).
4. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range].**

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 PREPARATION

- A. Coordinate and furnish anchorages and setting drawings, diagrams, templates, instructions and directions for installation of items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to the project site.

3.3 INSTALLATION, GENERAL

- A. Provide anchorage devices and fasteners where necessary for securing ornamental metal items to in place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws and other connectors as required.
- B. Fit exposed connections together to form tight, hairline joints, or, where indicated, with uniform reveals and spaces for sealants and joint fillers. Where cutting, welding and grinding are required for proper shop fitting and jointing of ornamental metal items, restore finishes to eliminate any evidence of such corrective work.
- C. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry or similar construction
 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 2. Set posts plumb within a tolerance of **1/16 inch in 3 feet** (2 mm in 1 m).
 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed **1/4 inch in 12 feet** (5 mm in 3 m).

- D. Corrosion Protection: Coat concealed surfaces of **[aluminum] [and] [copper alloys]** that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- E. Install concealed gaskets, joint fillers, insulation, and flashings as the work progresses, so as to make work weathertight, soundproof or lightproof as required.
- F. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- G. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.
- H. Restore protective coverings that have been damaged during shipment or installation of the work. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at the same location.
- I. Retain protective coverings intact and remove simultaneously from similarly finished items to preclude nonuniform oxidation and discoloration.
- J. Field Welding: Comply with applicable AWS specification for procedures of manual shielded metal arc welding, for appearance and quality of welds made, and for methods used in correcting welding work. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed welded joints smooth and restore finish to match finish of adjacent rail surfaces.

3.4 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending **2 inches (50 mm)** beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within **6 inches (150 mm)** of post.

3.5 ANCHORING POSTS

- A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with **[nonshrink, nonmetallic grout] [or] [anchoring cement]**, mixed and placed to comply with anchoring material manufacturer's written instructions.

- B. Form or core-drill holes not less than **5 inches** (125 mm) deep and **3/4 inch** (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with **[nonshrink, nonmetallic grout] [or] [anchoring cement]**, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Cover anchorage joint with flange of same metal as post, **[welded to post after placing anchoring material] [attached to post with set screws]**.
- D. Leave anchorage joint exposed with **[1/8-inch** (3-mm) **buildup, sloped away from post] [anchoring material flush with adjacent surface]**.
- E. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For aluminum railings, attach posts as indicated using fittings designed and engineered for this purpose.
 - 2. For copper-alloy railings, attach posts as indicated using fittings designed and engineered for this purpose.
 - 3. For stainless-steel railings, weld flanges to posts and bolt to metal-supporting surfaces.
 - 4. For steel railings, weld flanges to posts and bolt to metal-supporting surfaces.
- F. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.6 ATTACHING RAILINGS

- A. Anchor railing ends to concrete and masonry with **[sleeves concealed within] [flanges connected to] [brackets on underside of rails connected to]** railing ends and anchored to wall construction with anchors and bolts.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and **[welded to railing ends] [or] [connected to railing ends using nonwelded connections]**.
- C. Attach handrails to walls with wall brackets **[except where end flanges are used]**. Provide brackets with **1-1/2-inch** (38-mm) clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
 - 1. Use type of bracket with **[flange tapped for concealed anchorage to threaded hanger bolt] [predrilled hole for exposed bolt anchorage]**.
 - 2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets **[and railing end flanges]** to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

2. For hollow masonry anchorage, use toggle bolts.
3. For wood stud partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.
4. For steel-framed partitions, use hanger or lag bolts set into[**fire-retardant-treated**] wood backing between studs. Coordinate with stud installation to locate backing members.
5. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.
6. For steel-framed partitions, fasten brackets with toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.7 INSTALLING GLASS PANELS

- A. Glass-Supported Railings: Install assembly to comply with railing manufacturer's written instructions.
1. Attach base channel to building structure, then insert and connect factory-fabricated and -assembled glass panels[**if glass was bonded to base and top rail channels in factory**].
 2. Attach base channel to building structure, then insert glass into base channel and bond with glazing cement[**unless glass was bonded to base and top rail channels in factory**].
 - a. Support glass panels in base channel at quarter points with channel-shaped setting blocks that also act as shims to maintain uniform space for glazing cement. Fill remaining space in base channel with glazing cement for uniform support of glass.
 3. Adjust spacing of glass panels so gaps between panels are equal before securing in position.
 4. Erect glass railings under direct supervision of manufacturer's authorized technical personnel.
- B. Post-Supported Glass Railings: Install assembly to comply with railing manufacturer's written instructions and with requirements in other Part 3 articles. Erect posts and other metal railing components, then set factory-cut glass panels. Do not cut, drill, or alter glass panels in field. Protect edges from damage.

3.8 INSTALLING PLASTIC HANDRAIL CAPS

- A. Apply plastic handrail caps to top rails and handrails, where indicated, complying with manufacturer's written instructions for cutting, mounting, forming, welding, cleaning, applying end caps, and finishing.
- B. Minimize number of joints in plastic caps by installing in lengths as long as possible. Allow for shortening of plastic cap caused by welding and splicing process; butt ends together to produce hairline joint.

1. Continuously weld, splice, miter, and end-cap joints using cap manufacturer's electric welding iron designed for this purpose. Remove welding flash while material is still soft.
2. Weld only prongs on underside of plastic cap at splice, miter, and end-cap joints. After cutting plastic cap, dress ends with file to produce a hairline fit between abutting sections. After mounting cap, polish top surface with cap manufacturer's solvent designed for this purpose until joint becomes almost invisible.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Payment for these services will be made **[by Owner] [from the testing and inspecting allowance, as authorized by Change Orders]**.
- B. Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Railings will be tested according to ASTM E 894 and ASTM E 935 for compliance with performance requirements.
- C. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to DEN Project Manager and will comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10 CLEANING

- A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.
- B. Clean copper alloys according to metal finisher's written instructions in a manner that leaves an undamaged and uniform finish matching approved Sample.
- C. Clean and polish **[glass] [and] [plastic glazing]** as recommended in writing by manufacturer. Wash both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion.
- D. Clean **[wood rails] [and] [plastic handrail caps]** by wiping with a damp cloth and then wiping dry.
- E. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum **2.0-mil** (0.05-mm) dry film thickness.
 - F. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in [**Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."**] [**Section 099600 "High-Performance Coatings."**] [**Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."**]
 - G. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.
- 3.11 PROTECTION
- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
 - B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 057300

SECTION 057500 - DECORATIVE FORMED METAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Beam wraps.
2. Closures and trim.
3. Column covers and bases.
4. Chair rails.
5. Corner guards.
6. Decorative-metal-clad, hollow-metal doors and frames.
7. Diamond plate wainscot.
8. Elevator [**cab**] [**and**] [**entrance**] finishes.
9. Escalator enclosures.
10. Filler panels [**at demountable partitions**] [**between dissimilar construction**].
11. Gate Portal/Check-in backwall.
12. Heating-cooling unit enclosures.
13. Lighting coves.
14. Mechanical duct enclosures at Holdrooms.
15. Metal base.
16. Mullion cladding.
17. Pipe system covers.
18. Pockets for window treatment.
19. Sign Shelf at Subcore.
20. Subcore accent wall.
21. Support system for ceiling-hung Way Finding Signage.
22. Support system for Flight Information Display System (FIDS).
23. Miscellaneous items not specified in other Sections.
24. Window stools.
25. Exterior fins.
26. Exterior formed-metal-shaped panels.
27. Exterior sunshades.
28. Exterior trellises.
29. Exterior window covers.
30. Metal shapes as part of roof construction.

- B. Related Sections:

1. Section 055000 "Metal Fabrications" for non-decorative metal fabrications.
 2. Section 057000 "Decorative Metal" for items made primarily from plate, bars, extrusions, tubes, castings, and other forms of metal, but which may include sheet metal components.
 3. Section 057300 "Decorative Metal Railings."
 4. Section 076100 "Sheet Metal Roofing" for items made of formed metal for roofing.
 5. Section 076200 "Sheet Metal Flashing and Trim" for items made of formed metal for flashings and trim.
 6. Section 077100 "Roof Specialties" for items made of formed metal for parapets and copings.
 7. Section 081113 "Hollow Metal Doors and Frames" for flush hollow-metal doors and frames receiving decorative metal cladding.
 8. Section 089000 "Louvers and Vents" for louvers made of formed metal.
 9. **[Section 142100 "Electric Traction Elevators"] [and] [Section 142400 "Hydraulic Elevators"]** for elevator cab and entrance components made from sheet metal.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design exterior decorative formed metal items, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Decorative formed metal items, including anchors and connections, shall withstand the effects of gravity loads and the following loads and stresses without exceeding the allowable design working stress of materials involved and without exhibiting permanent deformation in any components:
1. Wind Loads on Exterior Items: **[As indicated on Drawings] [20 lbf/sq. ft. (957 Pa)] [30 lbf/sq. ft. (1436 Pa)] <Insert specific loads>**.
 2. Live Loads on Heating-Cooling Unit Enclosures: **100 lbf/sq. ft. (4.8 kN/sq. m)** or a concentrated load of **300 lbf (1.3 kN)** on an area of **4 sq. in. (26 sq. cm)**, whichever produces the greater stress.
- C. Seismic Performance: Exterior decorative formed metal items, including anchors and connections, shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7] <Insert requirement>**.
1. Component Importance Factor is 1.0.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: **120 deg F** (67 deg C), ambient; **180 deg F** (100 deg C), material surfaces.

- E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include finishing materials.

1. Include data substantiating that materials comply with requirements.

- B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Data for Credit IEQ 4.1: For **[adhesives] [and] [sealants]**, documentation including printed statement of VOC content.
3. Laboratory Test Reports for Credit IEQ 4: For **[adhesives] [sealants] [and] [paints and coatings]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Shop Drawings: Show fabrication and installation details for decorative formed metal.

1. Include plans, elevations, component details, and attachments to other work.
2. Indicate materials and profiles of each decorative formed metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.
 - a. Include setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed as unit of Work of other sections.

- D. Samples for Initial Selection: For products involving selection of color, texture, or design[, **including mechanical finishes**].

- E. Samples for Verification: For each type of exposed finish required, prepared on **6-inch-** (150-mm-) square Samples of metal of same thickness and material indicated for the Work.

1. Include 12 inch long samples of linear shapes.
2. **<Insert other samples>**.
3. Include entire column section for each type
4. **<Insert other samples>**.

- F. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For decorative formed metal elements that house items specified in other Sections. Show dimensions of housed items, including locations of housing penetrations and attachments, and necessary clearances.
- B. Qualification Data: For qualified [**Installer**] [**fabricator**] [**organic-coating applicator**] [**anodic finisher**] [**powder-coating applicator**] [**and**] [**professional engineer**].
- C. Mill Certificates: Signed by stainless-steel manufacturers certifying that products furnished comply with requirements.
- D. Welding certificates.
- E. Warranty: Submit copy of manufacturer's product warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For [**mirrorlike stainless-steel finish**] [**and**] [**statuary conversion coating copper-alloy finish**] to include in maintenance manuals.

1.7 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 MAINTENANCE MATERIAL

- A. Provide minimum two (2) gallons of each type of paint, primer or finish coating. Store in location as directed by DEN Project Manager.
 - 1. Instruct Owner's personnel in appropriate paint touch-up techniques.

1.9 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing decorative formed metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Installer Qualifications: Arrange for installation of ornamental work specified in this section by same firm that manufactured products, to highest degree possible.
- C. Organic-Coating Applicator Qualifications: A firm experienced in successfully applying organic coatings of type indicated to metals of types indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.

- D. Anodic Finisher Qualifications: A firm experienced in successfully applying anodic finishes of type indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.
- E. Powder-Coating Applicator Qualifications: A firm experienced in successfully applying powder coatings of type indicated to metals of types indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.
- F. Installer Qualifications: Fabricator of products.
- G. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 3. AWS D1.3, "Structural Welding Code - Sheet Steel."
 4. AWS D1.6, "Structural Welding Code - Stainless Steel."
- H. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockups for the following types of decorative formed metal:
 - a. **<Insert, in separate subparagraphs, description of each decorative metal type including mockup size>.**
 2. Where installed products are indicated to comply with certain design loadings including glass support, include structural computations, material properties, and other information needed for structural analysis that has been prepared by, or under the supervision of, a qualified professional engineer.
 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- I. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>.**
- J. Paint testing: Provide certification that factory applied paint complies with specified requirements.
- 1.10 DELIVERY, STORAGE, AND HANDLING
- A. Deliver decorative formed metal products wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.
 - B. Store products on elevated platforms in a dry location.

1.11 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls, columns, beams, and other construction contiguous with decorative formed metal by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Coordinate fabrication schedule with construction progress to avoid delay of Work.

1.12 COORDINATION

- A. Coordinate installation of anchorages for decorative formed metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- B. Coordinate installation of decorative formed metal with adjacent construction to ensure that wall assemblies, flashings, trim, and joint sealants, are protected against damage from the effects of weather, age, corrosion, and other causes.

1.13 WARRANTY

- A. Warranty: Installer to warrant all elements of fabrication, including material, anchors, and finish. Provide minimum three (3) year **<Insert number>** system warranty and five (5) year **<Insert number>** finish warranty.

1.14 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 SHEET METAL

- A. General: Provide sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25] <Insert number>** percent.
- C. Aluminum Sheet: Flat sheet complying with [ASTM B 209](#) (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of Alloy 5005-H32.

- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, **G90 (Z275)** coating, either commercial steel or forming steel.
- E. Steel Sheet: **[Uncoated, cold-rolled, ASTM A 1008/A 1008M, commercial steel, exposed] [or] [electrolytic zinc-coated, ASTM A 879/A 879M, with steel sheet substrate complying with ASTM A 1008/A 1008M, commercial steel, exposed].**
- F. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, **[Type 304] [Type 316]**, stretcher-leveled standard of flatness.
- G. Bronze Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper) or Alloy UNS No. C23000 (red brass, 85 percent copper).
- H. Brass Sheet: ASTM B 36/B 36M, Alloy UNS No. C26000 (cartridge brass, 70 percent copper).
- I. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.
- J. Titanium Sheet: ASTM B 265, Grade 1.

2.2 MISCELLANEOUS MATERIALS

- A. Gaskets: As required to seal joints in decorative formed metal and remain **[airtight] [weathertight]**; as recommended in writing by decorative formed metal manufacturer.
 - 1. ASTM D 1056, Type 1, Class A, grade as recommended by gasket manufacturer to obtain seal for application indicated.
 - 2. Closed-cell polyurethane foam, adhesive on two sides, release paper protected.
- B. Sealants, Exterior: ASTM C 920; elastomeric **[silicone] [polyurethane] [or] [polysulfide]** sealant; of type, grade, class, and use classifications required to seal joints in decorative formed metal and remain weathertight; and as recommended in writing by decorative formed metal manufacturer.
- C. Sealants, Interior: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834; of type and grade required to seal joints in decorative formed metal; and as recommended in writing by decorative formed metal manufacturer.
 - 1. Sealants shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Filler Metal and Electrodes: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded or brazed and as necessary for strength, corrosion resistance, and compatibility in fabricated items.
 - 1. Use filler metals that will match the color of metal being joined and will not cause

discoloration.

- E. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated. Do not use metals that are incompatible with materials joined.
1. Provide concealed fasteners for interconnecting decorative formed metal items and for attaching them to other work unless **[otherwise indicated] [exposed fasteners are unavoidable or are the standard fastening method]**.
 2. Provide **[Phillips] [tamper-resistant] [square or hex socket]** flat-head machine screws for exposed fasteners unless otherwise indicated.
- F. Structural Anchors: For applications indicated to comply with certain design loads, provide **[chemical] [or] [torque-controlled expansion]** anchors with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- G. Nonstructural Anchors: For applications not indicated to comply with design loads, provide **[powder-actuated fasteners] [metal expansion sleeve anchors] [or] [metal-impact expansion anchors]** of type, size, and material necessary for type of load and installation indicated, as recommended by manufacturer, unless otherwise indicated.
- H. Anchor Materials:
1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or [ASTM F 1941](#) (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy **[Group 1 (A1)] [Group 2 (A4)]** stainless-steel bolts, [ASTM F 593](#) (ASTM F 738M), and nuts, [ASTM F 594](#) (ASTM F 836M).
- I. Sound-Deadening Materials:
1. Insulation: Unfaced, mineral-fiber blanket insulation complying with ASTM C 665, Type I, and passing ASTM E 136 test.
 2. Mastic: Cold-applied asphalt emulsion complying with ASTM D 1187.
- J. Backing Materials: Provided or recommended by decorative formed metal manufacturer.
- K. Laminating Adhesive: Adhesive recommended by metal fabricator that will fully bond metal to metal and that will prevent telegraphing and oil canning and is compatible with substrate and noncombustible after curing.
1. Contact Adhesive: VOC content of not more than 80 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Metal-to-Metal Adhesive: VOC content of not more than 30 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Multipurpose Construction Adhesive: VOC content of not more than 70 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 4. Special-Purpose Contact Adhesive: (Contact adhesive used to bond melamine-covered board, metal, unsupported vinyl, ultrahigh molecular weight polyethylene, and rubber or wood veneer, 1/16 inch thick or less, to any surface): 250 g/L.
 5. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- L. Isolation Coating: Manufacturer's standard [**alkali-resistant coating**] [**bituminous paint**] [**epoxy coating**].
1. Coating shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 PAINTS AND COATINGS

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Lacquer for Copper Alloys: Clear, acrylic lacquer specially developed for coating copper-alloy products.
- E. Shop Primers: Comply with [**Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."**] [**Section 099600 "High-Performance Coatings."**]
- F. Universal Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- G. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- H. Shop Primer for Galvanized Steel: [**Cementitious galvanized metal primer complying with MPI#26**] [**Vinyl wash primer complying with MPI#80**] [**Water-based galvanized metal primer complying with MPI#134**].
- I. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble decorative formed metal items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Coordinate dimensions and attachment methods of decorative formed metal items with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.
- C. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature, in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening up of joints and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.
 - 1. Temperature Change (Range): 100 deg F, (55.5 deg C).
- D. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a **1/2-inch** (12-mm-) wide hem on the concealed side, or ease edges to a radius of approximately **1/32 inch** (1 mm) and support with concealed stiffeners.
- E. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use.
 - 1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
 - 2. Mill joints to a tight, hairline fit. Cope or miter corner joints. Form joints exposed to weather to exclude water penetration.
 - 3. Provide adequate separation of dissimilar metals subject to galvanic corrosion.
- F. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce decorative formed metal items as needed to attach and support other construction.
- G. Provide support framing, mounting and attachment clips, splice sleeves, fasteners, and accessories needed to install decorative formed metal items.
- H. Where welding or brazing is indicated, weld, or braze joints and seams continuously. Grind, fill, and dress to produce smooth, flush, exposed surfaces in which joints are not visible after finishing is completed.
 - 1. Use welding and brazing procedures that will blend with and not cause discoloration of metal being joined.

2.5 BEAM WRAPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hi-Tech Metals, Inc.
 2. Industrial Louvers Inc.
 3. Metal Sales & Service, Inc.; Metalwerks Division.
 4. MM Systems Corporation.
 5. Southwest Metalsmiths.
 6. **<Insert manufacturer's name>**.
 7. or approved equal.
- B. Form beam wraps from metal of type and thickness indicated below. Fabricate to fit tightly to adjoining construction.
1. Aluminum Sheet: [**0.063 inch (1.60 mm)**] [**Thickness required to comply with performance requirements**] **<Insert thickness>**.
 - a. Finish: [**Baked enamel or powder coat**] [**Siliconized polyester**] [**High-performance organic coating**] [**Mill**] [**Clear anodic**] [**Color anodic**].
 2. Steel Sheet: [**0.060 inch (1.52 mm)**] [**Thickness required to comply with performance requirements**] **<Insert thickness>**.
 - a. Finish: [**Factory primed**] [**Baked enamel**] [**Powder coat**].
 3. Stainless-Steel Sheet: [**0.050 inch (1.27 mm)**] [**Thickness required to comply with performance requirements**] **<Insert thickness>**.
 - a. Finish: [**No. 2B**] [**No. 4**] [**No. 6**] [**No. 7**] [**No. 8**].
- C. Fabricate with calk stop angle to retain backer rod and sealant.

2.6 CLOSURES AND TRIM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Fry Reglet Corporation.
 2. Pittcon Industries.
 3. **<Insert manufacturer's name>**.
 4. or approved equal.
- B. Form closures and trim from metal of type and thickness indicated below. Fabricate to fit tightly to adjoining construction[, **with weathertight joints at exterior installations**].
1. Aluminum Sheet: [**0.063 inch (1.60 mm)**] [**Thickness required to comply with performance requirements**] **<Insert thickness>**.

- a. Finish: **[Baked enamel or powder coat] [Siliconized polyester] [High-performance organic coating] [Mill] [Clear anodic] [Color anodic].**
 2. Galvanized-Steel Sheet: **[0.052 inch (1.32 mm)] [Thickness required to comply with performance requirements] <Insert thickness>.**
 - a. Finish: **[Factory primed] [Baked enamel] [Siliconized polyester] [High-performance organic coating] [Powder coat].**
 3. Steel Sheet: **[0.048 inch (1.21 mm)] [Thickness required to comply with performance requirements] <Insert thickness>.**
 - a. Finish: **[Factory primed] [Baked enamel] [Powder coat].**
 4. Closures and trim may be fabricated from prefinished metal sheet in lieu of finishing after fabrication provided unfinished edges are concealed from view and not exposed to weather.
- C. Conceal fasteners where possible; otherwise, locate where they are as inconspicuous as possible. Size fasteners to support closures and trim, with fasteners spaced to prevent buckling or waviness in finished surfaces.
- D. Drill and tap holes needed for securing closures and trim to other surfaces.
- E. Incorporate gaskets where indicated or needed for concealed, continuous seal at abutting surfaces.
- F. Miter or cope trim members at corners and reinforce with bent metal splice plates to form tight joints.

2.7 COLUMN COVERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ATAS International, Inc.
 2. Ceilings Plus.
 3. Construction Services, Inc.
 4. Couturier Iron Craft, Inc.
 5. Firestone Metal Products, LLC; Una-Clad.
 6. Fry Reglet Corporation.
 7. Hi-Tech Metals, Inc.
 8. Industrial Louvers Inc.
 9. Kanalco Ltd.
 10. Leed Himmel Industries, Inc.
 11. Metal Sales & Service, Inc.; Metalwerks Division.
 12. MM Systems Corporation.
 13. Nelson Industrial Inc.
 14. Pittcon Industries.
 15. Protean Construction Products, Inc.

16. Southwest Metalsmiths.
 17. <Insert manufacturer's name>.
 18. or approved equal.
- B. Spackled-Seam Type: Form column covers from 0.125-inch (3.2-mm) aluminum, rolled to radii indicated. Taper edges of adjoining pieces of column covers, for taping and spackling, to 0.094-inch (2.4-mm) thickness in approximately 1 inch (25 mm) of width. Punch tapered edges for gypsum board screws at 1/2 inch (12 mm) o.c., and mill grooves in tapered edge to improve bond with joint compound.
1. Support Framing: At vertical joints, provide 1-1/2-by-3-5/8-inch (38-by-89-mm) steel channel support posts formed from 0.040-inch (1.0-mm) galvanized steel.
 2. Joint Treatment Materials: Provide joint treatment compounds and reinforcing tape complying with requirements in Section 092900 "Gypsum Board."
- C. Snap-Together Type: Form column covers to shapes indicated from metal of type and minimum thickness indicated below. Return vertical edges and bend to form hook that will engage continuous mounting clips.
1. Aluminum Sheet: [0.063 inch (1.60 mm)] [Thickness required to comply with performance requirements] <Insert thickness>.
 - a. Finish: [Baked enamel or powder coat] [Siliconized polyester] [High-performance organic coating] [Mill] [Clear anodic] [Color anodic].
 2. Steel Sheet: [0.060 inch (1.52 mm)] [Thickness required to comply with performance requirements] <Insert thickness>.
 - a. Finish: [Factory primed] [Baked enamel] [Powder coat].
 3. Stainless-Steel Sheet: [0.109 inch (2,78 mm)] [Thickness required to comply with performance requirements] <Insert thickness>.
 - a. Finish: [No. 2B] [No. 4] [No. 6] [No. 7] [No. 8].
 4. Bronze Sheet: [0.051 inch (1.29 mm)] [Thickness required to comply with performance requirements] <Insert thickness>.
 - a. Finish: [Buffed finish, lacquered] [Hand-rubbed finish, lacquered] [Statuary conversion coating over satin finish].
 5. Brass Sheet: [0.051 inch (1.29 mm)] [Thickness required to comply with performance requirements] <Insert thickness>.
 - a. Finish: [Buffed] [Hand-rubbed] finish, lacquered.
 - b. Delete first subparagraph below if not acceptable or not applicable.
 6. Column covers may be fabricated from prefinished metal sheet in lieu of finishing after fabrication provided unfinished edges are concealed from view.
 7. Form returns at vertical joints to provide hairline V-joints.

8. Form returns at vertical joints to provide [**1/2-inch- (12-mm-)**] [**3/4-inch- (18-mm-)**] wide reveal at joints. Provide snap-in metal filler strips at reveals that leave reveals [**1/2 inch (12 mm) deep**] [**flush**].
9. Form returns at vertical joints to accommodate backer rod and sealant.
10. Fabricate column covers with hairline horizontal V-joints produced by forming returns on mating ends of column cover sections. Locate horizontal joints as indicated.
11. Fabricate column covers without horizontal joints.
12. Fabricate column covers with horizontal butt joints, tightly fitted and backed with a sleeve for field splicing with adhesive.
13. Fabricate column covers with [**1/2-inch- (12-mm-) wide**] reveals at horizontal joints produced by forming returns on mating ends of column cover sections. Provide snap-in metal filler strips at reveals matching reveals at vertical joints. Locate horizontal joints as indicated.
14. Fabricate [**base**] [**ceiling**] ring to [**match**] [**contrast with**] column covers.
15. Fabricate with calk stop/stiffener ring.
16. Apply manufacturer's recommended sound-deadening [**insulation**] [**mastic**] [**mastic and insulation**] to backs of column covers.

2.8 STAINLESS STEEL CORNER GUARDS

- A. Surface-mounted, Metal Corner Guards: Fabricated from one-piece, formed or extruded metal with formed edges; with 90 degree or 135 degree turn to match wall condition

1. Manufacturers: Subject to compliance with requirements, provide one of the following:
 - a. Construction Specialties, Inc.
 - b. IPC Door and Wall Protection Systems; Division of InPro Corp.
 - c. Pawling Corp.
 - d. **<Insert manufacturer's name>**
 - e. or approved equal.
2. Material: Stainless steel, Type 304.
 - a. Thickness: Minimum 0.0625 in. (1.6 mm).
 - b. Finish: Directional satin, No. 4
3. Wing Size: **<Insert number> <Refer to Drawings>**.
4. Corner Radius: 1/8 inch (3 mm).
5. Mounting: Flat-head, stainless steel, countersunk screws through factory-drilled mounting holes.

2.9 STAINLESS STEEL CHAIR RAILS

- A. Form custom chair rails from metal of type and thickness indicated below. Coordinate size of chair rails, location, and method of attachment to adjoining construction with

details on Drawings.

1. Stainless Steel Sheet Thickness: **<Insert number> <Refer to Drawings>**.
 - a. Finish: Refer to Drawings.
 - b. Attachment: Refer to Drawings.
 - c. Form and pattern: Refer to Drawings.

2.10 STAINLESS STEEL SUPPORT FOR FLIGHT INFORMATION DISPLAY SYSTEMS (FIDS)

- A. Monitor Brackets and cable/connector covers shall be as designed and manufactured by Display Devices, 5880 Sheridan Blvd., Arvada, CO.
- B. Stainless steel cable and cable fittings shall be Ronstan Stainless Steel 316g, spiral strand, 1 x 19 cable, WR6119 with Ronstan Stainless Steel threaded swage ends, RF 1511-3222, with nuts and washers.
 1. Hardware: Stainless steel, as described on Drawings. Use security screws at panel fasteners.
 2. Finish: AISI No. 4.

2.11 DIAMOND PLATE, CHROME-PLATED STEEL WAINSCOT

- A. **<Insert requirements or refer to Drawings>**.

2.12 DUCT ENCLOSURES AT HOLD ROOMS

- A. **<Insert requirements or refer to Drawings>**.

2.13 SIGN SHELF AT SUBCORE

- A. **<Insert requirements or refer to Drawings>**.

2.14 SUBCORE ACCENT WALL

- A. **<Insert requirements or refer to Drawings>**.

2.15 SUPPORT SYSTEM FOR WAY FINDING SIGNAGE

- A. **<Insert requirements or refer to drawings>**.

2.16 DECORATIVE-METAL-CLAD DOORS AND FRAMES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Dawson Metal Co., Inc.
 2. InKan Limited.
 3. Krieger Specialty Products Company.
 4. **<Insert manufacturer's name>**.
 5. or approved equal.
- B. Laminate metal sheets, of type and thickness indicated below, to faces of **[hollow-metal doors and frames] [and] [elevator entrances]** where indicated:
1. Bronze Sheet: **[0.040 inch (1.02 mm)] <Insert thickness>**.
 - a. Finish: **[Buffed finish, lacquered] [Hand-rubbed finish, lacquered] [Statuary conversion coating over satin finish, lacquered]**.
 2. Brass Sheet: **[0.040 inch (1.02 mm)] <Insert thickness>**.
 - a. Finish: **[Buffed] [Hand-rubbed]** finish lacquered.
 3. Stainless-Steel Sheet: **[0.038 inch (0.95 mm)] <Insert thickness>**.
 - a. Finish: **[No. 2B] [No. 4] [No. 6] [No. 7] [No. 8]**.
 4. Titanium Sheet: **[0.025 inch (0.64 mm)] <Insert thickness>**.
 - a. Finish: **[Dull] [Bright]** matte.

2.17 ESCALATOR ENCLOSURES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hi-Tech Metals, Inc.
 2. KPK Stainless.
 3. Metal Sales & Service, Inc.; Metalwerks Division.
 4. Southwest Metalsmiths.
 5. **<Insert manufacturer's name>**.
 6. or approved equal.
- B. Form escalator enclosures from metal of type and thickness indicated below. Coordinate size of enclosures, location of cutouts, and method of attachment to adjoining construction.
1. Stainless-Steel Sheet: **[0.062 inch (1.59 mm)] [Thickness required to comply with performance requirements] <Insert thickness>**.

- a. Finish: **[No. 2B] [No. 4] [No. 6] [No. 7] [No. 8]**.
2. Bronze Sheet: **[0.081 inch (2.05 mm)] [Thickness required to comply with performance requirements] <Insert thickness>**.
 - a. Finish: **[Buffed finish, lacquered] [Hand-rubbed finish, lacquered] [Statuary conversion coating over satin finish]**.

2.18 FILLER PANELS

- A. Form filler panels for closing ends of partition systems and for other applications indicated. Form from two sheets of metal of type and thickness indicated below, separated by channels formed from the same material, producing a panel of same thickness as **[partitions] [mullions]** unless otherwise indicated. Incorporate reveals, trim, and concealed anchorages for attaching to adjacent surfaces.
 1. Galvanized-Steel Sheet: **[0.064 inch (1.63 mm)] <Insert thickness>**.
 - a. Finish: **[Factory primed] [Baked enamel] [Siliconized polyester] [High-performance organic coating] [Powder coat]**.
 2. Steel Sheet: **[0.060 inch (1.52 mm)] <Insert thickness>**.
 - a. Finish: **[Factory primed] [Baked enamel] [Powder coat]**.
 3. Filler panels may be fabricated from prefinished metal sheet in lieu of finishing after fabrication provided unfinished edges are concealed from view.
- B. Fill interior of panel with sound-deadening insulation permanently attached to inside panel faces.
- C. Adhesively attach gaskets to filler panel edges where they abut mullions or glazing. Use **1-inch-** (25-mm-) square material, unless otherwise indicated, set approximately **1/4 inch** (6 mm) into channeled edge of filler panel.
- D. Attach gaskets to all edges of panels that abut adjacent surfaces to form a continuous seal. Use compressible gaskets or mastic sealing tape, applied to center of panel edges to be concealed from view, unless otherwise indicated.
- E. Do not mechanically fasten filler panels to mullions.

2.19 HEATING-COOLING UNIT ENCLOSURES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Airflex Industries, Inc.
 2. Architectural Grille; Div. of Giumenta Corp.
 3. Arsko Manufacturing Company.

4. Kees, Inc.
 5. Precision Metal Fabricators, Inc.
 6. **<Insert manufacturer's name>**.
 7. or approved equal.
- B. Fabricate heating-cooling unit enclosures from metal of type and thickness indicated below:
1. Galvanized-Steel Sheet:
 - a. Framing: **[0.108 inch (2.74 mm)] [Thickness required to comply with performance requirements] <Insert thickness>**.
 - b. Sills and Stools: **[0.079 inch (2.01 mm)] [Thickness required to comply with performance requirements] <Insert thickness>**.
 - c. Front Panels and Bases: **[0.064 inch (1.63 mm)] <Insert thickness>**.
 - d. Concealed Panels and Trim: **[0.040 inch (1.02 mm)] <Insert thickness>**.
 - e. Finish: **[Factory primed] [Baked enamel] [Siliconized polyester] [High-performance organic coating] [Powder coat]**.
 2. Steel Sheet:
 - a. Framing: **[0.105 inch (2.66 mm)] [Thickness required to comply with performance requirements] <Insert thickness>**.
 - b. Sills and Stools: **[0.075 inch (1.90 mm)] [Thickness required to comply with performance requirements] <Insert thickness>**.
 - c. Front Panels and Bases: **[0.060 inch (1.52 mm)] <Insert thickness>**.
 - d. Concealed Panels and Trim: **[0.036 inch (0.91 mm)] <Insert thickness>**.
 - e. Finish: **[Factory primed] [Baked enamel] [Powder coat]**.
- C. Weld seams and connections unless otherwise indicated or unless other methods are necessary for access to heating and cooling equipment.
- D. Incorporate stiffeners or laminated backing using noncombustible materials as needed for strength and rigidity.
1. Fill space between stiffeners with sound-deadening insulation attached to face sheet with insulation adhesive unless otherwise indicated.
 2. Coat concealed faces of metal panels more than **6 inches (150 mm)** wide with a heavy coating of sound-deadening mastic applied at the minimum rate of **20 sq. ft./gal. (0.5 sq. m/L)**.
- E. Provide louvers and grilles of size, type, and materials indicated.
1. For removable grilles, use modular units with recessed openings formed into surfaces of enclosures and without blank filler panels between grilles, so face panels and stools are continuous. Fabricate removable grilles and openings to precise tolerances to produce well-fitted assemblies free of warp or rattle, with grilles supported continuously along parallel edges and with tops flush with top of enclosure.

- F. Incorporate removable tops and fronts where indicated or needed for access to heating-cooling units and to piping, ductwork, controls, and electrical service, with panels and openings as follows:
1. Fabricate with a fitting tolerance of not less than **1/32 inch** (0.8 mm) and not more than **1/16 inch** (1.6 mm) at each edge, with face of panels flush with adjoining fixed surfaces of enclosure.
 2. Form panels for easy removal without interfering with adjoining construction or furniture. Hold panels in place with concealed clips and hardware that prevent warp and rattle.
- G. Incorporate hinged access panels in enclosures for access to heating-cooling unit controls, as either separate elements or integrated with grille openings, as indicated or needed.
- H. Coordinate construction, configuration, and dimensions of enclosures with those of heating-cooling units. Provide support for heating-cooling units and controls where indicated. Provide blind knockouts and supports for piping, ductwork, control lines, electrical conduit, and wiring where indicated or needed.
- I. Locate fixed surfaces of enclosure to coincide precisely with window mullions and partition system terminations. Provide closures at ends of units, at recessed openings in base of units, and at other locations where needed to conceal unfinished wall or floor surfaces, piping, conduit, ductwork, or heating-cooling units.
1. Provide built-in partitions (bulkheads) within enclosures between heating-cooling units, located to coincide with mullions and partition system terminations. Seal partitions to faces of enclosures with compressible gaskets or mastic sealing tape, and cover both sides of partitions with sound-deadening insulation attached to partitions with insulation adhesive.

2.20 LIGHTING COVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Fry Reglet Corporation.
 2. Gordon, Inc.; Gordon Interior Specialties Division.
 3. Hi-Tech Metals, Inc.
 4. MM Systems Corporation.
 5. Pittcon Industries.
 6. **<Insert manufacturer's name>**.
 7. or approved equal.
- B. Form lighting coves from metal of type and thickness indicated below. Coordinate size of coves, location of cutouts for electrical wiring, and method of attachment to adjoining construction.
1. Aluminum Sheet: [**0.063 inch** (1.60 mm)] **<Insert thickness>**.

- a. Finish: [**Baked enamel or powder coat**] [**Siliconized polyester**] [**High-performance organic coating**] [**Mill**] [**Clear anodic**] [**Color anodic**].
2. Galvanized-Steel Sheet: [**0.052 inch (1.32 mm)**] <Insert thickness>.
 - a. Finish: [**Factory primed**] [**Baked enamel**] [**Siliconized polyester**] [**High-performance organic coating**] [**Powder coat**].
3. Steel Sheet: [**0.048 inch (1.21 mm)**] <Insert thickness>.
 - a. Finish: [**Factory primed**] [**Baked enamel**] [**Powder coat**].
4. Fabricate light covers with [**hairline butt joints**] [**tapered edges for taping and spackling**].
5. Provide [**mitered corners, factory welded with backplates**] [**factory endcaps**].
6. Lighting covers may be fabricated from prefinished metal sheet in lieu of finishing after fabrication provided unfinished edges are concealed from view.

2.21 METAL BASE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Fry Reglet Corporation.
 2. Pittcon Industries.
 3. <Insert manufacturer's name>.
 4. or approved equal.
- B. Form metal base from metal of type and thickness indicated below:
 1. Aluminum Sheet: [**0.063 inch (1.60 mm)**] <Insert thickness>.
 - a. Finish: [**Baked enamel or powder coat**] [**Siliconized polyester**] [**High-performance organic coating**] [**Mill**] [**Clear anodic**] [**Color anodic**].
 2. Stainless-Steel Sheet: [**0.050 inch (1.27 mm)**] <Insert thickness>.
 - a. Finish: [**No. 2B**] [**No. 4**] [**No. 6**] [**No. 7**] [**No. 8**].

2.22 MULLION CLADDING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Hi-Tech Metals, Inc.
 2. International Metal Worksw.
 3. KPK Stainless.
 4. Metal Sales & Service, Inc.; Metalwerks Division.
 5. Southwest Metalsmiths.

6. **<Insert manufacturer's name>**.
7. or approved equal.

B. Form mullion cladding from metal of type and thickness indicated below. Fabricate to fit tightly to adjoining construction.

1. Aluminum Sheet: **[0.063 inch (1.60 mm)] <Insert thickness>**.
 - a. Finish: **[Baked enamel or powder coat] [Siliconized polyester] [High-performance organic coating] [Mill] [Clear anodic] [Color anodic]**.
2. Galvanized-Steel Sheet: **[0.052 inch (1.32 mm)] <Insert thickness>**.
 - a. Finish: **[Factory primed] [Baked enamel] [Siliconized polyester] [High-performance organic coating] [Powder coat]**.
3. Stainless-Steel Sheet: **[0.050 inch (1.27 mm)] <Insert thickness>**.
 - a. Finish: **[No. 2B] [No. 4] [No. 6] [No. 7] [No. 8]**.

2.23 PIPE SYSTEM COVERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Arscos Manufacturing Company.
2. Grice Engineering, Inc.
3. **<Insert manufacturer's name>**.
4. or approved equal.

B. Form pipe system covers from metal of type and thickness indicated below. Coordinate size of covers, location of cutouts for piping, and method of attachment to adjoining construction.

1. Galvanized-Steel Sheet: **[0.052 inch (1.32 mm)] <Insert thickness>**.
 - a. Finish: **[Factory primed] [Baked enamel] [Siliconized polyester] [High-performance organic coating] [Powder coat]**.
2. Steel Sheet: **[0.048 inch (1.21 mm)] <Insert thickness>**.
 - a. Finish: **[Factory primed] [Baked enamel] [Powder coat]**.

2.24 POCKETS FOR WINDOW TREATMENT

A. Form pockets from metal of type and thickness indicated below, with end closures. Coordinate dimensions and attachment methods with window treatment equipment, window frames, ceiling suspension system, and other related construction to produce a coordinated, closely fitting assembly.

1. Aluminum Sheet: **[0.063 inch (1.60 mm)] <Insert thickness>**.
 - a. Finish: **[Baked enamel or powder coat] [Siliconized polyester] [High-performance organic coating] [Mill] [Clear anodic] [Color anodic]**.
 2. Galvanized-Steel Sheet: **[0.052 inch (1.32 mm)]**.
 - a. Finish: **[Factory primed] [Baked enamel] [Siliconized polyester] [High-performance organic coating] [Powder coat]**.
 3. Steel Sheet: **[0.048 inch (1.21 mm)] <Insert thickness>**.
 - a. Finish: **[Factory primed] [Baked enamel] [Powder coat]**.
 4. Pockets for window treatment may be fabricated from prefinished metal sheet in lieu of finishing after fabrication provided unfinished edges are concealed from view.
- B. Reinforce pockets for attaching window treatment equipment and hardware, or increase metal thickness.
- C. Divide continuous pockets with built-in partitions located to separate adjoining drapery and blind units, to coincide with window mullions, and to receive filler panels at ends of partitions.

2.25 WINDOW STOOLS

- A. Form window stools from metal of type and thickness indicated below, with end closures:
1. Aluminum Sheet: **[0.063 inch (1.60 mm)] <Insert thickness>**.
 - a. Finish: **[Baked enamel or powder coat] [Siliconized polyester] [High-performance organic coating] [Mill] [Clear anodic] [Color anodic]**.
 2. Galvanized-Steel Sheet: **[0.052 inch (1.32 mm)] <Insert thickness>**.
 - a. Finish: **[Factory primed] [Baked enamel] [Siliconized polyester] [High-performance organic coating] [Powder coat]**.
 3. Stainless-Steel Sheet: **[0.050 inch (1.27 mm)] [1.3 mm] <Insert thickness>**.
 - a. Finish: **[No. 2B] [No. 4] [No. 6] [No. 7] [No. 8]**.
 4. Bronze Sheet: **[0.051 inch (1.29 mm)] <Insert thickness>**.
 - a. Finish: **[Buffed finish, lacquered] [Hand-rubbed finish, lacquered] [Statuary conversion coating over satin finish]**.
- B. Weld seams at end closures.

- C. Braze seams at end closures.
- D. Apply sound-deadening [**insulation**] [**mastic**] to underside of window stools.

2.26 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- D. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.
- E. Finish [**items indicated on Drawings**] <Insert product> after assembly.
- F. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.27 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
- C. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.
 - 1. Color: [**Champagne**] [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] <Insert color>.
 - 2. Color: [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**].
- D. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils** (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from**

manufacturer's full range] <Insert color and gloss>.

- E. Siliconized Polyester Finish: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than **0.2 mil** (0.005 mm) for primer and **0.8 mil** (0.02 mm) for topcoat.
1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager** from manufacturer's full range] <Insert color and gloss>.
- F. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with **[AAMA 2604] [AAMA 2605]** and containing not less than **[50] [70]** percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager** from manufacturer's full range] <Insert color and gloss>.
- G. High-Performance Organic Finish: **[Three] [Four]**-coat fluoropolymer finish complying with AAMA 2605 and containing not less than **[50] [70]** percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager** from manufacturer's full range] <Insert color and gloss>.

2.28 GALVANIZED-STEEL SHEET FINISHES

- A. Preparing Galvanized Items for Factory Priming: Thoroughly clean galvanized decorative formed metal of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- B. Preparing Galvanized Items for Factory Finishing: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
- C. Repairing Galvanized Surfaces: Clean welds and abraded areas and repair galvanizing to comply with ASTM A 780.
- D. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply shop primer to prepared surfaces of items unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
- E. Factory-Painted Finish: Comply with **[Section 099113 "Exterior Painting."]** **[Section 099600 "High-Performance Coatings."]**
1. Color: **[As indicated by manufacturer's designations] [Match DEN Project**

Manager's sample] [As selected by DEN Project Manager from manufacturer's full range].

- F. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of **1 mil** (0.025 mm) for topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of **2 mils** (0.05 mm).
1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>.**
- G. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than **1.5 mils** (0.04 mm). Prepare, treat, and coat metal to comply with resin manufacturer's written instructions.
1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>.**
- H. Siliconized-Polyester Coating: Immediately after cleaning and pretreating, apply manufacturer's standard epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than **0.2 mil** (0.005 mm) for primer and **0.8 mil** (0.02 mm) for topcoat.
1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>.**
- I. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with **[AAMA 2604] [AAMA 2605]** and containing not less than **[50] [70]** percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>.**
- J. High-Performance Organic Finish: **[Three] [Four]**-coat fluoropolymer finish complying with AAMA 2605 and containing not less than **[50] [70]** percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>.**

2.29 STEEL SHEET FINISHES

- A. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."
- B. Pretreatment: Immediately after cleaning, apply a conversion coating of type suited to organic coating applied over it.
- C. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply shop primer to prepared surfaces of items unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
- D. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of **2 mils** (0.05 mm).
 - 1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>**.
- E. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than **1.5 mils** (0.04 mm). Prepare, treat, and coat metal to comply with resin manufacturer's written instructions.
 - 1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>**.

2.30 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
- C. Bright, Cold-Rolled, Unpolished Finish: No. 2B.
- D. Directional Satin Finish: No. 4.
- E. Dull Satin Finish: No. 6.
- F. Satin, Reflective, Directional Polish: No. 7.

- G. Mirrorlike Reflective, Nondirectional Polish: No. 8 finish.
- H. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.31 COPPER-ALLOY FINISHES

- A. Finish designations for copper alloys comply with the system established for designating copper-alloy finish systems defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products."
- B. Buffed Finish: M21 (Mechanical Finish: buffed, smooth specular).
- C. Hand-Rubbed Finish: M31-M34 (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed).
- D. Medium-Satin Finish: M32 (Mechanical Finish: directionally textured, medium satin).
- E. Fine-Matte Finish: M42 (Mechanical Finish: nondirectional finish, fine matte).
- F. Buffed Finish, Lacquered: M21-O6x (Mechanical Finish: buffed, smooth specular; Coating: clear organic, air drying, as specified below).
 - 1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).
- G. Hand-Rubbed Finish, Lacquered: M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear organic, air drying, as specified below).
 - 1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).
- H. Medium-Satin Finish, Lacquered: M32-O6x (Mechanical Finish: directionally textured, medium satin; Coating: clear organic, air drying, as specified below).
 - 1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).
- I. Fine-Matte Finish, Lacquered: M42-O6x (Mechanical Finish: nondirectional finish, fine matte; Coating: clear organic, air drying, as specified below).
 - 1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).
- J. Statuary Conversion Coating over Satin Finish: M31-C55 (Mechanical Finish:

directionally textured, fine satin; Chemical Finish: conversion coating, sulfide)[, **with color matching DEN Project Manager's sample**].

- K. Statuary Conversion Coating over Satin Finish, Lacquered: M31-C55-O6x (Mechanical Finish: directionally textured, fine satin; Chemical Finish: conversion coating, sulfide; Coating: clear, organic, air drying, as specified below) [, **with color matching DEN Project Manager's sample**]:
1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).

2.32 TITANIUM FINISHES

- A. General: Fabricate items from finished titanium sheet, taking care not to damage finish during fabrication. Protect finish as needed during fabrication by applying a strippable, temporary protective covering.
- B. Dull Matte Finish: Pickled and annealed.
- C. Bright Matte Finish: Vacuum annealed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative formed metal.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Restore protective coverings that have been damaged during shipment or installation of the work. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at the same location.
1. Retain protective coverings intact and remove simultaneously from similarly finished items to preclude nonuniform oxidation and discoloration.
- B. Locate and place decorative formed metal items level and plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install decorative formed metal.

1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
 - C. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where needed to protect metal surfaces and to make a weathertight connection.
 - D. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.
 - E. Install concealed gaskets, joint fillers, insulation, sealants, and flashings, as the Work progresses, to make exterior decorative formed metal items weatherproof.
 - F. Install concealed gaskets, joint fillers, sealants, and insulation, as the Work progresses, to make interior decorative formed metal items soundproof or lightproof as applicable to type of fabrication indicated.
 - G. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.
 - H. Install decorative-formed-metal-clad doors and frames to comply with requirements specified in Section 081113 "Hollow Metal Doors and Frames."
 - I. Apply joint treatment at joints of spackled-seam-type metal column covers. Comply with requirements in Section 092900 "Gypsum Board."
 - J. Field Welding: Comply with applicable AWS specification for procedures of manual shielded metal arc welding, for appearance and quality of welds made, and for methods used in correcting welding work. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed welded joints smooth and restore finish to match finish of adjacent rail surfaces.
 1. Do not field weld without prior approval from DEN Project Manager, with DEN approved safety precautions in place.
- 3.3 ADJUSTING AND CLEANING
- A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.
 - B. Clean copper alloys according to metal finisher's written instructions in a manner that leaves an undamaged and uniform finish matching approved Sample.
 - C. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as

used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum **2.0-mil** (0.05-mm) dry film thickness.
- D. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in [**Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."**] [**Section 099600 "High-Performance Coatings."**] [**Section 099113 "Exterior Painting" Section 099123 "Interior Painting,"and Section 099600 "High-Performance Coatings."**]
- E. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.
- 3.4 PROTECTION
- A. Protect finishes of decorative formed metal items from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

PART 4 - MEASUREMENT

A. METHOD OF MEASUREMENT

1. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

A. METHOD OF PAYMENT

1. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 057500

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Framing with engineered wood products.
3. Shear wall panels.
4. Rooftop equipment bases and support curbs.
5. Wood blocking[, **cants,**] and nailers.
6. Wood furring[**and grounds**].
7. Wood sleepers.
8. Utility shelving.
9. Plywood backing panels.

B. Related Requirements:

1. Section 061063 "Exterior Rough Carpentry" for elevated decks and other exterior construction made of wood.
2. Section 061600 "Sheathing."
3. Section 061753 "Shop-Fabricated Wood Trusses" for wood trusses made from dimension lumber.
4. Section 062000 "Finish Carpentry" for finish carpentry.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 DEFINITIONS

- A. Exposed Framing: Framing not concealed by other construction.
- B. Dimension Lumber: Lumber of **2 inches nominal** (38 mm actual) or greater but less than **5 inches nominal** (114 mm actual) in least dimension.
- C. Timber: Lumber of **5 inches nominal** (114 mm actual) or greater in least dimension.

- D. Lumber grading agencies, and the abbreviations used to reference them, include the following:
1. NeLMA: Northeastern Lumber Manufacturers' Association.
 2. NLGA: National Lumber Grades Authority.
 3. RIS: Redwood Inspection Service.
 4. SPIB: The Southern Pine Inspection Bureau.
 5. WCLIB: West Coast Lumber Inspection Bureau.
 6. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
 6. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
1. Certificates for [**Credit MR 6**] [**Credit MR 7**]: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
 2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
 3. Product Data for Credit IEQ 4.4: For composite wood products, documentation indicating that product contains no urea formaldehyde.
 4. Laboratory Test Reports for Credit IEQ 4: For [**adhesives**] [**and**] [**composite-wood products**], documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
 - 1. Wood-preservative-treated wood.
 - 2. Fire-retardant-treated wood.
 - 3. Engineered wood products.
 - 4. Shear panels.
 - 5. Power-driven fasteners.
 - 6. Expansion anchors.
 - 7. Metal framing anchors.
- C. Manufacturer to provide a certificate that the Manufacturer has not less than five (5) years experience in the manufacturing of the types of products specified and that all materials are per Contract requirements.
- D. Installer to provide a certificate that the installer has not less than three (3) years experience in the installation of types of products specified.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.
 - 1. For lumber pressure treated with waterborne chemicals, space between each course to provide air circulation.

1.8 PROJECT CONDITIONS

- A. Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit.
 - 1. Correlate location of furring, nailers, blocking, grounds, and similar supports with

all other trades to allow attachment of other work.

1.9 WARRANTY

- A. Warranty: Installer to provide a minimum two (2) <Insert number> year warranty for materials and workmanship.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Certified Wood: Materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship[.]"["for the following:"]
1. Dimension lumber framing.
 2. Timber.
 3. Laminated-veneer lumber.
 4. Parallel-strand lumber.
 5. Prefabricated wood I-joists.
 6. Rim boards.
 7. Miscellaneous lumber.
- B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. For exposed lumber indicated to receive a stained or natural finish, [**mark grade stamp on end or back of each piece**] [or] [**omit grade stamp and provide certificates of grade compliance issued by grading agency**].
 3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 4. Provide dressed lumber, S4S, unless otherwise indicated.
- C. Maximum Moisture Content of Lumber: [**19 percent**] unless otherwise indicated.

- D. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, which meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2[**for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground**].
1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
1. For exposed lumber indicated to receive a stained or natural finish, [**mark end or back of each piece**] [**or**] [**omit marking and provide certificates of treatment compliance issued by inspection agency**].
- D. Application: Treat [**items indicated on Drawings, and the following**]:
1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 2. Wood sills, sleepers, blocking, [**furring,**] [**stripping,**] and similar concealed members in contact with masonry or concrete.
 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 4. Wood framing members that are less than **18 inches** (460 mm) above the ground in crawlspaces or unexcavated areas.
 5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 feet (3.2 m)** beyond the centerline of the burners at any time during the test.
1. Use treatment that does not promote corrosion of metal fasteners.
 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 4. Design Value Adjustment Factors: Treated lumber shall be tested according ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841. **[For enclosed roof framing, framing in attic spaces, and where high temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.]**
- C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. **[Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.]**
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
1. For exposed lumber indicated to receive a stained or natural finish, **[mark end or back of each piece] [or] [omit marking and provide certificates of treatment compliance issued by testing agency].**
- E. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.
- F. Application: Treat all lumber used on the interior of the building.
1. Untreated wood: Not allowed except for temporary construction, as approved by DEN Project Manager.

2.4 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions: **[Standard, Stud, or No. 3]** grade.

1. Application: **[All interior partitions]**.
2. Species:
 - a. Hem-fir (north); NLGA.
 - b. Mixed southern pine; SPIB.
 - c. Spruce-pine-fir; NLGA.
 - d. Hem-fir; WCLIB, or WWPA.
 - e. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 - f. Northern species; NLGA.
 - g. Eastern softwoods; NeLMA.
 - h. Western woods; WCLIB or WWPA.

B. Load-Bearing Partitions: **[Construction, Stud, or No. 3]** grade.

1. Application: **[Exterior walls] [and] [interior load-bearing partitions]**.
2. Species:
 - a. Hem-fir (north); NLGA.
 - b. Southern pine; SPIB.
 - c. Douglas fir-larch; WCLIB or WWPA.
 - d. Mixed southern pine; SPIB.
 - e. Spruce-pine-fir; NLGA.
 - f. Douglas fir-south; WWPA.
 - g. Hem-fir; WCLIB or WWPA.
 - h. Douglas fir-larch (north); NLGA.
 - i. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

C. Load-Bearing Partitions: Any species of machine stress-rated dimension lumber with a grade of not less than **[2400f-2.0E] [2100f-1.8E] [1650f-1.5E] <Insert grade>**.

1. Application: **[Exterior walls] [and] [interior load-bearing partitions]**.

D. Load-Bearing Partitions: Any species and grade with a modulus of elasticity of at least **[1,500,000 psi (10 350 MPa)] [1,300,000 psi (8970 MPa)] [1,100,000 psi (7590 MPa)] [1,000,000 psi (6900 MPa)] [900,000 psi (6210 MPa)]** and an extreme fiber stress in bending of at least **[1000 psi (6.9 MPa)] [850 psi (5.86 MPa)] [700 psi (4.83 MPa)] [600 psi (4.14 MPa)] [500 psi (3.45 MPa)]** for **2-inch nominal (38-mm actual)** thickness and **12-inch nominal (286-mm actual)** width for single-member use.

1. Application: **[Exterior walls] [and] [interior load-bearing partitions]**.

E. Ceiling Joists: **[Construction or No. 2] [Construction, Stud, or No. 3] [Standard, Stud, or No. 3]** grade.

1. Species:
 - a. Hem-fir (north); NLGA.

- b. Southern pine; SPIB.
 - c. Douglas fir-larch; WCLIB or WWPA.
 - d. Douglas fir-larch (north); NLGA.
 - e. Mixed southern pine; SPIB.
 - f. Spruce-pine-fir; NLGA.
 - g. Hem-fir; WCLIB or WWPA.
 - h. Douglas fir-south; WWPA.
 - i. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 - j. Northern species; NLGA.
 - k. Eastern softwoods; NeLMA.
 - l. Western woods; WCLIB or WWPA.
- F. Joists, Rafters, and Other Framing Not Listed Above: **[Select Structural] [No. 1] [No. 2] [Construction or No. 2] [Construction, Stud, or No. 3]** grade.
1. Species:
 - a. Hem-fir (north); NLGA.
 - b. Southern pine; SPIB.
 - c. Douglas fir-larch; WCLIB or WWPA.
 - d. Mixed southern pine; SPIB.
 - e. Spruce-pine-fir; NLGA.
 - f. Douglas fir-south; WWPA.
 - g. Hem-fir; WCLIB or WWPA.
 - h. Douglas fir-larch (north); NLGA.
 - i. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
- G. Joists, Rafters, and Other Framing Not Listed Above: Any species of machine stress-rated dimension lumber with a grade of not less than **[2400f-2.0E] [2100f-1.8E] [1650f-1.5E]** <Insert grade>.
- H. Joists, Rafters, and Other Framing Not Listed Above: Any species and grade with a modulus of elasticity of at least **[1,500,000 psi (10 350 MPa)] [1,300,000 psi (8970 MPa)] [1,100,000 psi (7590 MPa)] [1,000,000 psi (6900 MPa)] [900,000 psi (6210 MPa)]** and an extreme fiber stress in bending of at least **[1000 psi (6.9 MPa)] [850 psi (5.86 MPa)] [700 psi (4.83 MPa)] [600 psi (4.14 MPa)] [500 psi (3.45 MPa)]** for **2-inch nominal** (38-mm actual) thickness and **12-inch nominal** (286-mm actual) width for single-member use.
- I. Exposed Framing: Provide material hand-selected for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.
1. Application: Exposed **[exterior] [and] [interior]** framing **[indicated to receive a stained or natural finish]**.
 2. Species and Grade: As indicated above for load-bearing construction of same type.
 3. Species and Grade: Hem-fir (north); **[Select Structural] [No. 1]** grade; NLGA.
 4. Species and Grade: Southern pine; **[Select Structural] [No. 1] [No. 2]** grade; SPIB.

5. Species and Grade: Douglas fir-larch; [**Select Structural**] [**No. 1**] grade; WCLIB or WWPA.
6. Species and Grade: Mixed southern pine; [**Select Structural**] [**No. 1**] [**No. 2**] grade; SPIB.
7. Species and Grade: Spruce-pine-fir; [**Select Structural**] [**No. 1**] grade; NLGA.
8. Species and Grade: Douglas fir-south; [**Select Structural**] [**No. 1**] grade; WWPA.
9. Species and Grade: Hem-fir; [**Select Structural**] [**No. 1**] grade; WCLIB or WWPA.
10. Species and Grade: Douglas fir-larch (north); [**Select Structural**] [**No. 1**] grade; NLGA.
11. Species and Grade: Spruce-pine-fir (south); [**Select Structural**] [**No. 1**] grade; NeLMA, WCLIB, or WWPA.
12. Species and Grade: Eastern hemlock-balsam fir or eastern hemlock-tamarack; [**Select Structural**] [**No. 1**] grade; NeLMA.
13. Species and Grade: Beech-birch-hickory; [**Select Structural**] [**No. 1**] grade; NeLMA.
14. Species and Grade: Northern red oak; [**Select Structural**] [**No. 1**] grade; NeLMA.
15. Species and Grade: Redwood; [**Clear Heart Structural**] [**Clear Structural**] [**Select Structural**] [**No. 1**] grade; RIS.
16. Species and Grade: Mixed oak; [**Select Structural**] [**No. 1**] grade; NeLMA.
17. Species and Grade: Mixed maple; [**Select Structural**] [**No. 1**] grade; NeLMA.
18. Species and Grade: Western cedars; [**Select Structural**] [**No. 1**] grade; WCLIB or WWPA.

2.5 ENGINEERED WOOD PRODUCTS

- A. Engineered Wood Products, General: Products shall [**contain no urea formaldehyde.**] [**comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."**]
- B. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.
- C. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Boise Cascade Corporation.
 - b. Finnforest USA.
 - c. Georgia-Pacific.
 - d. Jager Building Systems Inc.
 - e. Louisiana-Pacific Corporation.
 - f. Pacific Woodtech Corporation.

- g. Roseburg Forest Products Co.
 - h. Standard Structures Inc.
 - i. Stark Truss Company, Inc.
 - j. West Fraser Timber Co., Ltd.
 - k. Weyerhaeuser Company.
 - l. <Insert manufacturer>
 - m. or approved equal.
 2. Extreme Fiber Stress in Bending, Edgewise: **3100 psi (21.3 MPa)** [**2900 psi (20.0 MPa)**] [**2600 psi (17.9 MPa)**] [**2250 psi (15.5 MPa)**] <Insert value> for 12-inch nominal- (286-mm actual-) depth members.
 3. Modulus of Elasticity, Edgewise: **2,000,000 psi (13 700 MPa)** [**1,800,000 psi (12 400 MPa)**] [**1,500,000 psi (10 300 MPa)**] <Insert value>.
- D. Parallel-Strand Lumber: Structural composite lumber made from wood strand elements with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Louisiana-Pacific Corporation.
 - b. Weyerhaeuser Company.
 - c. <Insert manufacturer>
 - d. or approved equal.
 2. Extreme Fiber Stress in Bending, Edgewise: **2900 psi (20 MPa)** for 12-inch nominal- (286-mm actual-) depth members.
 3. Modulus of Elasticity, Edgewise: **2,200,000 psi (15 100 MPa)**.
- E. Wood I-Joists: Prefabricated units, I-shaped in cross section, made with solid or structural composite lumber flanges and wood-based structural panel webs, let into and bonded to flanges. Provide units complying with material requirements of and with structural capacities established and monitored according to ASTM D 5055.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anthony-Domtar Inc.
 - b. Boise Cascade Corporation.
 - c. Georgia-Pacific.
 - d. J. M. Huber Corporation.
 - e. International Beams Inc.
 - f. International Paper Corporation.
 - g. Jager Building Systems Inc.
 - h. Louisiana-Pacific Corporation.
 - i. Nascor Incorporated.
 - j. Pacific Woodtech Corporation.
 - k. Roseburg Forest Products Co.

- I. Standard Structures Inc.
 - m. Stark Truss Company, Inc.
 - n. Superior Wood Systems.
 - o. Weyerhaeuser Company.
 - p. <Insert manufacturer's name>
 - q. or approved equal.
 2. Web Material: **[Either oriented strand board or plywood, complying with DOC PS 1 or DOC PS 2, Exposure 1] [Plywood, complying with DOC PS 1 or DOC PS 2, Exposure 1] [Plywood, complying with DOC PS 1, Exterior grade].**
 3. Structural Properties: Provide units with depths and design values not less than those indicated.
 4. Provide units complying with APA PRI-400, factory marked with APA trademark indicating nominal joist depth, joist class, span ratings, mill identification, and compliance with APA standard.
- F. Rim Boards: Product designed to be used as a load-bearing member and to brace wood I-joists at bearing ends, complying with research/evaluation report for I-joists.
1. Manufacturer: Provide products by same manufacturer as I-joists.
 2. Material: **[All-veneer product] [glued-laminated wood] [or] [product made from any combination solid lumber, wood strands, and veneers].**
 3. Thickness: **[1 inch (25 mm)] [1-1/8 inches (28 mm)] [1-1/4 inches (32 mm)].**
 4. Provide performance-rated product complying with APA PRR-401, **[rim board] [rim board plus]** grade, factory marked with APA trademark indicating thickness, grade, and compliance with APA standard.

2.6 SHEAR WALL PANELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Shear Transfer Systems.
 2. Simpson Strong-Tie Co., Inc.
 3. Weyerhaeuser Company.
 4. <Insert manufacturer>
 5. or approved equal.
- B. Wood-Framed Shear Wall Panels: Prefabricated assembly consisting of wood perimeter framing, tie downs, and Exposure I, Structural I plywood or OSB sheathing.
1. Products shall **[contain no urea formaldehyde.] [comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]**
- C. Steel-Framed Shear Wall Panels: Prefabricated assembly consisting of cold-formed galvanized steel panel, steel top and bottom plates, and wood studs.

- D. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, which meet or exceed those **[indicated] [of products of manufacturers listed]**. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.7 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.
 2. Nailers.
 3. Rooftop equipment bases and support curbs.
 4. Cants.
 5. Furring.
 6. Grounds.
 7. Utility shelving.
- B. For items of dimension lumber size, provide **[Standard, Stud, or No. 3]** grade lumber **[and any of the following species:]**
1. Hem-fir (north); NLGA.
 2. Mixed southern pine; SPIB.
 3. Spruce-pine-fir; NLGA.
 4. Hem-fir; WCLIB or WWPA.
 5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 6. Western woods; WCLIB or WWPA.
 7. Northern species; NLGA.
 8. Eastern softwoods; NeLMA.
- C. For utility shelving, provide lumber with **[19]** percent maximum moisture content and **[any of]** the following species and grades:
1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; **[Premium or No. 2 Common (Sterling)] [Standard or No. 3 Common]** grade; NeLMA, NLGA, WCLIB, or WWPA.
 2. Mixed southern pine; No. **[1] [2]** grade; SPIB.
 3. Hem-fir or hem-fir (north); **[Select Merchantable or No. 1 Common] [Construction or No. 2 Common]** grade; NLGA, WCLIB, or WWPA.
 4. Spruce-pine-fir (south) or spruce-pine-fir; **[Select Merchantable or No. 1 Common] [Construction or No. 2 Common]** grade; NeLMA, NLGA, WCLIB, or WWPA.
- D. For concealed boards, provide lumber with **[19]** percent maximum moisture content and **[any of]** the following species and grades:
1. Mixed southern pine; No. **[2] [3]** grade; SPIB.

2. Hem-fir or hem-fir (north); [**Construction or No. 2 Common**] [**Standard or No. 3 Common**] grade; NLGA, WCLIB, or WWPA.
 3. Spruce-pine-fir (south) or spruce-pine-fir; [**Construction or No. 2 Common**] [**Standard or No. 3 Common**] grade; NeLMA, NLGA, WCLIB, or WWPA.
 4. Eastern softwoods; No. [**2**] [**3**] Common grade; NeLMA.
 5. Northern species; No. [**2**] [**3**] Common grade; NLGA.
 6. Western woods; [**Construction or No. 2 Common**] [**Standard or No. 3 Common**] grade; WCLIB or WWPA.
- E. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- F. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- G. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.8 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, [**Exterior, AC**] [**Exterior, C-C Plugged**] [**Exposure 1, C-D Plugged**], [**fire-retardant treated**], in thickness indicated or, if not indicated, not less than [**1/2-inch (13-mm)**] [**3/4-inch (19-mm)**] nominal thickness.
1. Plywood shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.9 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners[**with hot-dip zinc coating complying with ASTM A 153/A 153M**].
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: **ASME B18.2.1** (ASME B18.2.3.8M).

- F. Bolts: Steel bolts complying with [ASTM A 307, Grade A](#) (ASTM F 568M, Property Class 4.6); with [ASTM A 563](#) (ASTM A 563M) hex nuts and, where indicated, flat washers.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material: Stainless steel with bolts and nuts complying with [ASTM F 593 and ASTM F 594, Alloy Group 1 or 2](#) (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

2.10 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cleveland Steel Specialty Co.
 - 2. KC Metals Products, Inc.
 - 3. Phoenix Metal Products, Inc.
 - 4. Simpson Strong-Tie Co., Inc.
 - 5. USP Structural Connectors.
 - 6. **<Insert manufacturer's name>**
 - 7. or approved equal.
- B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those **[indicated] [of products of manufacturers listed]**. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, [G60](#) (Z180) coating designation.
 - 1. Use for interior locations unless otherwise indicated.
- D. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); [G185](#) (Z550) coating designation; and not less than [0.036 inch](#) (0.9 mm) thick.
 - 1. Use for wood-preserved-treated lumber and where indicated.
- E. Stainless-Steel Sheet: ASTM A 666, **[Type 304] [Type 316]**.
 - 1. Use for exterior locations and where indicated.
- F. Joist Hangers: U-shaped joist hangers with [2-inch-](#) (50-mm-) long seat and [1-1/4-inch-](#)

(32-mm-) wide nailing flanges at least 85 percent of joist depth.

1. Thickness: [0.050 inch (1.3 mm)] [0.062 inch (1.6 mm)].
- G. I-Joist Hangers: U-shaped joist hangers with 2-inch- (50-mm-) long seat and 1-1/4-inch- (32-mm-) wide nailing flanges full depth of joist. Nailing flanges provide lateral support at joist top chord.
1. Thickness: [0.050 inch (1.3 mm)] [0.062 inch (1.6 mm)].
- H. Top Flange Hangers: U-shaped joist hangers, full depth of joist, formed from metal strap with tabs bent to extend over and be fastened to supporting member.
1. Strap Width: [1-1/2 inches (38 mm)] [2 inches (50 mm)].
 2. Thickness: [0.050 inch (1.3 mm)] [0.062 inch (1.6 mm)].
- I. Bridging: Rigid, V-section, nailless type, 0.050 inch (1.3 mm) thick, length to suit joist size and spacing.
- J. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch (25 mm) above base and with 2-inch- (50-mm-) minimum side cover, socket 0.062 inch (1.6 mm) thick, and standoff and adjustment plates 0.108 inch (2.8 mm) thick.
- K. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.
1. Width: [3/4 inch (19 mm)] [1-1/4 inches (32 mm)].
 2. Thickness: [0.050 inch (1.3 mm)] [0.062 inch (1.6 mm)].
 3. Length: [16 inches (400 mm)] [24 inches (600 mm)] [As indicated].
- L. Rafter Tie-Downs: Bent strap tie for fastening rafters or roof trusses to wall studs below, 1-1/2 inches (38 mm) wide by 0.050 inch (1.3 mm) thick. [**Tie fastens to side of rafter or truss, face of top plates, and side of stud below.**]
- M. Rafter Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening rafters or roof trusses to wall studs below, 2-1/4 inches (57 mm) wide by 0.062 inch (1.6 mm) thick. Tie fits over top of rafter or truss and fastens to both sides of rafter or truss, face of top plates, and side of stud below.
- N. Floor-to-Floor Ties: Flat straps, with holes for fasteners, for tying upper floor wall studs to band joists and lower floor studs, 1-1/4 inches (32 mm) wide by 0.050 inch (1.3 mm) thick by 36 inches (914 mm) long.
- O. Hold-Downs: Brackets for bolting to wall studs and securing to foundation walls with anchor bolts or to other hold-downs with threaded rods and designed with first of two bolts placed seven bolt diameters from reinforced base.
1. Bolt Diameter: [5/8 inch (15.8 mm)] [3/4 inch (19 mm)].
 2. Width: [2-1/2 inches (64 mm)] [3-3/16 inches (81 mm)].
 3. Body Thickness: [0.108 inch (2.8 mm)] [0.138 inch (3.5 mm)].
 4. Base Reinforcement Thickness: [0.108 inch (2.8 mm)] [0.239 inch (6.1 mm)].

- P. Wall Bracing: T-shaped bracing made for letting into studs in saw kerf, **1-1/8 inches** (29 mm) wide by **9/16 inch** (14 mm) deep by **0.034 inch** (0.85 mm) thick with hemmed edges.
- Q. Wall Bracing: Angle bracing made for letting into studs in saw kerf, **15/16 by 15/16 by 0.040 inch** (24 by 24 by 1 mm) thick with hemmed edges.

2.11 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Closed-cell neoprene foam, **1/4 inch** (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, **[butyl rubber] [or] [rubberized-asphalt]** compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than **0.025 inch** (0.6 mm).
- C. Adhesives for Gluing **[Furring] [and] [Sleepers]** to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
 - 1. Adhesives shall have a VOC content of **[70] <Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chlorpyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate **[furring,]nailers, blocking, [grounds,]**and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

- D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. [**Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.**]
- E. Shear Wall Panels: Install shear wall panels to comply with manufacturer's written instructions.
- F. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- G. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
- H. Do not splice structural members between supports unless otherwise indicated.
- I. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than **16 inches** (406 mm) o.c.
- J. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than **96 inches** (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than **96 inches** (2438 mm) o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and **2-inch nominal-** (38-mm actual-) thickness.
 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than **100 sq. ft.** (9.3 sq. m) and to solidly fill space below partitions.
 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than **20 feet** (6 m) o.c.
- K. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- L. Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
1. Use inorganic boron for items that are continuously protected from liquid water.
 2. Use copper naphthenate for items not continuously protected from liquid water.

- M. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
1. NES NER-272 for power-driven fasteners.
 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
- N. Power-Actuated Fasteners: Power-actuated fasteners are not permitted and shall not be used.
- O. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.
- P. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
1. Comply with **[approved] [indicated]** fastener patterns where applicable. **[Before fastening, mark fastener locations, using a template made of sheet metal, plastic, or cardboard.]**
 2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
 3. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

3.2 WOOD **[GROUND,] [SLEEPER,]** BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for **[screeding or]** attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- D. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than **1-1/2 inches** (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as

required for tolerance of finish work.

- B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- (19-by-63-mm actual-) size furring [horizontally] [and] [vertically] at [24 inches (610 mm)] [600 mm] o.c.
- C. Furring to Receive [Gypsum Board] : Install 1-by-2-inch nominal- (19-by-38-mm actual-) size furring vertically at [16 inches (406 mm)] [400 mm] o.c.

3.4 WALL AND PARTITION FRAMING INSTALLATION

- A. General: Provide single bottom plate and double top plates using members of 2-inch nominal (38-mm actual) thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions[**and for load-bearing partitions where framing members bearing on partition are located directly over studs**]. Fasten plates to supporting construction unless otherwise indicated.
 - 1. For exterior walls, provide [2-by-6-inch nominal- (38-by-140-mm actual-)] [2-by-4-inch nominal- (38-by-89-mm actual-)] size wood studs spaced [24 inches (610 mm)] [16 inches (406 mm)] [600 mm] [400 mm] o.c. unless otherwise indicated.
 - 2. For interior partitions and walls, provide [2-by-6-inch nominal- (38-by-140-mm actual-)] [2-by-4-inch nominal- (38-by-89-mm actual-)] [2-by-3-inch nominal- (38-by-64-mm actual-)] size wood studs spaced [24 inches (610 mm)] [16 inches (406 mm)] [600 mm] [400 mm] o.c. unless otherwise indicated.
 - 3. Provide continuous horizontal blocking at midheight of partitions more than 96 inches (2438 mm) high, using members of 2-inch nominal (38-mm actual) thickness and of same width as wall or partitions.
- B. Construct corners and intersections with three or more studs[, **except that two studs may be used for interior non-load-bearing partitions**].
- C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.
 - 1. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4-inch nominal (89-mm actual) depth for openings 48 inches (1200 mm) and less in width, 6-inch nominal (140-mm actual) depth for openings 48 to 72 inches (1200 to 1800 mm) in width, 8-inch nominal (184-mm actual) depth for openings 72 to 120 inches (1800 to 3000 mm) in width, and not less than 10-inch nominal (235-mm actual) depth for openings 10 to 12 feet (3 to 3.6 m) in width.
 - 2. For load-bearing walls, provide double-jamb studs for openings 60 inches (1500 mm) and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated[**or, if not indicated, according to Table R502.5(1) or Table R502.5(2), as applicable, in ICC's International Residential Code for One- and Two-Family Dwellings**].
- D. Provide diagonal bracing in [exterior walls, at both walls of each external corner] [**walls, at locations indicated**], at 45-degree angle, full-story height unless otherwise

indicated. Use [**1-by-4-inch nominal- (19-by-89-mm actual-)** size boards, let-in flush with faces of studs] [metal wall bracing, let into studs in saw kerf].

3.5 FLOOR JOIST FRAMING INSTALLATION

- A. General: Install floor joists with crown edge up and support ends of each member with not less than **1-1/2 inches** (38 mm) of bearing on wood or metal, or **3 inches** (76 mm) on masonry. Attach floor joists as follows:
1. Where supported on wood members, by [**toe nailing or by**] using metal framing anchors.
 2. Where framed into wood supporting members, by using wood ledgers as indicated or, if not indicated, by using metal joist hangers.
- B. Fire Cuts: At joists built into masonry, bevel cut ends **3 inches** (76 mm) and do not embed more than **4 inches** (102 mm).
- C. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds **48 inches** (1200 mm).
- D. Do not notch in middle third of joists; limit notches to one-sixth depth of joist, one-third at ends. Do not bore holes larger than 1/3 depth of joist; do not locate closer than **2 inches** (50 mm) from top or bottom.
- E. Provide solid blocking of **2-inch nominal** (38-mm actual) thickness by depth of joist at ends of joists unless nailed to header or band.
- F. Lap members framing from opposite sides of beams, girders, or partitions not less than **4 inches** (102 mm) or securely tie opposing members together. Provide solid blocking of **2-inch nominal** (38-mm actual) thickness by depth of joist over supports.
- G. Anchor members paralleling masonry with **1/4-by-1-1/4-inch** (6.4-by-32-mm) metal strap anchors spaced not more than **96 inches** (2438 mm) o.c., extending over and fastening to three joists. Embed anchors at least **4 inches** (102 mm) into grouted masonry with ends bent at right angles and extending **4 inches** (102 mm) beyond bend.
- H. Provide solid blocking between joists under jamb studs for openings.
- I. Under non-load-bearing partitions, provide double joists separated by solid blocking equal to depth of studs above.
1. Provide triple joists separated as above, under partitions receiving ceramic tile and similar heavy finishes or fixtures.
- J. Provide bridging of type indicated below, at intervals of **96 inches** (2438 mm) o.c., between joists.
1. Diagonal wood bridging formed from bevel-cut, **1-by-3-inch nominal-** (19-by-64-mm actual-) size lumber, double-crossed and nailed at both ends to joists.

2. Steel bridging installed to comply with bridging manufacturer's written instructions.

3.6 CEILING JOIST AND RAFTER FRAMING INSTALLATION

- A. Ceiling Joists: Install ceiling joists with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.
 1. Where ceiling joists are at right angles to rafters, provide additional short joists parallel to rafters from wall plate to first joist; nail to ends of rafters and to top plate and nail to first joist or anchor with framing anchors or metal straps. Provide **1-by-8-inch nominal-** (19-by-184-mm actual-) size or **2-by-4-inch nominal-** (38-by-89-mm actual-) size stringers spaced **48 inches** (1200 mm) o.c. crosswise over main ceiling joists.
- B. Rafters: Notch to fit exterior wall plates and **[toe nail or]** use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.
 1. At valleys, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and **2 inches** (50 mm) deeper. Bevel ends of jack rafters for full bearing against valley rafters.
 2. At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and **2 inches** (50 mm) deeper. Bevel ends of jack rafters for full bearing against hip rafter.
- C. Provide collar beams (ties) as indicated or, if not indicated, provide **1-by-6-inch nominal-** (19-by-140-mm actual-) size boards between every third pair of rafters, but not more than **48 inches** (1219 mm) o.c. Locate below ridge member, at third point of rafter span. Cut ends to fit roof slope and nail to rafters.
- D. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions if any.

3.7 STAIR FRAMING INSTALLATION

- A. Provide stair framing members of size, space, and configuration indicated or, if not indicated, to comply with the following requirements:
 1. Size: **2-by-12-inch nominal-** (38-by-286-mm actual-) size, minimum.
 2. Material: **[Laminated-veneer lumber] [parallel-strand lumber] [or] [solid lumber]**.
 3. Notching: Notch rough carriages to receive treads, risers, and supports; leave at least **3-1/2 inches** (89 mm) of effective depth.
 4. Spacing: At least three framing members for each **36-inch** (914-mm) clear width of stair.
- B. Provide stair framing with no more than **3/16-inch** (4.7-mm) variation between adjacent

treads and risers and no more than **3/8-inch** (9.5-mm) variation between largest and smallest treads and risers within each flight.

3.8 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes **[wet] [sufficiently wet that moisture content exceeds that specified]**, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.MEASUREMENT

3.9 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 4 - PAYMENT

4.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 061000

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.
3. Composite nail base insulated roof sheathing.
4. Subflooring.
5. Underlayment.
6. Sheathing joint and penetration treatment.

- B. Related Requirements:

1. **[Section 061000 "Rough Carpentry"] [Section 061053 "Miscellaneous Rough Carpentry"]** for plywood backing panels.
2. Section 072500 "Weather Barriers" for water-resistive barrier applied over wall sheathing.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for wood-preserved treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
 3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.

4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
6. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Certificates for [**Credit MR 6**] [**Credit MR 7**]: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
3. Product Data for Credit IEQ 4.4: For composite wood products, documentation indicating that product contains no urea formaldehyde.
4. Laboratory Test Reports for Credit IEQ 4: For [**adhesives**] [**and**] [**composite wood products**], documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For following products, from ICC-ES:

1. Preservative-treated plywood.
2. Fire-retardant-treated plywood.
3. Foam-plastic sheathing.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

1.7 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
1. Fire-Resistance Ratings: Indicated by design designations from **[UL's "Fire Resistance Directory."]** **[GA-600, "Fire Resistance Design Manual."]** <Insert listing organization and publication>.

2.2 WOOD PANEL PRODUCTS

- A. Emissions: Products shall meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Certified Wood: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":
1. Plywood.
 2. Oriented strand board.
 3. Fiberboard wall sheathing.
 4. Particleboard underlayment.
 5. Hardboard underlayment.
- C. Plywood: **[DOC PS 1] [Either DOC PS 1 or DOC PS 2 unless otherwise indicated].**
- D. Oriented Strand Board: DOC PS 2.
- E. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- F. Factory mark panels to indicate compliance with applicable standard.

2.3 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWWA U1; Use Category UC2[**for**

interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground].

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: **[Treat all plywood unless otherwise indicated] [Treat items indicated on Drawings] [and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing].**

2.4 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 feet (3.2 m)** beyond the centerline of the burners at any time during the test.
 1. Use treatment that does not promote corrosion of metal fasteners.
 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 4. Design Value Adjustment Factors: Treated lumber plywood shall be tested according ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified.**[For roof sheathing and where high-temperature fire-retardant treatment is indicated, span ratings for temperatures up to 170 deg F (76 deg C) shall be not less than span ratings specified.]**
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

- E. Application: **[Treat all plywood unless otherwise indicated.] [Treat plywood indicated on Drawings, and the following:]**
1. Roof **[and wall]** sheathing within **48 inches** (1220 mm) of **[fire] [party]** walls.
 2. Roof sheathing.
 3. Subflooring and underlayment for raised platforms.
 4. **<Insert category of plywood items required to be treated>**.

2.5 WALL SHEATHING

- A. Plywood Wall Sheathing: **[Exterior, Structural I] [Exterior] [Exposure 1, Structural I] [Exposure 1]** sheathing.
1. Span Rating: Not less than **[16/0] [20/0] [24/0] [32/16]**.
 2. Nominal Thickness: Not less than **[11/32 inch (8.7 mm)] [3/8 inch (9.5 mm)] [1/2 inch (13 mm)]**.
- B. Oriented-Strand-Board Wall Sheathing: **[Exposure 1, Structural I] [Exposure 1]** sheathing.
1. Span Rating: Not less than **[16/0] [20/0] [24/0] [24/16] [32/16]**.
 2. Nominal Thickness: Not less than **[5/16 inch (7.9 mm)] [3/8 inch (9.5 mm)] [1/2 inch (13 mm)]**.
- C. Paper-Surfaced Gypsum Wall Sheathing: ASTM C 1396/C 1396M, gypsum sheathing; with water-resistant-treated core and with water-repellent paper bonded to core's face, back, and long edges.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum.
 - b. G-P Gypsum Corporation.
 - c. LaFarge North America Inc.
 - d. National Gypsum Company.
 - e. Temple-Inland Inc.
 - f. United States Gypsum Co.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
 2. Type and Thickness: **[Regular, 1/2 inch (13 mm)] [Type X, 5/8 inch (15.9 mm)]** thick.
 3. Edge and End Configuration: **[V-shaped, tongue-and-groove long edges; square ends] [Square]**.
 4. Size: **[24 by 96 inches (610 by 2438 mm) for horizontal] [48 by 96 inches (1219 by 2438 mm) for vertical] [48 by 108 inches (1219 by 2743 mm) for vertical] [600 by 2400 mm for horizontal] [1200 by 2400 mm for vertical] [1200 by 2750 mm for vertical]** installation.

- D. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corporation; GlasRoc.
 - b. G-P Gypsum Corporation; Dens-Glass Gold.
 - c. National Gypsum Company; Gold Bond e(2)XP.
 - d. Temple-Inland Inc.; GreenGlass
 - e. United States Gypsum Co.; Securock.
 - f. **<Insert manufacturer's name; product name or designation>**.
 - g. or approved equal.
 2. Type and Thickness: [**Regular, 1/2 inch** (13 mm)] [**Type X, 5/8 inch** (15.9 mm)] thick.
 3. Size: [**48 by 96 inches** (1219 by 2438 mm)] [**48 by 108 inches** (1219 by 2743 mm)] [**48 by 120 inches** (1219 by 3048 mm)] [**1200 by 2400 mm**] [**1200 by 2750 mm**] [**1200 by 3050 mm**] for vertical installation.
- E. Cellulose Fiber-Reinforced Gypsum Sheathing: ASTM C 1278/C 1278M, gypsum sheathing.
1. Product: Subject to compliance with requirements, provide "Fiberock Sheathing with Aqua-Tough" by United States Gypsum Co.
 2. Type and Thickness: [**Regular, 1/2 inch** (13 mm)] [**Type X, 5/8 inch** (15.9 mm)] thick.
 3. Size: [**48 by 96 inches** (1219 by 2438 mm)] [**48 by 108 inches** (1219 by 2743 mm)] [**48 by 120 inches** (1219 by 3048 mm)] [**1200 by 2400 mm**] [**1200 by 2750 mm**] [**1200 by 3050 mm**].
- F. Cementitious Backer Units: ASTM C 1325, Type A.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. C-Cure; C-Cure Board 990.
 - b. Custom Building Products; Wonderboard.
 - c. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
 - d. USG Corporation; DUROCK Cement Board.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
 2. Thickness: [**1/2 inch** (12.7 mm)] [**5/8 inch** (15.9 mm)] [**As indicated**].
- G. Fiberboard Wall Sheathing: ASTM C 208, Type IV, [**Grade 1 (Regular)**] [**Grade 2 (Structural)**] cellulosic fiberboard sheathing with square edges, [**1/2 inch** (13 mm)] [**25/32 inch** (20 mm)] thick.
- H. Extruded-Polystyrene-Foam Wall Sheathing: ASTM C 578, Type IV, in manufacturer's standard lengths and widths with tongue-and-groove or shiplap long edges as standard with manufacturer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning.
 - d. Pactiv, Inc.
 - e. **<Insert manufacturer's name>**.
 - f. or approved equal.
 2. Thickness: [**3/4 inch (19 mm)**] [**1 inch (25 mm)**] [**As indicated**].
- I. Foil-Faced, Polyisocyanurate-Foam Wall Sheathing: ASTM C 1289, Type I or Type II, Class 2, rigid, cellular, polyisocyanurate thermal insulation. Foam-plastic core and facings shall have a flame-spread index of 25 or less when tested individually.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Atlas Roofing Corporation.
 - b. Dow Chemical Company (The).
 - c. Rmax, Inc.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
 2. Thickness: [**7/16 inch (11.1 mm)**] [**1/2 inch (13 mm)**] [**5/8 inch (15.9 mm)**] [**3/4 inch (19 mm)**] [**1 inch (25 mm)**] [**As indicated**].

2.6 ROOF SHEATHING

- A. Plywood Roof Sheathing: [**Exterior, Structural I**] [**Exterior**] [**Exposure 1, Structural I**] [**Exposure 1**] sheathing.
1. Span Rating: Not less than [**16/0**] [**20/0**] [**24/0**] [**32/16**] [**40/20**] [**48/24**].
 2. Nominal Thickness: Not less than [**15/32 inch (11.9 mm)**] [**1/2 inch (13 mm)**].
- B. Oriented-Strand-Board Roof Sheathing: [**Exposure 1, Structural I**] [**Exposure 1**] sheathing.
1. Span Rating: Not less than [**16/0**] [**20/0**] [**24/0**] [**24/16**] [**32/16**] [**40/20**] [**48/24**].
 2. Nominal Thickness: Not less than [**7/16 inch (11.1 mm)**] [**15/32 inch (11.9 mm)**] [**1/2 inch (13 mm)**] [**5/8 inch (16 mm)**] [**3/4 inch (19 mm)**].

2.7 COMPOSITE NAIL BASE INSULATED ROOF SHEATHING

- A. Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing: Rigid, cellular, polyisocyanurate thermal insulation with oriented strand board laminated to one face complying with ASTM C 1289, Type V.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Atlas Roofing Corporation.
 - b. Cornell Corporation.
 - c. Dow Chemical Company (The).
 - d. Johns Manville; Berkshire Hathaway Inc.
 - e. Rmax, Inc.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
 2. Polyisocyanurate-Foam Thickness: [**1 inch (25 mm)**] [**1-1/2 inches (38 mm)**] [**2 inches (50 mm)**] [**2-1/2 inches (64 mm)**] [**3 inches (76 mm)**] [**3-1/2 inches (89 mm)**] [**4 inches (102 mm)**].
 3. Oriented-Strand-Board Nominal Thickness: [**7/16 inch (11.1 mm)**] [**5/8 inch (15.9 mm)**].
- B. Vented, Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing: Rigid, cellular, polyisocyanurate thermal insulation complying with ASTM C 1289, Type II, Class 1, with oriented strand board adhered to spacers on one face.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Atlas Roofing Corporation.
 - b. Cornell Corporation.
 - c. Dow Chemical Company (The).
 - d. Johns Manville; Berkshire Hathaway Inc.
 - e. Rmax, Inc.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
 2. Polyisocyanurate-Foam Thickness: [**1 inch (25 mm)**] [**1-1/2 inches (38 mm)**] [**2 inches (50 mm)**] [**2-1/2 inches (64 mm)**] [**3 inches (76 mm)**] [**3-1/2 inches (89 mm)**] [**4 inches (102 mm)**].
 3. Oriented-Strand-Board Nominal Thickness: [**7/16 inch (11.1 mm)**] [**5/8 inch (15.9 mm)**].
 4. Spacers: Wood furring strips or blocks not less than **3/4 inch (19 mm)** thick and spaced not more than [**12 inches (300 mm)**] [**16 inches (400 mm)**] [**24 inches (600 mm)**] o.c.

2.8 SUBFLOORING AND UNDERLAYMENT

- A. Plywood Combination Subfloor-Underlayment: DOC PS 1, [**Exterior, Structural I, C-C Plugged**] [**Exterior, C-C Plugged**] [**Exposure 1, Structural I, Underlayment**] [**Exposure 1, Underlayment**] single-floor panels.
 1. Span Rating: Not less than [**16**] [**20**] [**24**] [**32**] [**48**] o.c.

2. Nominal Thickness: Not less than [**23/32 inch (18.3 mm)**] [**7/8 inch (22.2 mm)**] [**1 inch (25 mm)**].
 3. Edge Detail: Square.
 4. Edge Detail: Tongue and groove.
 5. Surface Finish: Fully sanded face.
- B. Oriented-Strand-Board Combination Subfloor-Underlayment: Exposure 1 single-floor panels.
1. Span Rating: Not less than [**16**] [**20**] [**24**] [**32**] [**48**] o.c.
 2. Nominal Thickness: Not less than [**23/32 inch (18.3 mm)**] [**7/8 inch (22.2 mm)**] [**1 inch (25 mm)**].
 3. Edge Detail: Square.
 4. Edge Detail: Tongue and groove.
 5. Surface Finish: [**Fully sanded**] [**Resin-impregnated overlay**] face.
- C. Plywood Subflooring: [**Exterior, Structural I**] [**Exterior**] [**Exposure 1, Structural I**] [**Exposure 1**] single-floor panels or sheathing.
1. Span Rating: Not less than [**16**] [**20**] [**24**] [**32**] [**48**] o.c. [**or**] [**32/16**] [**40/20**] [**48/24**].
 2. Nominal Thickness: Not less than [**23/32 inch (18.3 mm)**] [**7/8 inch (22.2 mm)**] [**1 inch (25 mm)**].
- D. Oriented-Strand-Board Subflooring: Exposure 1[, **Structural I sheathing**] [**single-floor panels or sheathing**].
1. Span Rating: Not less than [**16**] [**20**] [**24**] [**32**] [**48**] o.c. [**or**] [**32/16**] [**40/20**] [**48/24**] [**60/32**].
 2. Nominal Thickness: Not less than [**23/32 inch (18.3 mm)**] [**7/8 inch (22.2 mm)**] [**1 inch (25 mm)**].
- E. Underlayment, General: Provide underlayment in nominal thicknesses indicated or, if not indicated, not less than **1/4 inch (6.4 mm)** over smooth subfloors and not less than **3/8 inch (9.5 mm)** over board or uneven subfloors.
- F. Plywood Underlayment for Resilient Flooring: DOC PS 1, [**Exterior A-C**] [**Exterior B-C**] [**Exterior, C-C Plugged**] [**Exposure 1 Underlayment**] with fully sanded face.
- G. Plywood Underlayment for Ceramic Tile: DOC PS 1, Exterior, C-C Plugged, not less than **5/8-inch (15.9-mm)** nominal thickness, for ceramic tile set in [**organic adhesive**] [**epoxy adhesive**] [**EGP (exterior glue plywood)**] [**latex-Portland cement mortar**].
- H. Plywood Underlayment for Carpet: DOC PS 1, [**Exterior, C-C Plugged**] [**Exposure 1, Underlayment**] [**Interior, Underlayment**].
- I. Particleboard Underlayment: ANSI A208.1, [**Grade PBU**] [**Grade M-2, made with binder containing no urea formaldehyde**].
- J. Hardboard Underlayment: ANSI A135.4, Class 4 (Service), Surface S1S; with back side sanded.

2.9 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. For roof[**and wall**] sheathing, provide fasteners [**with hot-dip zinc coating complying with ASTM A 153/A 153M**] [**of Type 304 stainless steel**].
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
- F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
1. For steel framing less than **0.0329 inch** (0.835 mm) thick, use screws that comply with ASTM C 1002.
 2. For steel framing from **0.033 to 0.112 inch** (0.84 to 2.84 mm) thick, use screws that comply with ASTM C 954.
- G. Screws for Fastening Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117. Provide washers or plates if recommended by sheathing manufacturer.

2.10 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for [**Paper-Surfaced**] [**Glass-Mat**] Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Section 079200 "Joint Sealants."
- B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by

tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum **2 inches** (50 mm) wide, **10 by 10 or 10 by 20 threads/inch** (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

- C. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

2.11 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with **[APA AFG-01] [ASTM D 3498]** that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

1. Adhesives shall have a VOC content of **[50] [70] <Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
1. NES NER-272 for power-driven fasteners.
 2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."
- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

- E. Coordinate **[wall] [and] [roof]** sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Combination Subfloor-Underlayment:
 - a. **[Glue and nail] [Nail]** to wood framing.
 - b. Screw to cold-formed metal framing.
 - c. Space panels **1/8 inch** (3 mm) apart at edges and ends.
 - 2. Subflooring:
 - a. **[Glue and nail] [Nail] [Nail or staple]** to wood framing.
 - b. Screw to cold-formed metal framing.
 - c. Space panels **1/8 inch** (3 mm) apart at edges and ends.
 - 3. Wall and Roof Sheathing:
 - a. **[Nail] [Nail or staple]** to wood framing. **[Apply a continuous bead of glue to framing members at edges of wall sheathing panels.]**
 - b. Screw to cold-formed metal framing.
 - c. Space panels **1/8 inch** (3 mm) apart at edges and ends.
 - 4. Underlayment:
 - a. **[Nail] [Nail or staple]** to subflooring.
 - b. Space panels **1/32 inch** (0.8 mm) apart at edges and ends.
 - c. Fill and sand edge joints of underlayment receiving resilient flooring immediately before installing flooring.

3.3 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to wood framing with **[nails] [or] [screws]**.
 2. Fasten gypsum sheathing to cold-formed metal framing with screws.
 3. Install boards with a **3/8-inch** (9.5-mm) gap where non-load-bearing construction abuts structural elements.
 4. Install boards with a **1/4-inch** (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent boards without forcing. Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing. Attach boards at perimeter and within field of board to each steel stud.
1. Space fasteners approximately **8 inches** (200 mm) o.c. and set back a minimum of **3/8 inch** (9.5 mm) from edges and ends of boards.
 2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- D. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
1. Space fasteners approximately **8 inches** (200 mm) o.c. and set back a minimum of **3/8 inch** (9.5 mm) from edges and ends of boards.
 2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- E. Seal sheathing joints according to sheathing manufacturer's written instructions.
1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
 2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.
- ### 3.4 CEMENTITIOUS BACKER UNIT INSTALLATION
- A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.5 FIBERBOARD SHEATHING INSTALLATION

- A. Comply with ASTM C 846 and with manufacturer's written instructions.
- B. Fasten fiberboard sheathing panels to intermediate supports and then at edges and ends. Use galvanized roofing nails[**or galvanized staples**]; comply with manufacturer's recommended spacing and referenced fastening schedule. Drive fasteners flush with surface of sheathing and locate perimeter fasteners at least **3/8 inch** (9.5 mm) from edges and ends.
- C. Install sheathing vertically with long edges parallel to, and centered over, studs. Install solid wood blocking where end joints do not occur over framing. Allow **1/8-inch** (3-mm) open space between edges and ends of adjacent units. Stagger horizontal joints if any.
- D. Cover sheathing as soon as practical after installation to prevent deterioration from wetting.

3.6 FOAM-PLASTIC SHEATHING INSTALLATION

- A. Comply with manufacturer's written instructions.
- B. Foam-Plastic Wall Sheathing: Install vapor-relief strips or equivalent for permitting escape of moisture vapor that otherwise would be trapped in stud cavity behind sheathing.
- C. Apply sheathing tape to joints between foam-plastic sheathing panels and at items penetrating sheathing. Apply at upstanding flashing to overlap both flashing and sheathing.

3.7 PARTICLEBOARD UNDERLAYMENT INSTALLATION

- A. Comply with CPA's recommendations for type of subfloor indicated. Fill and sand gouges, gaps, and chipped edges. Sand uneven joints flush.

- 1. Fastening Method: [**Glue and nail**] [**Nail**] [**Nail or staple**] underlayment to subflooring.

3.8 HARDBOARD UNDERLAYMENT INSTALLATION

- A. Comply with CPA's recommendations and hardboard manufacturer's written instructions for preparing and applying hardboard underlayment.

- 1. Fastening Method: [**Nail**] [**Nail or staple**] underlayment to subflooring.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 061600

SECTION 062023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior trim, including non-fire-rated interior door[**and sidelight**] frames.
2. Fire-rated interior door[**and sidelight**] frames.
3. Interior [plywood] [hardboard] [board] paneling.
4. Shelving[**and clothes rods**].
5. Interior [stairs] [and] [railings].
6. Interior ornamental wood columns.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view[**and for framing exposed to view**].
2. Section 064113 "Wood-Veneered-Faced Architectural Cabinets" for custom wood-veneer cabinets.
3. Section 064116 "Plastic-Laminate-Faced Architectural Cabinets" for custom plastic-laminate cabinets.
4. Section 064213 "Stile and Rail Wood Paneling" for solid-wood and veneered stile and rail paneling.
5. Section 064216 "Flush Wood Paneling" for veneer-faced flush wood panels.
6. Section 064219 "Plastic-Laminate-Faced Wood Paneling" for plastic-laminate-faced flush wood panels.
7. Section 064400 "Ornamental Woodwork" for misc. shop-assembled woodwork items.
8. Section 064600 "Wood Trim" for standing and running wood trim.
9. Section 066400 "Plastic Paneling" for glass-fiber reinforced plastic paneling.
10. Section 099123 "Interior Painting" for priming and backpriming of interior finish carpentry.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 DEFINITIONS

- A. MDF: Medium-density fiberboard.
- B. MDO: Plywood with a medium-density overlay on the face.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical-treatment manufacturer's written instructions for finishing treated material.
 - 2. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
 - 3. Wall panel certificate: Submit certificate that wall panel backing adhesive and laminate comply with reference fire-resistance requirements.
 - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.
 - 5. Include copies of warranties from chemical-treatment manufacturers for each type of treatment.
 - 6. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: Submit shop drawings showing location of each item, dimensioned plans and elevations, large scale details, attachment devices and other components.
- C. Quality Certification: Submit woodwork Manufacturer's (Fabricator's) certification, stating that fabricated woodwork complies with quality grades and other requirements indicated.
- D. Certificate from the fabricator providing proof of not less than five (5) years experience in the fabrication of the types of products specified.
- E. Certificate from the installer providing proof of not less than five (5) years of successful experience in the installation of similar types of products and shall have completed at least three (3) jobs of similar size and scope.
- F. LEED Submittals:
 - 1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

2. Certificates for [**Credit MR 6**] [**Credit MR 7**]: Chain-of-custody certificates indicating that composite wood products comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
 3. Product Data for Credit IEQ 4.1: For adhesives and glues used at Project site, documentation including printed statement of VOC content.
 4. Product Data for Credit IEQ 4.4: For composite wood products, documentation indicating that product contains no urea formaldehyde.
 5. Laboratory Test Reports for Credit IEQ 4: For [**adhesives**] [**and**] [**composite wood products**], documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- G. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.
- H. Samples for Verification:
1. For each species and cut of lumber and panel products with non-factory-applied finish, with 1/2 of exposed surface finished, **50 sq. in.** (300 sq. cm) for lumber and **8 by 10 inches** (200 by 250 mm) for panels.
 2. For foam plastic moldings, with 1/2 of exposed surface finished; **50 sq. in.** (300 sq. cm).
 3. For each finish system and color of lumber and panel products with factory-applied finish, **50 sq. in.** (300 sq. cm) for lumber and **8 by 10 inches** (200 by 250 mm) for panels.
 4. For interior wood columns, include[**quarter-section**] Samples of cap, base, plinth, and **6-inch-** (150-mm-) long[**quarter-section**] Sample of shaft.[**Samples need not be same diameter as required columns.**]
- 1.5 INFORMATIONAL SUBMITTALS
- A. Evaluation Reports: For fire-retardant-treated wood, from ICC-ES.
 - B. Sample Warranty: For manufacturer's warranty.
- 1.6 CLOSEOUT SUBMITTALS
- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof

sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

- B. Deliver interior finish carpentry materials only when environmental conditions meet requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions meet requirements specified for installation areas.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.
- C. If, due to unforeseen circumstances, woodwork must be stored in other than installation areas, store only in areas meeting requirements specified for installation areas.
- D. WARRANTY
- E. Warranty: Fabricator/installer to warrant all work from date of final acceptance of materials, fabrication, and installation of all items.
- F. Manufacturer's Warranty for Columns: Manufacturer agrees to repair or replace columns that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Minimum **[two (2)]** <Insert number> years from date of Substantial Completion.
- G. CONSTRUCTION WASTE MANAGEMENT
 - 1. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Regional Materials: The following wood products shall be manufactured within **500 miles** (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** (800 km) of Project site.
1. Interior trim.
 2. Fire-rated interior door[**and sidelight**] frames.
 3. Interior [**plywood**] [**hardboard**] [**board**] paneling.
 4. Shelving[**and clothes rods**].
 5. Interior [**stairs**] [**and**] [**railings**].
 6. Interior ornamental wood columns.
- B. Certified Wood: The following wood products shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":
1. Interior trim.
 2. Fire-rated interior door[**and sidelight**] frames.
 3. Interior [**plywood**] [**hardboard**] [**board**] paneling.
 4. Shelving[**and clothes rods**].
 5. Interior [**stairs**] [**and**] [**railings**].
 6. Interior ornamental wood columns.
- C. Low-Emitting Materials: Composite wood products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Lumber: DOC PS 20 and the following grading rules:
1. NeLMA: Northeastern Lumber Manufacturers' Association, "Standard Grading Rules for Northeastern Lumber."
 2. NHLA: National Hardwood Lumber Association, "Rules for the Measurement and Inspection of Hardwood & Cypress."
 3. NLGA: National Lumber Grades Authority, "Standard Grading Rules for Canadian Lumber."
 4. SPIB: The Southern Pine Inspection Bureau, "Standard Grading Rules for Southern Pine Lumber."
 5. WCLIB: West Coast Lumber Inspection Bureau, Standard No. 17, "Grading Rules for West Coast Lumber."
 6. WWPA: Western Wood Products Association, "Western Lumber Grading Rules."
- E. Factory mark each piece of lumber with grade stamp of inspection agency indicating grade, species, moisture content at time of surfacing, and mill.
1. For exposed lumber, mark grade stamp on end or back of each piece[, **or omit**

grade stamp and provide certificates of grade compliance issued by inspection agency].

- F. Softwood Plywood: DOC PS 1.
- G. Hardboard: AHA A135.4.
- H. MDF: ANSI A208.2, **[Grade 130] <Insert grade>**, **made with binder containing no urea-formaldehyde resin**].
- I. Particleboard: ANSI A208.1, **[Grade M-2] [Grade M-2-Exterior Glue] [Grade M-2, made with binder containing no urea-formaldehyde resin]**.
- J. Melamine-Faced Particleboard: Particleboard complying with ANSI A208.1, Grade M-2, finished on both faces with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.
 - 1. Color: **[White] [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWWA U1; Use Category UC2.
 - 1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 18 percent respectively.
 - 2. Preservative Chemicals: Acceptable to authorities having jurisdiction[**and containing no arsenic or chromium**].
 - 3. For exposed items indicated to receive transparent finish, do not use chemical formulations that contain colorants or that bleed through or otherwise adversely affect finishes.
 - 4. Do not use material that is warped or does not comply with requirements for untreated material.
 - 5. Mark lumber with treatment-quality mark of an inspection agency approved by the American Lumber Standard Committee's Board of Review.
 - a. For exposed lumber indicated to receive a stained or natural finish, **[mark end or back of each piece] [or] [omit marking and provide certificates of treatment compliance issued by inspection agency]**.
 - 6. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
 - a. For exposed plywood indicated to receive a stained or natural finish, mark back of each piece.
 - 7. Application: **[Where indicated] [All interior lumber and plywood] <Insert application>**.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: For applications indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction, and comply with testing requirements; testing by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 feet (3.2 m)** beyond the centerline of the burners at any time during the test.
1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent respectively.
- C. For exposed items indicated to receive a stained or natural finish, use[**organic resin**] chemical formulations that do not contain colorants, and provide materials that do not have marks from spacer sticks on exposed face.
- D. Do not use material that does not comply with requirements for untreated material or is warped or discolored.
- E. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
1. For exposed lumber indicated to receive a stained or natural finish, [**mark end or back of each piece**] [**or**] [**omit marking and provide certificates of treatment compliance issued by inspection agency**].
 2. For exposed plywood indicated to receive a stained or natural finish, mark back of each piece.
- F. Fire Performance Characteristics: Provide materials which are identical to those tested per ASTM methods and time periods indicated, are marked and listed for fire performance characteristics by Underwriters Laboratories, Inc., or other testing and inspecting agency acceptable to authorities having jurisdiction, and comply with the following requirements:
1. Mill lumber after treatment, within limits set for wood removal that does not affect listed fire performance characteristics, using a woodworking plant certified by testing and inspecting agency.
 2. Mill lumber before treatment and institute special procedures during treatment and drying processes to prevent warping, discoloration from drying sticks or other causes, marring or other defects in appearance of treated woodwork.
 3. At Contractor's option, mill treated lumber in either sequence indicated above.
 4. Marking: Identify treated lumber with separable paper classification marking of inspecting and testing agency, unless otherwise indicated.
 5. Kiln dry woodwork after treatment to levels required for non fire retardant treated woodwork materials. Maintain moisture content required by kiln drying, before and after treatment.
 6. Discard treated lumber that does not comply with requirements of referenced

woodworking standard. Do not use twisted, warped, bowed, discolored, or otherwise damaged or defective lumber.

- G. Fire-retardant particleboard: Provide panels with fire-retardant chemicals incorporated at time of manufacture to achieve surface-burning characteristics of 20 for flame spread and 25 for smoke developed when tested in accordance with ASTM E 84. Comply with ANSI A108.1 for Grade 1-M-1 panels with density of 45 lbs./cu. ft. for thicknesses of 3/4" and less and 44 lbs./cu. ft. for thicknesses of 13/16" to 1 1/4"; except as follows:
1. Modulus of rupture and modulus of elasticity: 1600 psi and 350,000 psi, respectively, for 48 lb. density, 1300 psi, respectively, and 275,000 psi for 44 lb. density.
 2. Linear expansion: 0.35% for 45 lb. density and 0.50% for 44 lb. density.
 3. Screw-holding capacity, face and edge: 300 lbs. and 250 lbs., respectively, for 45 lb. density, and of 250 and 175 lbs., respectively, for 44 lb. density.
- H. Application: **[Where indicated] [All interior lumber and plywood] <Insert application>**.

2.4 INTERIOR TRIM

- A. Softwood Lumber Trim for Transparent Finish (Stain or Clear Finish):
1. Species and Grade: Eastern white pine, **[C Select] [D Select] [Finish or 1 Common] [Premium or 2 Common]**; NeLMA or NLGA.
 2. Species and Grade: Idaho white, lodgepole, ponderosa, radiata, or sugar pine; **[C Select (Choice)] [D Select (Quality)] [1 Common (Colonial)] [2 Common (Sterling)]**; NLGA or WWPA.
 3. Species and Grade: Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine; **[C Select (Choice)] [D Select (Quality)] [Finish or 1 Common (Colonial)] [Premium or 2 Common (Sterling)]**; NeLMA, NLGA, or WWPA.
 4. Species and Grade: White woods, **[C Select] [D Select] [1 Common] [2 Common]**; WWPA.
 5. Species and Grade: Douglas fir-larch or Douglas fir south, **[Superior or C & Btr] [Prime or D]** finish; NLGA, WCLIB, or WWPA.
 6. Species and Grade: Southern pine, **[B & B] [C & Btr]** finish; SPIB.
 7. Species and Grade: Western red cedar, **[Clear Heart] [Grade A] [Grade B]**; NLGA, WCLIB, or WWPA.
 8. Maximum Moisture Content: **[19] [15] percent [with at least 85 percent of shipment at 12 percent or less]**.
 9. Finger Jointing: **[Allowed] [Not allowed]**.
 10. Face Surface: **[Surfaced (smooth)] [Saw textured]**.
- B. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):
1. Species and Grade: **[Red oak] [White maple] [Alder] [Aspen, basswood, cottonwood, sap gum, sycamore, white maple, or yellow poplar] <Insert species>**; **[Clear] [A Finish] [B Finish]**; NHLA.

2. Maximum Moisture Content: [13] [10] [9] <Insert value> percent.
3. Finger Jointing: Not allowed.
4. Gluing for Width: [Allowed] [Not allowed] [Use for lumber trim wider than 6 inches (150 mm)].
5. Veneered Material: [Allowed] [Not allowed] [Use for lumber trim wider than 6 inches (150 mm)].
6. Face Surface: [Surfaced (smooth)] [Saw textured].
7. Matching: Selected for compatible grain and color.

C. Lumber Trim for Opaque Finish (Painted Finish):

1. Species and Grade: Eastern white pine, [D Select] [Finish or 1 Common] [Premium or 2 Common]; NeLMA or NLGA.
2. Species and Grade: Idaho white, lodgepole, ponderosa, radiata, or sugar pine; [D Select (Quality)] [1 Common (Colonial)] [2 Common (Sterling)]; NLGA or WWPA.
3. Species and Grade: Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine; [D Select (Quality)] [Finish or 1 Common (Colonial)] [Premium or 2 Common (Sterling)]; NeLMA, NLGA, or WWPA.
4. Species and Grade: White woods, [D Select] [1 Common] [2 Common]; WWPA.
5. Species and Grade: Douglas fir-larch or Douglas fir south, [Superior or C & Btr] [Prime or D] finish; NLGA, WCLIB, or WWPA.
6. Species and Grade: Spruce-pine-fir, [1 Common] [2 Common]; NeLMA, NLGA, WCLIB, or WWPA.
7. Species and Grade: Alder, aspen, basswood, cottonwood, gum, magnolia, soft maple, sycamore, tupelo, or yellow poplar; [A Finish] [B Finish]; NHLA.
8. Maximum Moisture Content: [19] [15] percent [with at least 85 percent of shipment at 12 percent or less].
9. Maximum Moisture Content: [13] [10] [9] <Insert value> percent.
10. Finger Jointing: [Allowed] [Not allowed].
11. Face Surface: [Surfaced (smooth)] [Saw textured].
12. Optional Material: Primed MDF of same actual dimensions as lumber indicated may be used in lieu of lumber.

D. Softwood Moldings for Transparent Finish (Stain or Clear Finish): WMMPA WM 4, N-grade wood moldings. Made to patterns included in WMMPA WM 12.

1. Species: [Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine] [Southern pine] [Western red cedar] [Douglas fir] <Insert species>.
2. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
3. Finger Jointing: Not allowed.
4. Matching: Selected for compatible grain and color.
5. Base Pattern: [WM 623, 9/16-by-3-1/4-inch (14-by-83-mm) ogee] [WM 713, 9/16-by-3-1/4-inch (14-by-83-mm) ranch] [WM 753, 9/16-by-3-1/4-inch (14-by-83-mm) beaded-edge] [WM 620, 9/16-by-4-1/4-inch (14-by-108-mm) ogee] [WM 750, 9/16-by-4-1/4-inch (14-by-108-mm) beaded-edge] base.

6. Shoe-Mold Pattern: [WM 129, 7/16-by-11/16-inch (11-by-17-mm) quarter-round] [WM 126, 1/2-by-3/4-inch (13-by-19-mm) quarter-round] [WM 131, 1/2-by-3/4-inch (13-by-19-mm) ogee] shoe mold.
 7. Casing Pattern: [WM 327, 11/16-by-2-1/4-inch (17-by-57-mm) clamshell] [WM 366, 11/16-by-2-1/4-inch (17-by-57-mm) featheredge] [WM 376, 11/16-by-2-1/4-inch (17-by-57-mm) beaded-edge] casing.
 8. Mull-Casing Pattern: [WM 957, 3/8-by-1-3/4-inch (9.5-by-44-mm) beaded-edge] [WM 973, 3/8-by-1-3/4-inch (9.5-by-44-mm) bullnose] [WM 983, 3/8-by-1-3/4-inch (9.5-by-44-mm) featheredge] casing.
 9. Stop Pattern: [WM 856, 3/8-by-1-3/8-inch (9.5-by-35-mm) ranch] [WM 946, 3/8-by-1-3/8-inch (9.5-by-35-mm) ogee] [WM 886, 3/8-by-1-3/8-inch (9.5-by-35-mm) bullnose] stop.
 10. Chair-Rail Pattern: WM 297, 11/16-by-3-inch (17-by-76-mm) chair rail.
- E. Hardwood Moldings for Transparent Finish (Stain or Clear Finish): WMMPA HWM 2, N-grade wood moldings made to patterns included in WMMPA HWM 1.
1. Species: [Red oak] [White maple] [Aspen, basswood, cottonwood, sap gum, sycamore, white maple, or yellow poplar] <Insert species>.
 2. Kiln-dried softwood or MDF, with exposed surfaces veneered with species indicated, may be used in lieu of solid wood.
 3. Maximum Moisture Content: 9 percent.
 4. Finger Jointing: Not allowed.
 5. Matching: Selected for compatible grain and color.
 6. Base Pattern: [HWM 633, 7/16-by-3-1/4-inch (11-by-83-mm) ogee] [HWM 713, 7/16-by-3-1/4-inch (11-by-83-mm) ranch] [HWM 753, 7/16-by-3-1/4-inch (11-by-83-mm) beaded-edge] [WM 620, 7/16-by-4-1/4-inch (11-by-108-mm) ogee] base.
 7. Shoe-Mold Pattern: [HWM 129, 7/16-by-11/16-inch (11-by-17-mm) quarter-round] [HWM 126, 1/2-by-3/4-inch (13-by-19-mm) quarter-round] [HWM 131, 1/2-by-3/4-inch (13-by-19-mm) ogee] shoe mold.
 8. Casing Pattern: [HWM 328, 1/2-by-2-1/4-inch (13-by-57-mm) clamshell] [HWM 366, 1/2-by-2-1/4-inch (13-by-57-mm) featheredge] [HWM 376, 1/2-by-2-1/4-inch (13-by-57-mm) beaded-edge] casing.
 9. Mull-Casing Pattern: [HWM 989, 3/16-by-2-inch (5-by-51-mm) square-edge] [HWM 988, 3/8-by-1-1/2-inch (9.5-by-38-mm) featheredge] [HWM 987, 3/8-by-2-inch (9.5-by-51-mm) featheredge] casing.
 10. Stop Pattern: [HWM 856, 3/8-by-1-3/8-inch (9.5-by-35-mm) ranch] [HWM 946, 3/8-by-1-3/8-inch (9.5-by-35-mm) ogee] [HWM 886, 3/8-by-1-3/8-inch (9.5-by-35-mm) bullnose] stop.
 11. Chair-Rail Pattern: HWM 297, 11/16-by-3-inch (17-by-76-mm) chair rail.
- F. Moldings for Opaque Finish (Painted Finish): Made to patterns included in WMMPA WM 12.
1. Softwood Moldings: WMMPA WM 4, P grade.
 - a. Species: [Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine] <Insert species>.

- b. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
 2. Hardwood Moldings: WMMPA HWM 2, P-grade.
 - a. Species: **[Aspen, basswood, cottonwood, gum, magnolia, soft maple, tupelo, or yellow poplar] <Insert species>**.
 - b. Maximum Moisture Content: 9 percent.
 3. Optional Material: Primed MDF.
 4. Finger Jointing: **[Allowed] [Not allowed]**.
 5. Base Pattern: **[WM 623, 9/16-by-3-1/4-inch (14-by-83-mm) ogee] [WM 713, 9/16-by-3-1/4-inch (14-by-83-mm) ranch] [WM 753, 9/16-by-3-1/4-inch (14-by-83-mm) beaded-edge] [WM 620, 9/16-by-4-1/4-inch (14-by-108-mm) ogee] [WM 750, 9/16-by-4-1/4-inch (14-by-108-mm) beaded-edge]** base.
 6. Shoe-Mold Pattern: **[WM 129, 7/16-by-11/16-inch (11-by-17-mm) quarter-round] [WM 126, 1/2-by-3/4-inch (13-by-19-mm) quarter-round] [WM 131, 1/2-by-3/4-inch (13-by-19-mm) ogee]** shoe mold.
 7. Casing Pattern: **[WM 327, 11/16-by-2-1/4-inch (17-by-57-mm) clamshell] [WM 366, 11/16-by-2-1/4-inch (17-by-57-mm) featheredge] [WM 376, 11/16-by-2-1/4-inch (17-by-57-mm) beaded-edge]** casing.
 8. Mull-Casing Pattern: **[WM 957, 3/8-by-1-3/4-inch (9.5-by-44-mm) beaded-edge] [WM 973, 3/8-by-1-3/4-inch (9.5-by-44-mm) bullnose] [WM 983, 3/8-by-1-3/4-inch (9.5-by-44-mm) featheredge]** casing.
 9. Stop Pattern: **[WM 856, 3/8-by-1-3/8-inch (9.5-by-35-mm) ranch] [WM 946, 3/8-by-1-3/8-inch (9.5-by-35-mm) ogee] [WM 886, 3/8-by-1-3/8-inch (9.5-by-35-mm) bullnose]** stop.
 10. Chair-Rail Pattern: WM 297, **11/16-by-3-inch (17-by-76-mm)** chair rail.
- G. PVC-Wrapped Moldings: WMMPA WM 2 and made to patterns included in WMMPA WM 12.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Louisiana-Pacific Corporation.
 - b. Nickell Moulding Company, Inc.
 - c. Spectrim Building Products.
 - d. Zamma Corporation.
 - e. **<Insert manufacturer>**
 - f. or approved equal.
 2. Base Pattern: **[WM 623, 9/16-by-3-1/4-inch (14-by-83-mm) ogee] [WM 713, 9/16-by-3-1/4-inch (14-by-83-mm) ranch]** base.
 3. Shoe-Mold Pattern: **[WM 129, 7/16-by-11/16-inch (11-by-17-mm) quarter-round] [WM 126, 1/2-by-3/4-inch (13-by-19-mm) quarter-round]** shoe mold.
 4. Casing Pattern: **[WM 327, 11/16-by-2-1/4-inch (17-by-57-mm) clamshell] [WM 366, 11/16-by-2-1/4-inch (17-by-57-mm) featheredge]** casing.
 5. Mull-Casing Pattern: **[WM 973, 3/8-by-1-3/4-inch (9.5-by-44-mm) bullnose] [WM 983, 3/8-by-1-3/4-inch (9.5-by-44-mm) featheredge]** casing.

6. Stop Pattern: [WM 856, 3/8-by-1-3/8-inch (9.5-by-35-mm) ranch] [WM 886, 3/8-by-1-3/8-inch (9.5-by-35-mm) bullnose] stop.
 7. Chair-Rail Pattern: WM 297, 11/16-by-3-inch (17-by-76-mm) chair rail.
 8. Colors, Textures, and Grain Patterns: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range].
- H. Foam Plastic Moldings: Molded product of shapes indicated, with a tough outer skin on exposed surfaces; factory primed. Exposed surfaces shall not be shaped after molding.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apex Urethane Millwork.
 - b. Architectural Moldings Ltd.; Balmer Architectural Mouldings Division.
 - c. Architectural Ornament, Inc.
 - d. Artistic Architectural Ornaments, Inc.
 - e. Carter Millwork, Inc.
 - f. Century Architectural Specialties LLC.
 - g. Chemcrest Architectural Products.
 - h. Diamond Mfg., Inc.
 - i. Focal Point Architectural Products.
 - j. Fypon Ltd.
 - k. Melton Classics Incorporated.
 - l. Railing & Building Products, Inc.
 - m. Vintage Mouldings Manufacturing Ltd.
 - n. <Insert manufacturer>
 - o. or approved equal.
 2. Density: Not less than 20 lb/cu. ft. (320 kg/cu. m).
 3. Flame-Spread Index: Not more than [75] <Insert number> when tested according to ASTM E 84.
 4. Thickness: Not more than 1/2 inch (12.7 mm).
 5. Width: Not more than 8 inches (204 mm).
 6. Patterns: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples].

2.5 FIRE-RATED INTERIOR DOOR[AND SIDELIGHT] FRAMES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. <Insert, in separate subparagraphs, manufacturer's name>.
 2. or approved equal.
- B. Frames, complete with casings, fabricated from fire-retardant particleboard or fire-retardant MDF with veneered exposed surfaces, or from solid fire-retardant-treated wood. Frames shall comply with NFPA 80 and be listed and labeled by a testing and

inspecting agency acceptable to authorities having jurisdiction, based on testing according to NFPA 252.

1. Species: **[Red oak] [White oak] [White maple] [Cherry] <Insert species>**.
2. Fire Rating: **[20 minutes] [30 minutes] [45 minutes] [60 minutes] [90 minutes] [As indicated]**.

2.6 PANELING

A. Hardwood Veneer Plywood Paneling: Manufacturer's stock hardwood plywood panels complying with HPVA HP-1[, **made without urea-formaldehyde adhesive**].

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Chesapeake Hardwood Products, Inc.
 - b. Georgia-Pacific Corp.
 - c. Holland Southwest International.
 - d. **<Insert manufacturer>**
 - e. or approved equal.
2. Face Veneer Species and Cut: **[Rotary-cut white birch] [Plain-sliced red oak] [Plain-sliced hickory] <Insert species and cut>**.
3. Veneer Matching: **[Random match] [Selected for similar color and grain]**.
4. Backing Veneer Species: **[Same species as face veneer] [Any hardwood compatible with face species]**.
5. Construction: Veneer core.
6. Thickness: **[1/8 inch (3.2 mm)] [5/32 inch (4 mm)] [5 mm] [1/4 inch (6.4 mm)] [5/16 inch (7.9 mm)] [7/16 inch (11 mm)]**.
7. Panel Size: **[48 by 96 inches (1219 by 2438 mm)] [48 by 120 inches (1219 by 3048 mm)]**.
8. Panel Size: **[1200 by 2400 mm] [1200 by 3000 mm]**.
9. Glue Bond: Type II (interior).
10. Face Pattern: Manufacturer's standard **[V] [channel]**-grooved pattern, with grooves at edges, center, and third points of panels, and at other locations to provide pattern resembling random-width boards.
11. Finish: **[Manufacturer's standard, transparent, UV-resistant, protective finish] [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range]**.

B. Hardboard Paneling: Interior factory-finished hardboard paneling complying with AHA 135.5.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Chesapeake Hardwood Products, Inc.
 - b. Georgia-Pacific Corp.

- c. Marlite.
 - d. <Insert manufacturer>
 - e. or approved equal.
 2. Thickness: [**1/8 inch (3.2 mm)**] [**5/32 inch (4 mm)**] [**1/4 inch (6.4 mm)**].
 3. Finish: [**Class I**] [**Class II**].
 4. Surface-Burning Characteristics: As follows, tested according to ASTM E 84:
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 5. Colors, Textures, and Patterns: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**].
- C. Board Paneling: Interior wood-board paneling complying with WMMPA WM 9.
1. Species: [**Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine**] [**Southern pine**] [**Western red cedar**] [**Figured red gum**] <Insert species>.
 2. Grade: [**Clear No. 1**] [**Clear No. 2**] [**Knotty No. 1**] [**Knotty No. 2**] [**Finger jointed**].
 3. Maximum Moisture Content: [**15 percent with at least 85 percent of shipment at 12 percent or less**] [**9 percent**].
 4. Pattern: [**V-joint, tongue and groove, PT 82**] [**Beaded ceiling, PT 85**] [**Beveled-edge channel, shiplapped, PT 82**] [**As indicated**].
 5. Net Coverage Width: Not less than [**5-1/16 inches (128 mm)**] [**6-3/4 inches (171 mm)**] [**8-3/4 inches (222 mm)**].
- D. Board Paneling:
1. Species and Grade: Eastern white pine, [**C Select**] [**D Select**] [**Finish or 1 Common**] [**Premium or 2 Common**]; NeLMA or NLGA.
 2. Species and Grade: Idaho white, lodgepole, ponderosa, radiata, or sugar pine; [**C Select (Choice)**] [**D Select (Quality)**] [**1 Common (Colonial)**] [**2 Common (Sterling)**]; NLGA or WWPA.
 3. Species and Grade: Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine; [**C Select (Choice)**] [**D Select (Quality)**] [**Finish or 1 Common (Colonial)**] [**Premium or 2 Common (Sterling)**]; NeLMA, NLGA, or WWPA.
 4. Species and Grade: Southern pine, [**B & B**] [**C & Btr**] [**No. 2**] Paneling; SPIB.
 5. Species and Grade: Western red cedar, [**Clear Heart**] [**Grade A**] [**Grade B**]; NLGA, WCLIB, or WWPA.
 6. Maximum Moisture Content: [**19**] [**15**] percent[**with at least 85 percent of shipment at 12 percent or less**].
 7. Pattern: V-joint, tongue and groove, [**NeLMA EWP 4**] [**SPIB SPP 54**] [or] [**WWPA WP 4**].
 8. Pattern: Pickwick, tongue and groove, [**NeLMA EWP 2**] [**SPIB SPP 52**] [or] [**WWPA WP 2**].
 9. Pattern: Rounded-edge channel groove, tongue and groove, [**SPIB SPP 60**] [or] [**WWPA WP 6**].

10. Pattern: Edge and center bead, tongue and groove, **[NeLMA E & CB]** **[or]** **[WWPA E & CB Ceiling]**.
11. Net Coverage Width: Not less than **[5-1/16 inches (128 mm)]** **[6-3/4 inches (171 mm)]** **[8-3/4 inches (222 mm)]**.

2.7 SHELVING AND CLOTHES RODS

- A. **[Exposed]** **[Closet]** **[Utility]** Shelving: Made from **[the following material]** **[one of the following materials]**, **3/4 inch (19 mm)** thick.
1. Particleboard with **[radiused and filled]** **[or]** **[solid-wood]** front edge.
 2. MDF with **[radiused]** **[or]** **[solid-wood]** front edge.
 3. MDO softwood plywood with solid-wood edge.
 4. Melamine-faced particleboard with **[radiused and filled]** **[applied-PVC]** front edge.
 5. Wood boards as specified above for **[lumber trim for opaque]** **[softwood lumber trim for transparent]** **[hardwood lumber trim for transparent]** finish.
 6. Softwood Boards: Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine; **[C Select (Choice)]** **[D Select (Quality)]** **[Finish or 1 Common (Colonial)]** **[Premium or 2 Common (Sterling)]**; NeLMA, NLGA, or WWPA; kiln dried.
 7. Softwood Boards: Douglas fir-larch, Douglas fir south, or hem-fir; **[Superior or C & Btr]** **[Prime or D]** finish; NLGA, WCLIB, or WWPA; or southern pine, **[B & B]** **[C]** finish; SPIB; kiln dried.
- B. Shelf Cleats: **[3/4-by-3-1/2-inch (19-by-89-mm) boards]** **[3/4-by-5-1/2-inch (19-by-140-mm) boards]** **[3/4-by-5-1/2-inch (19-by-140-mm) boards with hole and notch to receive clothes rods]**, as specified above for **[shelving]** **[lumber trim for opaque finish]** **[softwood lumber trim for transparent finish]** **[hardwood lumber trim for transparent finish]**.
- C. Shelf Brackets with Rod Support: BHMA A156.16, B04051; prime-painted formed steel.
- D. Shelf Brackets without Rod Support: BHMA A156.16, B04041; prime-painted formed steel.
- E. Standards for Adjustable Shelf Brackets: BHMA A156.9, B04102; **[powder-coat-finished]** **[brass-finished]** **[zinc-plated]** steel.
- F. Adjustable Shelf Brackets: BHMA A156.9, B04112; **[powder-coat-finished steel]** **[brass-finished steel]** **[zinc-plated steel]** **[bronze-anodized aluminum]** **[black-anodized aluminum]** **[natural aluminum]**.
- G. Standards for Adjustable Shelf Supports: BHMA A156.9, B04071; **[powder-coat-finished]** **[brass-finished]** **[zinc-plated]** steel.
- H. Adjustable Shelf Supports: BHMA A156.9, B04081 or B04091; **[powder-coat-finished]** **[brass-finished]** **[zinc-plated]** steel.

- I. Clothes Rods: **1-1/2-inch-** (38-mm-) diameter, [clear, kiln-dried hardwood] [clear, kiln-dried Douglas fir or southern pine].
- J. Clothes Rods: **1-5/16-inch-** (33-mm-) diameter, [aluminum tubes] [chrome-plated-steel tubes] [color-coated steel tubes] [stainless-steel tubes] [chrome-plated-steel telescoping tubes with end brackets for mounting on shelf cleats].
- K. Rod Flanges: Clear, kiln-dried, [Douglas fir or southern pine] [eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine] [red oak] [white maple] [aspen, basswood, cottonwood, sap gum, white maple, or yellow poplar] <Insert species> turnings [with clear finish].
- L. Rod Flanges: [Aluminum] [Chrome-plated steel] [Stainless steel].

2.8 STAIRS AND RAILINGS

- A. Treads: **1-1/16-inch** (27-mm), clear, kiln-dried, edge-glued, [rift-sawn red oak] [red oak] [hard maple] [poplar] <Insert species> stepping with half-round nosing.
- B. Risers: **13/16-inch** (21-mm), clear, kiln-dried, edge-glued [red oak] [hard maple] [poplar] <Insert species> stock.
- C. Risers: **3/4-inch** (19-mm) finish boards as specified above for interior lumber trim for opaque finish.
- D. Treads: [**3/4-inch** (19-mm)] [**1-inch** (25-mm)] kiln-dried [Douglas fir, C & Btr VG (Vertical Grain) stepping; NLGA, WCLIB, or WWPA] [Hem-fir, C & Btr VG (Vertical Grain) stepping; NLGA, WCLIB, or WWPA] [Southern pine, B & B stepping; SPIB] with half-round or rounded edge nosing.
- E. Treads: [**3/4-inch** (19-mm)] [**1-inch** (25-mm)] particleboard with half-round nosing.
- F. Risers: **3/4-inch** (19-mm) kiln-dried [Douglas fir, C & Btr; NLGA, WCLIB, or WWPA] [Douglas fir, D; NLGA, WCLIB, or WWPA] [Hem-fir, C & Btr; NLGA, WCLIB, or WWPA] [Hem-fir, D; NLGA, WCLIB, or WWPA] [Southern pine, B & B; SPIB] [Southern pine, D; SPIB].
- G. Finished Stringers: **3/4-inch** (19-mm) finish boards as specified above for interior lumber trim for opaque finish.
- H. Interior Railings: Clear, kiln-dried [red oak] [hard maple] [yellow poplar] <Insert species>, of pattern indicated, either solid or laminated.
- I. Balusters: Clear, kiln-dried, [red oak] [hard maple] [yellow poplar] <Insert species>, turned balusters of pattern and size indicated.
- J. Balusters: **1-1/16-inch-** (27-mm-) square, clear, kiln-dried [red oak] [hard maple] [yellow poplar] <Insert species>.

- K. Newel Posts: Clear, kiln-dried, [**red oak**] [**hard maple**] [**yellow poplar**] <Insert species>, turned newel posts of pattern and size indicated.
- L. Newel Posts: **2-3/4-inch-** (70-mm-) square, clear, kiln-dried [**red oak**] [**hard maple**] [**yellow poplar**] <Insert species>, either solid or laminated.

2.9 ORNAMENTAL WOOD COLUMNS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Chadsworth's Incorporated.
 - 2. Colonial Columns, Inc.
 - 3. Hartmann-Sanders.
 - 4. Melton Classics Incorporated.
 - 5. Somerset Door & Column Company.
 - 6. Turncraft Div.; Cascade Wood Products, Inc.
 - 7. Worthington Millwork.
 - 8. <Insert manufacturer>
 - 9. or approved equal.
- B. Factory fabricate columns for transparent finish from clear, kiln-dried [**eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine**] [**aspen, basswood, cottonwood, sap gum, white maple, or yellow poplar**] [**red oak**] [**white maple**] [**mahogany**] <Insert species>.
- C. Factory fabricate columns for opaque finish from clear, kiln-dried [**eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine**] [**aspen, basswood, cottonwood, sap gum, white maple, or yellow poplar**] <Insert species>. Column staves may be finger jointed.
- D. Shafts: Built up from tongue-and-groove staves joined with waterproof glue. Lathe turn shafts to provide base diameter indicated and true architectural entasis taper.[**Precisely mill flutes as indicated.**]
- E. Capital and Base: [**Molded glass-fiber-reinforced plastic**] [**Built up from wood components with waterproof glue. Turn circular elements on lathes.**]
- F. Prime columns for opaque finish with one coat of interior wood primer compatible with specified topcoats.

2.10 MISCELLANEOUS MATERIALS

- A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.
- B. Low-Emitting Materials: Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for

the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.
 - 1. Wood glue shall have a VOC content of 30 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Installation Adhesive for Foam Plastic Moldings: Product recommended for indicated use by foam plastic molding manufacturer.
 - 1. Adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Paneling Adhesive: Comply with paneling manufacturer's written recommendations for adhesives.
 - 1. Adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Multipurpose Construction Adhesive: Formulation complying with ASTM D 3498 that is recommended for indicated use by adhesive manufacturer.
 - 1. Adhesive shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.11 FABRICATION

- A. Back out or kerf backs of the following members except those with ends exposed in finished work:
 - 1. Interior standing and running trim except shoe and crown molds.
 - 2. Wood-board paneling.
- B. Ease edges of lumber less than 1 inch (25 mm) in nominal thickness to 1/16-inch (1.5-mm) radius and edges of lumber 1 inch (25 mm) or more in nominal thickness to 1/8-inch (3-mm) radius.
- C. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber at time of fabrication and for relative humidity conditions in the installation areas.
- D. Fabricate woodwork to dimensions, profiles, and details indicated with openings and mortises precut, where possible, to receive hardware and other items and work.
- E. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

- F. Pre-Cut Openings: Fabricate architectural woodwork with pre-cut openings, where possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately and use templates or roughing in diagrams for proper size and shape. Smooth edges of cutoffs and, where located in countertops and similar exposures seal edges of cutouts with a water resistant coating.
- G. Measurements: Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain field measurements and verify dimensions and shop drawing details as required for accurate fit.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 48 hours[**unless longer conditioning is recommended by manufacturer**].

3.3 INSTALLATION, GENERAL

- A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, too small to fabricate with proper jointing arrangements, or with defective surfaces, sizes, or patterns.
- B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
 - 1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
 - 2. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation.
 - 3. Except where prefinished matching fasteners heads are required, use fine finishing nails for exposed nailing, countersunk, filled flush, and sand with woodwork.

4. Install to tolerance of **1/8 inch in 96 inches** (3 mm in 2438 mm) for level and plumb. Install adjoining interior finish carpentry with **1/32-inch** (0.8-mm) maximum offset for flush installation and **1/16-inch** (1.5-mm) maximum offset for reveal installation.
5. Install stairs with no more than **3/16-inch** (4.7-mm) variation between adjacent treads and risers and with no more than **3/8-inch** (9.5-mm) variation between largest and smallest treads and risers within each flight.
6. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.4 STANDING AND RUNNING TRIM INSTALLATION

- A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than **24 inches** (610 mm) long, except where necessary. Stagger joints in adjacent and related standing and running trim. [**Cope**] [**Miter**] at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
 1. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
 2. Install trim after gypsum-board joint finishing operations are completed.
 3. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.

3.5 PANELING INSTALLATION

- A. Plywood Paneling: Select and arrange panels on each wall to minimize noticeable variations in grain character and color between adjacent panels. Leave **1/4-inch** (6-mm) gap to be covered with trim at top, bottom, and openings. Install with uniform tight joints between panels.
 1. Attach panels to supports with manufacturer's recommended panel adhesive and fasteners. Space fasteners and adhesive as recommended by panel manufacturer.
 2. Conceal fasteners to greatest practical extent.
 3. Arrange panels with grooves and joints over supports. Fasten to supports with nails of type and at spacing recommended by panel manufacturer. Use fasteners with prefinished heads matching groove color.
- B. Hardboard Paneling: Install according to manufacturer's written recommendations. Leave **1/4-inch** (6-mm) gap to be covered with trim at top, bottom, and openings. Butt adjacent panels with moderate contact. Use fasteners with prefinished heads matching paneling color.
 1. Wood Stud or Furring Substrate: Install with **1-inch** (25-mm) annular-ring shank

- hardboard nails.
 - 2. Plaster or Gypsum-Board Substrate: Install with **1-5/8-inch** (41-mm) annular-ring shank hardboard nails.
 - 3. Nailing: Space nails **4 inches** (100 mm) o.c. at panel perimeter and **8 inches** (200 mm) o.c. at intermediate supports unless otherwise required by manufacturer.
- C. Board Paneling: Install according to manufacturer's written instructions. Arrange in random-width pattern suggested by manufacturer unless boards or planks are of uniform width.
- 1. Install in full lengths without end joints.
 - 2. Stagger end joints in random pattern to uniformly distribute joints on each wall.
 - 3. Install with uniform end joints with only end-matched (tongue-and-groove) joints within each field of paneling.
 - 4. Install with uniform end joints. Locate end joints only over furring or blocking.
 - 5. Select and arrange boards on each wall to minimize noticeable variations in grain character and color between adjacent boards. Install with uniform tight joints between boards.
 - 6. Fasten paneling by face nailing, setting nails, and filling over nail heads.
 - 7. Fasten paneling with trim screws, set below face and filled.
 - 8. Fasten paneling by blind nailing through tongues.
 - 9. Fasten paneling with paneling system manufacturer's concealed clips.
 - 10. Fasten paneling to gypsum wallboard with panel adhesive.

3.6 SHELVING AND CLOTHES ROD INSTALLATION

- A. Cut shelf cleats at ends of shelves about **1/2 inch** (13 mm) less than width of shelves and sand exposed ends smooth.
- B. Install shelf cleats by fastening to framing or backing with finish nails or trim screws, set below face and filled. Space fasteners not more than **16 inches** (400 mm) o.c. [**Use 2 fasteners at each framing member or fastener location for cleats 4 inches nominal** (89 mm actual) **in width and wider.**]
 - 1. Apply a bead of multipurpose construction adhesive to back of shelf cleats before installing. Remove adhesive that is squeezed out after fastening shelf cleats in place.
- C. Install shelf brackets according to manufacturer's written instructions, spaced not more than [**32 inches** (800 mm)] [**36 inches** (900 mm)] o.c. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.
- D. Install standards for adjustable shelf supports according to manufacturer's written instructions. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors. Space fasteners not more than **12 inches** (300 mm) o.c.
- E. Install standards for adjustable shelf brackets according to manufacturer's written instructions, spaced not more than **36 inches** (900 mm) o.c. and within **6 inches** (150

mm) of end of shelves. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.

- F. Cut shelves to neatly fit openings with only enough gap to allow shelves to be removed and reinstalled. Install shelves, fully seated on cleats, brackets, and supports.
 - 1. Fasten shelves to cleats with finish nails or trim screws, set flush.
 - 2. Fasten shelves to brackets to comply with bracket manufacturer's written instructions.
- G. Install rod flanges for rods as indicated. Fasten to shelf cleats, framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors. Install rods in rod flanges.

3.7 STAIR AND RAILING INSTALLATION

- A. Treads and Risers at Interior Stairs: Secure treads and risers by gluing and nailing to rough carriages.
 - 1. Closed Stringers: [**House treads and risers into wall stringers, glue, and wedge into place**] [**Cope wall stringers to fit tightly over treads and risers**].
- B. Balusters: Dovetail or mortise balusters into treads, glue, and nail in place. Let into railings and glue in place.
- C. Newel Posts: Secure newel posts to stringers, rough carriages, and risers with countersunk-head wood screws and glue.
- D. Railings: Secure wall rails with metal brackets. Fasten freestanding railings to newel posts and to trim at walls with countersunk-head wood screws or rail bolts, and glue. Assemble railings at goosenecks, easements, and splices with rail bolts and glue.

3.8 ORNAMENTAL COLUMN INSTALLATION

- A. Install columns to comply with manufacturer's written instructions. Comply with requirements below unless manufacturer's written instructions state otherwise.
- B. Lay out column locations on ceiling and plumb down to locate column locations at floor.
- C. Set plinths in location, shim as required to temporarily level, and scribe and trim as required so that tops of plinths will sit level without use of shims. Seal cut surfaces with wood sealer or primer and fasten plinths to floor using pins or fasteners as recommended by manufacturer.
- D. Set columns in location, shim as required to temporarily plumb, and scribe and trim as required so that columns will sit plumb without shims.
- E. Scribe and trim tops of columns to fit to ceiling.

- F. Seal ends of columns with wood sealer or primer.
- G. Install column caps on columns and fasten to columns.
- H. Secure columns in place at top and bottom with fasteners recommended by manufacturer.

3.9 ADJUSTING

- A. Replace interior finish carpentry that is damaged or does not comply with requirements. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.10 CLEANING

- A. Clean interior finish carpentry on exposed and semiexposed surfaces. Restore damaged or soiled areas and touch up factory-applied finishes, if any.

3.11 PROTECTION

- A. Protect installed products from damage from weather and other causes during construction.
- B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 062023

SECTION 064113 - WOOD-VENEER-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Architectural wood cabinets.
 - 2. Wood furring, blocking, shims, and hanging strips for installing architectural wood cabinets unless concealed within other construction before cabinet installation.
 - 3. Shop finishing of architectural wood cabinets.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ALLOWANCES

- A. Veneer for wood-veneer-faced architectural cabinets is part of veneer allowance. Allowance includes the cost of veneer that is wasted due to selection, cutting, and trimming.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product[, **including**] **[panel products] [fire-retardant-treated materials] [cabinet hardware and accessories] [and] [finishing materials and processes]**.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
2. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured[**and regionally extracted and manufactured**] materials. Include statement indicating cost for each regionally manufactured material.
 - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
 - b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
4. Certificates for [**Credit MR 6**] [**Credit MR 7**]: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.
5. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
6. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that products contain no urea formaldehyde.
7. Laboratory Test Reports for Credit IEQ 4.4: For composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.

2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 3. Show locations and sizes of cutouts and holes for **[electrical switches and outlets] [and other items]** installed in architectural wood cabinets.
 4. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
 5. Apply AWI Quality Certification Program label to Shop Drawings.
- D. Samples for Initial Selection: Provide minimum 8" x 10" for each type, color, pattern and surface finish.
1. Shop-applied transparent finishes.
 2. Shop-applied opaque finishes.
 3. PVC edge material.
 4. Thermoset decorative panels.
 5. Exposed cabinet hardware, one unit of each type and finish.
- E. Samples for Verification:
1. Lumber for transparent finish, not less than **[5 inches (125 mm) wide by 12 inches (300 mm) long] [5 inches (125 mm) wide by 24 inches (600 mm) long]**, for each species and cut, finished on one side and one edge.
 2. Veneer leaves representative of and selected from flitches to be used for transparent-finished cabinets.
 3. Lumber and panel products with shop-applied opaque finish, **5 inches (125 mm) wide by 12 inches (300 mm) long** for lumber and **[8 by 10 inches (200 by 250 mm)] [12 by 12 inches (300 by 300 mm)]** for panels, for each finish system and color, with **[one-half of]** exposed surface finished.
 4. Thermoset decorative panels, **[8 by 10 inches (200 by 250 mm)] [12 by 12 inches (300 by 300 mm)]**, for each color, pattern, and surface finish, **[with edge banding on one edge]**.
 5. Corner pieces as follows:
 - a. Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, **18 inches (450 mm) high by 18 inches (450 mm) wide by 6 inches (150 mm) deep**.
 - b. Miter joints for standing trim.
 6. Exposed cabinet hardware and accessories, one unit for each type **[and finish]**.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[Installer] [fabricator]**.
- B. Quality Certification: Submit woodwork Manufacturer's (Fabricator's) certification, stating that fabricated woodwork complies with quality grades and other requirements indicated.

- C. Certificate from the fabricator providing proof of not less than five (5) years experience in the fabrication of the types of products specified.
 - D. Certificate from the installer providing proof of not less than five (5) years of successful experience in the installation of similar types of products and shall have completed at least 3 jobs of similar size and scope.
 - E. Product Certificates: For **[each type of product.] [the following:]**
 - 1. Composite wood and agrifiber products.
 - 2. Thermoset decorative panels.
 - 3. Glass.
 - 4. Adhesives.
 - F. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates .
 - G. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.
 - H. Maintenance Data: Submit manufacturers care and maintenance data, including care and cleaning instructions.
- 1.7 CLOSEOUT SUBMITTALS
- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".
- 1.8 QUALITY ASSURANCE
- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.
 - B. Installer Qualifications: **[Fabricator of products]** Certified participant in AWI's Quality Certification Program.
 - C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
 - D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockups of **[typical architectural wood cabinets as shown on Drawings]** <Insert description>.

2. Fabricate one carcass for each type of cabinet required. DEN Project Manager is to review and approve carcass before remaining cabinet work can be proceeded with. Contractor to pay for the expense of transporting the DEN Project Manager to carcass site and back.
 3. Complete fabrication of each carcass approved and deliver to job site for DEN Project Manager review. Once the mock-up for a type of cabinet is approved, all remaining cabinets of that type may be fabricated.
 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Coordination: Distribute copies of approved schedule for cabinet hardware specified in Section 087100, "Door Hardware" to manufacturer of architectural woodwork; coordinate cabinet shop drawings and fabrication with hardware requirements, including a cut sheet for all hardware items and typical fasteners.
- F. Distribute copies of casework shop drawings to stainless steel supplier and coordinate fabrication and installation.
- G. Warranty: Fabricator/installer to warrant for minimum two (2) years from date of final acceptance materials, fabrication and installation of all items.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soiling, and deterioration.
- B. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.10 FIELD CONDITIONS

- A. Conditioning: Woodwork Manufacturer and Installer shall advise Contractor of temperature and humidity requirements for woodwork installation and storage areas. Do not install woodwork until required temperature and relative humidity have been stabilized and will be maintained in installation areas.
- B. Maintain temperature and humidity in installation area as required to maintain moisture content of installed woodwork within a 1.0 percent tolerance of optimum moisture content, from date of installation through remainder of construction period. Require Woodwork Manufacturer to establish optimum moisture content and required temperature and humidity conditions.
- C. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

- D. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between [25 and 55] [17 and 50] <Insert humidity range> percent during the remainder of the construction period.
- E. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.
- F. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.11 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that wood-veneer-faced architectural cabinets can be supported and installed as indicated.
- B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 087111 "Door Hardware (Descriptive Specification)" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

1.12 WARRANTY

- A. Warranty: Fabricator/installer to warrant for minimum two (2) years from date of final acceptance materials, fabrication, and installation of all items.

1.13 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 FABRICATION, GENERAL

- A. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber at time of fabrication and for relative humidity conditions in the installation areas.
- B. Fabricate woodwork to dimensions, profiles, and details indicated with openings and mortises precut, where possible, to receive hardware and other items and work.
- C. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- D. Pre Cut Openings: Fabricate architectural woodwork with precut openings, where possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately and use templates or roughing in diagrams for proper size and shape. Smooth edges of cutoffs and, where located in countertops and similar exposures seal edges of cutouts with a water resistant coating.
- E. Measurements: Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain field measurements and verify dimensions and shop drawing details as required for accurate fit.

2.2 ARCHITECTURAL CABINET FABRICATORS

- A. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of architectural wood cabinets with sequence-matched wood veneers **[wood paneling] [wood doors with face veneers that are sequence matched with woodwork] [and] [transparent-finished wood doors that are required to be of same species as woodwork]**.
- B. Fabricators: Subject to compliance with requirements, provide products by one of the following:
 - 1. **<Insert, in separate subparagraphs, names and possibly contact information for preapproved woodworking firms>**.
 - 2. or approved equal.

2.3 ARCHITECTURAL WOOD CABINETS, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural wood cabinets indicated for construction, finishes, installation, and other requirements.
 - 1. Provide **[labels] [and] [certificates]** from AWI certification program indicating

- that woodwork[, **including installation,**] complies with requirements of grades specified.
2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

2.4 WOOD CABINETS FOR TRANSPARENT FINISH

- A. Grade: [**Premium**] [**Custom**] [**Economy**].
- B. Regional Materials: Wood cabinets for transparent finish shall be manufactured within **500 miles** (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** (800 km) of Project site.
- C. Regional Materials: Wood cabinets for transparent finish shall be manufactured within **500 miles** (800 km) of Project site.
- D. Certified Wood: Wood cabinets for transparent finish shall be produced from wood certified as "FSC Pure"[or "**FSC Mixed Credit**"] according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- E. Type of Construction: [**Frameless**] [**Face frame**].
- F. Cabinet and Door and Drawer Front Interface Style: [**Flush overlay**] [**Reveal overlay**] [**Lipped**] [**Flush inset**].
- G. Reveal Dimension: [**1/2 inch (13 mm)**] [**As indicated**] <Insert dimension>.
- H. Wood for Exposed Surfaces:[**As indicated.**]
 1. Species: [**Red oak**] [**White oak**] [**White ash**] [**White birch**] <Insert species>.
 2. Cut: [**Plain sliced/plain sawn**] [**Rift cut/rift sawn**] [**Quarter cut/quarter sawn**].
 3. Grain Direction: [**Vertically for drawer fronts, doors, and fixed panels**] [**Horizontally for drawer fronts, doors, and fixed panels**] [**Vertically for doors and fixed panels, horizontally for drawer fronts**] [**As indicated**].
 4. Matching of Veneer Leaves: [**Book**] [**Slip**] [**Random**] match.
 5. Veneer Matching within Panel Face: [**Running**] [**Balance**] [**Center-balance**] match.
 6. Veneer Matching within Room: Provide cabinet veneers in each room or other space from a single flitch with doors, drawer fronts, and other surfaces matched in a sequenced set with continuous match where veneers are interrupted perpendicular to the grain.
 7. Comply with veneer and other matching requirements indicated for blueprint-matched paneling.
- I. Semi-exposed Surfaces: Provide surface materials indicated below:

1. Surfaces Other Than Drawer Bodies: [**Same species and cut indicated for exposed surfaces**] [**Thermoset decorative panels**] [**Compatible species to that indicated for exposed surfaces, stained to match**].
 - a. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
 2. Drawer Subfronts, Backs, and Sides: [**Solid-hardwood lumber, same species indicated for exposed surfaces**] [**Solid-hardwood lumber, stained to match species indicated for exposed surfaces**] [**Solid-hardwood lumber**] [**Thermoset decorative panels with PVC or polyester edge banding**].
 3. Drawer Bottoms: [**Hardwood plywood**] [**Thermoset decorative panels**].
- J. Dust Panels: **1/4-inch** (6.4-mm) plywood or tempered hardboard above compartments and drawers unless located directly under tops.
- K. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
1. Join subfronts, backs, and sides with [**glued rabbeted joints supplemented by mechanical fasteners**] [**or**] [**glued dovetail joints**].

2.5 WOOD CABINETS FOR OPAQUE FINISH

- A. Grade: [**Premium**] [**Custom**] [**Economy**].
- B. Regional Materials: Wood cabinets for opaque finish shall be manufactured within **500 miles** (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** (800 km) of Project site.
- C. Regional Materials: Wood cabinets for opaque finish shall be manufactured within **500 miles** (800 km) of Project site.
- D. Certified Wood: Wood cabinets for opaque finish shall be produced from wood certified as "FSC Pure"[**or "FSC Mixed Credit"**] according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- E. Type of Construction: [**Frameless**] [**Face frame**].
- F. Cabinet and Door and Drawer Front Interface Style: [**Flush overlay**] [**Reveal overlay**] [**Lipped**] [**Flush inset**].
- G. Reveal Dimension: [**1/2 inch (13 mm)**] [**As indicated**] <Insert dimension>.
- H. Species for Exposed Lumber Surfaces: Any closed-grain hardwood.
- I. Panel Product for Exposed Surfaces: Medium-density [**fiberboard**] [**overlay**].
- J. Semiexposed Surfaces: Provide surface materials indicated below:

1. Surfaces Other Than Drawer Bodies: **[Match materials indicated for exposed surfaces] [Thermoset decorative panels]**.
 - a. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
 2. Drawer Sides and Backs: **[Solid-hardwood lumber] [Thermoset decorative panels with PVC or polyester edge banding]**.
 3. Drawer Bottoms: **[Hardwood plywood] [Thermoset decorative panels]**.
- K. Dust Panels: **1/4-inch** (6.4-mm) plywood or tempered hardboard above compartments and drawers unless located directly under tops.
- L. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
1. Join subfronts, backs, and sides with **[glued rabbeted joints supplemented by mechanical fasteners] [or] [glued dovetail joints]**.

2.6 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than **3 inches** (75 mm) wide.
 2. Wood Moisture Content: **[5 to 10] [4 to 9]** percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
1. Recycled Content of Medium-Density Fiberboard and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
 2. Composite Wood and Agrifiber Products: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 3. Medium-Density Fiberboard: ANSI A208.2, **[Grade 130] <Insert grade>**, **made with binder containing no urea formaldehyde**.
 4. Particleboard: ANSI A208.1, **[Grade M-2] [Grade M-2, made with binder containing no urea formaldehyde] [Grade M-2-Exterior Glue]**.
 5. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.
 - a. Products: Subject to compliance with requirements, provide one of the following:

- 1) Environ Biocomposites Manufacturing LLC; Biofiber Wheat.
 - 2) Sorm Incorporated; Primeboard Premium Wheat.
 - 3) **<Insert manufacturer's name; product name or designation>**.
 - 4) or approved equal.
6. Softwood Plywood: DOC PS 1[, **medium-density overlay**].
 7. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1[, **made with adhesive containing no urea formaldehyde**].
 8. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.7 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
1. Use treated materials that comply with requirements of referenced woodworking standard. Do not use materials that are warped, discolored, or otherwise defective.
 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 feet (3.2 m)** beyond the centerline of the burners at any time during the test.
1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
 2. For items indicated to receive a stained or natural finish, use organic resin chemical formulation.
 3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
 4. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.

- C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.
1. For panels **3/4 inch** (19 mm) thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, **1600 psi** (11 MPa); modulus of elasticity, **300,000 psi** (2070 MPa); internal bond, **80 psi** (550 kPa); and screw-holding capacity on face and edge, **250 and 225 lbf** (1100 and 1000 N), respectively.
 2. For panels **13/16 to 1-1/4 inches** (20 to 32 mm) thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, **1300 psi** (9 MPa); modulus of elasticity, **250,000 psi** (1720 MPa); linear expansion, 0.50 percent; and screw-holding capacity on face and edge, **250 and 175 lbf** (1100 and 780 N), respectively.
 3. Products: Subject to compliance with requirements, provide one of the following:
 - a. Flakeboard Company Limited; Duraflake FR.
 - b. SierraPine; Encore FR.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
- D. Fire-Retardant Fiberboard: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Panel Source International, Inc.; Pyroblock Platinum.
 - b. SierraPine; Medite FR.
 - c. **<Insert manufacturer>**
 - d. or approved equal.

2.8 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087111 "Door Hardware (Descriptive Specification)."
- B. Butt Hinges: **2-3/4-inch** (70-mm), five-knuckle steel hinges made from **0.095-inch-** (2.4-mm-) thick metal, and as follows:
1. Semiconcealed Hinges for Flush Doors: BHMA A156.9, B01361.
 2. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.
- C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, **[100] [135] [170]** degrees of opening[, **self-closing**].

- D. Back-Mounted Pulls: BHMA A156.9, B02011.
- E. Wire Pulls: Back mounted, solid [metal] [plastic], [4 inches (100 mm) long, 5/16 inch (8 mm) in diameter] [5 inches (127 mm) long, 2-1/2 inches (63.5 mm) deep, and 5/16 inch (8 mm) in diameter].
- F. Catches: [Magnetic catches, BHMA A156.9, B03141] [Push-in magnetic catches, BHMA A156.9, B03131] [Roller catches, BHMA A156.9, B03071] [Ball friction catches, BHMA A156.9, B03013].
- G. Adjustable Shelf Standards and Supports: [BHMA A156.9, B04071; with shelf rests, B04081] [BHMA A156.9, B04102; with shelf brackets, B04112].
- H. Shelf Rests: BHMA A156.9, B04013; [metal] [plastic] [metal, two-pin type with shelf hold-down clip].
- I. Drawer Slides: BHMA A156.9.
- Grade 1 and Grade 2: Side mounted[and extending under bottom edge of drawer]; [full-extension] [partial-extension] type; [zinc-plated steel] [epoxy-coated steel] with polymer rollers.
 - Grade 1HD-100 and Grade 1HD-200: Side mounted; [full-extension] [full-overtravel-extension] type; zinc-plated-steel ball-bearing slides.
 - For drawers not more than 3 inches (75 mm) high and not more than 24 inches (600 mm) wide, provide [Grade 2] [Grade 1].
 - For drawers more than 3 inches (75 mm) high but not more than 6 inches (150 mm) high and not more than 24 inches (600 mm) wide, provide [Grade 1] [Grade 1HD-100].
 - For drawers more than 6 inches (150 mm) high or more than 24 inches (600 mm) wide, provide [Grade 1HD-100] [Grade 1HD-200].
 - For computer keyboard shelves, provide [Grade 1] [Grade 1HD-100].
 - For trash bins not more than 20 inches (500 mm) high and 16 inches (400 mm) wide, provide [Grade 1HD-100] [Grade 1HD-200].
- J. [Plastic] [Aluminum] Slides for Sliding Glass Doors: BHMA A156.9, B07063.
- K. Door Locks: BHMA A156.11, E07121.
- L. Drawer Locks: BHMA A156.11, E07041.
- M. Door and Drawer Silencers: BHMA A156.16, L03011.
- N. Float Glass for Cabinet Doors: ASTM C 1036, Type I, [Class 1 (clear)] [Class 2 or 3 (tinted)], Quality-Q3, [3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] thick.
- Tint Color: [Blue-green] [Bronze] [Green] [Gray] <Insert color>.
- O. Tempered Float Glass for Cabinet Doors: ASTM C 1048, Kind FT, Condition A, Type I, [Class 1 (clear)] [Class 2 or 3 (tinted)], Quality-Q3[, with exposed edges seamed before tempering], 6 mm thick unless otherwise indicated.

1. Tint Color: **[Blue-green] [Bronze] [Green] [Gray] <Insert color>**.
- P. Mirror Glass for Cabinet Doors: ASTM C 1503, Mirror **[Select] [Glazing]**, Quality-Q3, **[3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm]** thick.
- Q. Decorative Glass for Cabinet Doors: Provide decorative glass complying with Section 088113 "Decorative Glass Glazing."
- R. Tempered Float Glass for Cabinet Shelves: ASTM C 1048, Kind FT, Condition A, Type I, **[Class 1 (clear)] [Class 2 or 3 (tinted)]**, Quality-Q3; with exposed edges seamed before tempering, 6 mm thick.
 1. Tint Color: **[Blue-green] [Bronze] [Green] [Gray] <Insert color>**.
- S. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 1. Dark, Oxidized, Satin Bronze, Oil Rubbed: BHMA 613 for bronze base; BHMA 640 for steel base; match DEN Project Manager's sample.
 2. Bright Brass, Clear Coated: BHMA 605 for brass base; BHMA 632 for steel base.
 3. Bright Brass, Vacuum Coated: BHMA 723 for brass base; BHMA 729 for zinc-coated-steel base.
 4. Satin Brass, Blackened, Bright Relieved, Clear Coated: BHMA 610 for brass base; BHMA 636 for steel base.
 5. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
 6. Bright Chromium Plated: BHMA 625 for brass or bronze base; BHMA 651 for steel base.
 7. Satin Stainless Steel: BHMA 630.
- T. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.9 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: **[Softwood or hardwood lumber] [Fire-retardant-treated softwood lumber]**, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesives: Do not use adhesives that contain urea formaldehyde.
- D. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.10 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 - 1. Corners of Cabinets: **1/16 inch** (1.5 mm) unless otherwise indicated.
- C. Complete fabrication, including assembly[, **finishing,**] and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify DEN Project Manager seven (7) days in advance of the dates and times woodwork fabrication will be complete.
 - 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- D. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
- E. Install glass to comply with applicable requirements in Section 088000 "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

2.11 SHOP FINISHING

- A. General: Finish architectural wood cabinets at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. General: Shop finish transparent-finished architectural wood cabinets at fabrication shop as specified in this Section. Refer to Section 099123 "Interior Painting" for field finishing opaque-finished architectural woodwork.
- C. General: Drawings indicate items that are required to be shop finished. Finish such items at fabrication shop as specified in this Section. Refer to [**Section 099123 "Interior Painting"**] [**and**] [**Section 099300 "Staining and Transparent Finishing"**] for field finishing architectural woodwork not indicated to be shop finished.
- D. Finish Materials: Use finish materials that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- E. Shop Priming: Shop apply the prime coat including backpriming, if any, for[**transparent-finished**] items specified to be field finished. Refer to [**Section 099123 "Interior Painting"**] [**and**] [**Section 099300 "Staining and Transparent Finishing"**] for material and application requirements.
- F. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural wood cabinets, as applicable to each unit of work.
1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of cabinets.
- G. Transparent Finish:
1. Grade: [**Premium**] [**Same as item to be finished**].
 2. Finish: System - 1, nitrocellulose lacquer.
 3. Finish: System - 2, precatalyzed lacquer.
 4. Finish: System - 3, postcatalyzed lacquer.
 5. Finish: System - 4, water-based latex acrylic.
 6. Finish: System - 5, conversion varnish.
 7. Finish: System - 6, synthetic penetrating oil.
 8. Finish: System - 7, catalyzed vinyl.
 9. Finish: System - 8, water-based cross-linking acrylic.
 10. Finish: System - 9, UV curable acrylated epoxy, polyester, or urethane.
 11. Finish: System - 10, water-based UV curable.
 12. Finish: System - 11, catalyzed polyurethane.
 13. Finish: System - 12, water-based polyurethane.
 14. Finish: System - 13, catalyzed polyester.
 15. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to cabinets made from closed-grain wood before staining and finishing.
 16. Staining: [**None required**] [**Match approved sample for color**] [**Match DEN Project Manager's sample**].
 17. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
 18. Filled Finish for Open-Grain Woods:[**After staining, apply wash-coat sealer and allow to dry.**] Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
 19. Sheen: [**Flat, 15-30**] [**Satin, 31-45**] [**Semigloss, 46-60**] [**Gloss, 61-100**] gloss units measured on 60-degree gloss meter per ASTM D 523.
- H. Opaque Finish:
1. Grade: [**Premium**] [**Same as item to be finished**].
 2. Finish: System - 1, nitrocellulose lacquer.
 3. Finish: System - 2, precatalyzed lacquer.
 4. Finish: System - 3, postcatalyzed lacquer.
 5. Finish: System - 4, water-based latex acrylic.
 6. Finish: System - 5, conversion varnish.
 7. Finish: System - 7, catalyzed vinyl.
 8. Finish: System - 8, water-based cross-linking acrylic.
 9. Finish: System - 9, UV curable acrylated epoxy, polyester, or urethane.

10. Finish: System - 10, water-based UV curable.
11. Finish: System - 11, catalyzed polyurethane.
12. Finish: System - 12, water-based polyurethane.
13. Finish: System - 13, catalyzed polyester.
14. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range].**
15. Sheen: **[Flat, 15-30] [Satin, 31-45] [Semigloss, 46-60] [Gloss, 61-100]** gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.
- B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Treated Wood: Handle, store, and install pressure treated wood in compliance with recommendations of chemical treatment manufacturer including those for adhesives, where required for installation.
- D. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of **1/8 inch in 96 inches** (3 mm in 2400 mm).
- E. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- F. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Except where prefinished matching fasteners heads are required, use fine finishing nails[**or finishing screws**] for exposed fastening, countersunk and filled flush with woodwork.
 1. For shop finished items, use filler matching finish of items being installed.
- G. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than **1/8 inch in 96-inch** (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 2. Maintain veneer sequence matching of cabinets with transparent finish.
 3. Fasten wall cabinets through back, near top and bottom, and at ends not more than **16 inches** (400 mm) o.c. with [**No. 10 wafer-head screws sized for not less than 1-1/2-inch** (38-mm) penetration into wood framing, blocking, or hanging strips] [**No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish**] [**toggle bolts through metal backing or metal framing behind wall finish**].
- H. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.
1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are applied in shop.
- I. Refer to [**Section 099123 "Interior Painting"**] [**and**] [**Section 099300 "Staining and Transparent Finishing"**] for final finishing of installed architectural woodwork[**not indicated to be shop finished**].

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

3.4 HARDWARE SCHEDULE

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 064113

SECTION 064116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Plastic-laminate-faced architectural cabinets.
2. Stainless steel items incorporated into woodwork.
3. All thermoset polymer alloy surfaces.
4. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.
2. Section 064219 "Plastic-Laminate-Faced Wood Paneling" for plastic laminated wood paneling.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>**

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product[, **including**] [**panel products**] [**high-pressure decorative laminate**] [**stainless steel items incorporated into woodwork**] [**all thermoset polymer alloy surfaces**] [**adhesive for bonding plastic laminate**] [**fire-retardant-treated materials**] [**and**] [**cabinet hardware and accessories**].

1. Include data for fire-retardant treatment from chemical-treatment manufacturer

- and certification by treating plant that treated materials comply with requirements.
2. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured materials. Include statement indicating cost for each regionally manufactured material.
 - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
 3. Certificates for **[Credit MR 6] [Credit MR 7]**: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.
 4. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 5. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that products contain no urea formaldehyde.
 6. Laboratory Test Reports for Credit IEQ 4.4: For composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
1. Show details full size.
 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 3. Show locations and sizes of cutouts and holes for **[electrical switches and outlets] [and other items]** installed in architectural plastic-laminate cabinets.
 - 4.
 5. Apply AWI Quality Certification Program label to Shop Drawings.
- D. Samples for Initial Selection: Provide minimum 8" x 10" for each type, color, pattern, and surface finish. One sample for each cabinet liner type, 8" x 10".
1. Plastic laminates.
 2. PVC edge material.
 3. Thermoset decorative panels.

4. Exposed cabinet hardware, one unit of each type and finish.
5. Polymer alloy: For each type, color, pattern, and surface finish. One typical color matched seam.

E. Samples for Verification:

1. Plastic laminates, [**8 by 10 inches** (200 by 250 mm)] [**12 by 12 inches** (300 by 300 mm)], for each[**type,**] color, pattern, and surface finish[, **with one sample applied to core material**] [**and specified edge material applied to one edge**].
2. Wood-grain plastic laminates, [**12 by 24 inches** (300 by 600 mm)] [**24 by 24 inches** (600 by 600 mm)], for each[**type,**] pattern and surface finish[, **with one sample applied to core material**] [**and specified edge material applied to one edge**].
3. Thermoset decorative panels, [**8 by 10 inches** (200 by 250 mm)] [**12 by 12 inches** (300 by 300 mm)], for each color, pattern, and surface finish[, **with edge banding on one edge**].
4. Corner pieces as follows:
 - a. Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, **18 inches** (450 mm) high by **18 inches** (450 mm) wide by **6 inches** (150 mm) deep.
 - b. Miter joints for standing trim.
5. Exposed cabinet hardware and accessories, one unit for each type[**and finish**].

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For [**Installer**] [**fabricator**].
- B. Quality Certification: Submit woodwork Manufacturer's (Fabricator's) certification, stating that fabricated woodwork complies with quality grades and other requirements indicated.
- C. Product Certificates: For [**each type of product.**] [**the following:**]
 1. Composite wood and agrifiber products.
 2. Thermoset decorative panels.
 3. High-pressure decorative laminate.
 4. Thermoset polymer alloy.
 5. Glass.
 6. Adhesives.
- D. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates .
- E. Certificate from the fabricator providing proof of not less than five (5) years experience in the fabrication of the types of products specified.

- F. Certificate from the installer providing proof of not less than five (5) years of successful experience in the installation of similar types of products and shall have completed at least 3 jobs of similar size and scope.
- G. Certificate from the manufacturer certifying that the polymer alloy cladding complies with the Denver Building Code for its intended use.
- H. Wall panel certificate: Submit certificate that wall panel backing adhesive and laminate comply with reference fire-resistance requirements.
- I. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.
- J. Maintenance Data: Submit manufacturer's care and maintenance data, including care and cleaning instructions.

1.6 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.
- B. Installer Qualifications: [**Fabricator of products**] [**Certified participant in AWI's Quality Certification Program**].
- C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockups of [**typical plastic-laminate cabinets as shown on Drawings**] **<Insert description>**.
 - 2. Fabricate one carcass for each type of cabinet required. DEN Project Manager is to review and approve carcass before remaining cabinetwork can be proceeded with. Contractor to pay for the expense of transporting the DEN Project Manager to carcass site and back.

3. Complete fabrication of each carcass approved and deliver to job site for DEN Project Manager review. Once the mock-up for a type of cabinet is approved, all remaining cabinets of that type may be fabricated.
 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Coordination: Distribute copies of approved schedule for cabinet hardware specified in **[Section 087100, "Door Hardware"] [this Section]** to manufacturer of architectural woodwork; coordinate cabinet shop drawings and fabrication with hardware requirements, including a cut sheet for all hardware items and typical fasteners.
- F. Distribute copies of casework shop drawings to stainless steel supplier and coordinate fabrication and installation.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soiling, and deterioration.
 - B. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
- 1.9 FIELD CONDITIONS
- A. Conditioning: Woodwork Manufacturer and Installer shall advise Contractor of temperature and humidity requirements for woodwork installation and storage areas. Do not install woodwork until required temperature and relative humidity have been stabilized and will be maintained in installation areas.
 - B. Maintain temperature and humidity in installation area as required to maintain moisture content of installed woodwork within a 1.0 percent tolerance of optimum moisture content, from date of installation through remainder of construction period. Require Woodwork Manufacturer to establish optimum moisture content and required temperature and humidity conditions.
 - C. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
 - D. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between **60 and 90 deg F** (16 and 32 deg C) and relative humidity between **[25 and 55] [17 and 50] <Insert humidity range>** percent during the remainder of the construction period.
 - E. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and

indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.

- F. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.10 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.
- B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 087111 "Door Hardware (Descriptive Specification)" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

1.11 WARRANTY

- A. Warranty: Provide warranty for two (2) <Insert number> years from date of final acceptance materials, fabrication, and installation of all items.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 FABRICATION, GENERAL

- A. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber at time of fabrication and for relative humidity conditions in the installation areas.
- B. Fabricate woodwork to dimensions, profiles, and details indicated with openings and mortises precut, where possible, to receive hardware and other items and work.
- C. Complete fabrication, assembly, finishing, hardware application, and other work before

shipment to project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

- D. Pre Cut Openings: Fabricate architectural woodwork with precut openings, where possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately and use templates or roughing in diagrams for proper size and shape. Smooth edges of cutoffs and, where located in countertops and similar exposures seal edges of cutouts with a water resistant coating.
- E. Measurements: Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain field measurements and verify dimensions and shop drawing details as required for accurate fit.

2.2 ARCHITECTURAL CABINET FABRICATORS

- A. Fabricators: Subject to compliance with requirements, provide products by one of the following:
 - 1. **<Insert, in separate subparagraphs, names and possibly contact information for preapproved woodworking firms>.**
 - 2. or approved equal.

2.3 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.
 - 1. Provide **[labels] [and] [certificates]** from AWI certification program indicating that woodwork[, **including installation,**] complies with requirements of grades specified.
 - 2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.
- B. Grade: **[Premium] [Custom] [Economy]**.
- C. Regional Materials: Plastic-laminate cabinets shall be manufactured within **500 miles** (800 km) of Project site.
- D. Certified Wood: Plastic-laminate cabinets shall be made from wood products certified as "FSC Pure"[**or "FSC Mixed Credit"**] according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- E. Type of Construction: **[Frameless] [Face frame] [As indicated]**.

- F. Cabinet, Door, and Drawer Front Interface Style: [**Flush overlay**] [**Reveal overlay**] [**Lipped**] [**Flush inset**].
- G. Reveal Dimension: [**1/2 inch (13 mm)**] [**As indicated**] <Insert dimension>.
- H. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Abet Laminati, Inc.
 - b. Formica Corporation.
 - c. Lamin-Art, Inc.
 - d. Panolam Industries International, Inc.
 - e. Wilsonart International; Div. of Premark International, Inc.
 - f. <Insert manufacturer's name>.
 - g. or approved equal.
- I. Laminate Cladding for Exposed Surfaces:
1. Horizontal Surfaces: [**Grade HGS**] .
 2. Postformed Surfaces: Grade HGP.
 3. Vertical Surfaces: [**Grade HGS**] .
 4. Edges: [**Grade HGS**] Pattern Direction: [**Vertically for drawer fronts, doors, and fixed panels**] [**Horizontally for drawer fronts, doors, and fixed panels**] [**Vertically for doors and fixed panels, horizontally for drawer fronts**] [**As indicated**].
- J. Materials for Semiexposed Surfaces:
1. Surfaces Other Than Drawer Bodies: [**High-pressure decorative laminate, NEMA LD 3, Grade VGS**] .
 - a. Edges of Plastic-Laminate Shelves: [**PVC tape, 0.018-inch (0.460-mm) minimum thickness, matching laminate in color, pattern, and finish**] [**PVC T-mold matching laminate in color, pattern, and finish**] [**PVC edge banding, 0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish**].
 - b. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
 - c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, [**Grade VGS**] .
 2. Drawer Sides and Backs: [**Solid-hardwood lumber**] [**Thermoset decorative panels with PVC or polyester edge banding**].
 3. Drawer Bottoms: [**Hardwood plywood**] [**Thermoset decorative panels**].
- K. Dust Panels: **1/4-inch (6.4-mm)** plywood or tempered hardboard above compartments

and drawers unless located directly under tops.

- L. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- M. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 - 1. Join subfronts, backs, and sides with **[glued rabbeted joints supplemented by mechanical fasteners] [or] [glued dovetail joints]**.
- N. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. As indicated by laminate manufacturer's designations.
 - 2. Match DEN Project Manager's sample.
 - 3. As selected by DEN Project Manager from laminate manufacturer's full range in the following categories:
 - a. Solid colors, **[gloss] [matte]** finish.
 - b. Solid colors with core same color as surface, **[gloss] [matte]** finish.
 - c. Wood grains, **[gloss] [matte]** finish.
 - d. Patterns, **[gloss] [matte]** finish.

2.4 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
 - 1. Wood Moisture Content: **[5 to 10] [4 to 9]** percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
 - 1. Recycled Content of Medium-Density Fiberboard and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
 - 2. Composite Wood and Agrifiber Products: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - 3. Medium-Density Fiberboard: ANSI A208.2, **[Grade 130] <Insert grade>**, **made with binder containing no urea formaldehyde**.
 - 4. Particleboard: ANSI A208.1, **[Grade M-2] [Grade M-2, made with binder containing no urea formaldehyde] [Grade M-2-Exterior Glue]**.
 - 5. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.

- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Environ Biocomposites Manufacturing LLC; Biofiber Wheat.
 - 2) Sorm Incorporated; Primeboard Premium Wheat.
 - 3) **<Insert manufacturer's name; product name or designation>**.
 - 4) or approved equal.
6. Softwood Plywood: DOC PS 1[, **medium-density overlay**].
7. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1[, **made with adhesive containing no urea formaldehyde**].
8. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.5 ARCHITECTURAL POLYMER ALLOY CLADDING

- A. Provide architectural polymer alloy cladding that complies with the following:
 1. Thickness: As indicated on drawings.
 2. Impact Resistance: No fracture per NEMA LD3-3.03, 1/2 lb. ball.
 3. Hardness: 52-56, Barcol Impressor.
 4. Tensile Strength: 3900 psi, per ASTM D-638.
 5. Tensile Modulus: 1.0 x 10(6) psi per ASTM D-638.
 6. High temperature, boiling water and conductive heat resistance: No change per NEMA LD3-3.06, LD3-3.05 and LD3-3.08 respectively.
 7. Abrasion resistance: .08g/100 cycles per CS 221-66.
 8. Cigarette resistance: No lasting effect, NEMA LD3-3.07.
 9. Color stability: No change per NEMA LD3-3.10.
 10. Weight: 4.4 lbs./SF for a 1/2" thickness.
 11. Stain and chemical resistance: No lasting effect when exposed to acetone, Ethanol, gasoline, Methanol, 99.5% Acetic acid, 37% hydrochloric acid, 85% Phosphoric acid, 77% sulphuric acid, 1% ammonia, 1% lye, nail polish remover, coffee and ammonium Hydroxide.
 12. Surface burning characteristics: Flame spread: 10, smoke developed: 95-175.
 13. Finish: Matte, as obtained by light sanding with 320-350 grid sandpaper, glass level 5-18.
 14. Sealants and adhesives: Color-matched seam adhesive for joint seams. Match bowl color for seaming to sink bowls. Sealants to match polymer alloy in color, to be silicone and to comply with requirements of Section 07900, "Joint Sealers".

2.6 STAINLESS STEEL

- A. Provide stainless steel that complies with the following:
 1. Bar Stock: ASTM A 276, Type 302 or 304.
 2. Plate: ASTM A 167, Type 302 or 304.

3. Stainless steel finish: AISI number 4, brushed, directional with grain oriented along the length of the material or vertical on planar surfaces or as denoted by the DEN Project Manager.
4. Gauge: As noted on drawings.
5. Fasteners: Stainless steel, conceal to greatest extent possible.
6. Hinges: Stainless steel, concealed from view.

2.7 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
1. Use treated materials that comply with requirements of referenced woodworking standard. Do not use materials that are warped, discolored, or otherwise defective.
 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 feet** (3.2 m) beyond the centerline of the burners at any time during the test.
1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
 2. For items indicated to receive a stained or natural finish, use organic resin chemical formulation.
 3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
 4. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
- C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.
1. For panels **3/4 inch** (19 mm) thick and less, comply with ANSI A208.1 for Grade

- M-2 except for the following minimum properties: modulus of rupture, **1600 psi** (11 MPa); modulus of elasticity, **300,000 psi** (2070 MPa); internal bond, **80 psi** (550 kPa); and screw-holding capacity on face and edge, **250 and 225 lbf** (1100 and 1000 N), respectively.
2. For panels **13/16 to 1-1/4 inches** (20 to 32 mm) thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, **1300 psi** (9 MPa); modulus of elasticity, **250,000 psi** (1720 MPa); linear expansion, 0.50 percent; and screw-holding capacity on face and edge, **250 and 175 lbf** (1100 and 780 N), respectively.
 3. Products: Subject to compliance with requirements, provide one of the following:
 - a. Flakeboard Company Limited; Duraflake FR.
 - b. SierraPine; Encore FR.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
- D. Fire-Retardant Fiberboard: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Panel Source International, Inc.; Pyroblock Platinum.
 - b. SierraPine; Medite FR.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.

2.8 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087111 "Door Hardware (Descriptive Specification)."
- B. Butt Hinges: **2-3/4-inch** (70-mm), five-knuckle steel hinges made from **0.095-inch-** (2.4-mm-) thick metal, and as follows:
 1. Semiconcealed Hinges for Flush Doors: BHMA A156.9, B01361.
 2. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.
- C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, **[100] [135] [170]** degrees of opening[, **self-closing**].
- D. Back-Mounted Pulls: BHMA A156.9, B02011.
- E. Wire Pulls: Back mounted, solid **[metal] [plastic]**, **[4 inches** (100 mm) **long, 5/16 inch** (8 mm) **in diameter]** **[5 inches** (127 mm) **long, 2-1/2 inches** (63.5 mm) **deep, and 5/16 inch** (8 mm) **in diameter]**.

- F. Catches: [**Magnetic catches, BHMA A156.9, B03141**] [**Push-in magnetic catches, BHMA A156.9, B03131**] [**Roller catches, BHMA A156.9, B03071**] [**Ball friction catches, BHMA A156.9, B03013**].
- G. Adjustable Shelf Standards and Supports: [**BHMA A156.9, B04071; with shelf rests, B04081**] [**BHMA A156.9, B04102; with shelf brackets, B04112**].
- H. Shelf Rests: BHMA A156.9, B04013; [**metal**] [**plastic**] [**metal, two-pin type with shelf hold-down clip**].
- I. Drawer Slides: BHMA A156.9.
- Grade 1 and Grade 2: Side mounted[**and extending under bottom edge of drawer**]; [**full-extension**] [**partial-extension**] type; [**zinc-plated steel**] [**epoxy-coated steel**] with polymer rollers.
 - Grade 1HD-100 and Grade 1HD-200: Side mounted; [**full-extension**] [**full-overtravel-extension**] type; zinc-plated-steel ball-bearing slides.
 - For drawers not more than **3 inches** (75 mm) high and not more than **24 inches** (600 mm) wide, provide [**Grade 2**] [**Grade 1**].
 - For drawers more than **3 inches** (75 mm) high but not more than **6 inches** (150 mm) high and not more than **24 inches** (600 mm) wide, provide [**Grade 1**] [**Grade 1HD-100**].
 - For drawers more than **6 inches** (150 mm) high or more than **24 inches** (600 mm) wide, provide [**Grade 1HD-100**] [**Grade 1HD-200**].
 - For computer keyboard shelves, provide [**Grade 1**] [**Grade 1HD-100**].
 - For trash bins not more than **20 inches** (500 mm) high and **16 inches** (400 mm) wide, provide [**Grade 1HD-100**] [**Grade 1HD-200**].
- J. [**Plastic**] [**Aluminum**] Slides for Sliding Glass Doors: BHMA A156.9, B07063.
- K. Door Locks: BHMA A156.11, E07121.
- L. Drawer Locks: BHMA A156.11, E07041.
- M. Door and Drawer Silencers: BHMA A156.16, L03011.
- N. Float Glass for Cabinet Doors: ASTM C 1036, Type I, [**Class 1 (clear)**] [**Class 2 or 3 (tinted)**], Quality-Q3, [**3.0 mm**] [**4.0 mm**] [**5.0 mm**] [**6.0 mm**] thick.
- Tint Color: [**Blue-green**] [**Bronze**] [**Green**] [**Gray**] <Insert color>.
- O. Tempered Float Glass for Cabinet Doors: ASTM C 1048, Kind FT, Condition A, Type I, [**Class 1 (clear)**] [**Class 2 or 3 (tinted)**], Quality-Q3[, **with exposed edges seamed before tempering**], 6 mm thick unless otherwise indicated.
- Tint Color: [**Blue-green**] [**Bronze**] [**Green**] [**Gray**] <Insert color>.
- P. Mirror Glass for Cabinet Doors: ASTM C 1503, Mirror [**Select**] [**Glazing**], Quality-Q3, [**3.0 mm**] [**4.0 mm**] [**5.0 mm**] [**6.0 mm**] thick.

- Q. Decorative Glass for Cabinet Doors: Provide decorative glass complying with Section 088113 "Decorative Glass Glazing."
- R. Tempered Float Glass for Cabinet Shelves: ASTM C 1048, Kind FT, Condition A, Type I, **[Class 1 (clear)] [Class 2 or 3 (tinted)]**, Quality-Q3; with exposed edges seamed before tempering, 6 mm thick.
1. Tint Color: **[Blue-green] [Bronze] [Green] [Gray] <Insert color>**.
- S. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
1. Dark, Oxidized, Satin Bronze, Oil Rubbed: BHMA 613 for bronze base; BHMA 640 for steel base; match DEN Project Manager's sample.
 2. Bright Brass, Clear Coated: BHMA 605 for brass base; BHMA 632 for steel base.
 3. Bright Brass, Vacuum Coated: BHMA 723 for brass base; BHMA 729 for zinc-coated-steel base.
 4. Satin Brass, Blackened, Bright Relieved, Clear Coated: BHMA 610 for brass base; BHMA 636 for steel base.
 5. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
 6. Bright Chromium Plated: BHMA 625 for brass or bronze base; BHMA 651 for steel base.
 7. Satin Stainless Steel: BHMA 630.
- T. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.9 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: **[Softwood or hardwood lumber] [Fire-retardant-treated softwood lumber]**, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesives: Do not use adhesives that contain urea formaldehyde.
- D. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Adhesive for Bonding Plastic Laminate: **[Unpigmented contact cement] [Contact cement] [PVA] [Urea formaldehyde] [Resorcinol]**.
1. Adhesive for Bonding Edges: Hot-melt adhesive[**or adhesive specified above**

for faces].

2.10 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Fabricate cabinets to dimensions, profiles, and details indicated.
- C. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify DEN Project Manager seven (7) days in advance of the dates and times woodwork fabrication will be complete.
 - 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- D. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
- E. Install glass to comply with applicable requirements in Section 088000 "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.
- B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

- A. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.

- C. Treated Wood: Handle, store, and install pressure treated wood in compliance with recommendations of chemical treatment manufacturer including those for adhesives, where required for installation.
- D. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of **1/8 inch in 96 inches** (3 mm in 2400 mm).
- E. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- F. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Except where prefinished matching fasteners heads are required, use fine finishing nails[**or finishing screws**] for exposed fastening, countersunk and filled flush with woodwork.
1. Use filler matching finish of items being installed.
- G. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
1. Install cabinets with no more than **1/8 inch in 96-inch** (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 2. Fasten wall cabinets through back, near top and bottom, and at ends not more than **16 inches** (400 mm) o.c. with [**No. 10 wafer-head screws sized for not less than 1-1/2-inch** (38-mm) **penetration into wood framing, blocking, or hanging strips**] [**No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish**] [**toggle bolts through metal backing or metal framing behind wall finish**].
- H. Tops: Anchor securely to base units and other support systems as indicated.
- I. Paneling: Anchor paneling to supporting substrate with concealed panel hanger clips.
- J. Polymer alloy cladding: Comply with all manufacturer's recommendations for installation. All edges to be eased unless otherwise noted on drawings. Provide materials of thickness and profile shown. Provide blocking and bracing and ancillary support. Fabricate baby changing counter with an integral coved backsplash at factory. Tightly seam any joints. Factory fabricate to greatest extent possible. Joints shall be inconspicuous and flush. Provide factory cutouts for in-alloy devices. Reject defective work. Cut and finish edges with clean sharp returns.
- K. Installing Stainless Steel Items:
1. Coordinate work with work by other trades.
 2. Comply with the intent of details.
 3. External corners: Ease 1/32" unless otherwise noted.
 4. Anchor all items securely. Adhere stainless steel to plywood where indicated per Manufacturer's recommendations.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semiexposed surfaces.

3.4 [HARDWARE SCHEDULE]

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 064116

SECTION 064213 - STILE AND RAIL WOOD PANELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Stile and rail wood paneling (stile and rail wall surfacing).
2. Wood furring, blocking, shims, and hanging strips for installing stile and rail wood paneling unless concealed within other construction before paneling installation.
3. Shop finishing of stile and rail wood paneling.

- B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing paneling and that are concealed within other construction before paneling installation.
2. Section 064600 "Wood Trim" for wood trim installed on or next to stile and rail wood paneling.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ALLOWANCES

- A. Veneer for paneling is part of veneer allowance. Allowance includes the cost of veneer that is wasted due to selection, cutting, and trimming.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.

1.5 ACTION SUBMITTALS

- A. Product Data: Product Data: For each type of product[, **including] [panel products] [adhesives] [fire-retardant-treated materials] [and] [finishing materials and**

processes].

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
2. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured[**and regionally extracted and manufactured**] materials. Include statement indicating cost for each regionally manufactured material.
 - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
 - b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
4. Certificates for [**Credit MR 6**] [**Credit MR 7**]: Chain-of-custody certificates indicating that paneling complies with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.
5. Product Data for Credit IEQ 4.1: For installation adhesives, documentation including printed statement of VOC content.
6. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
7. Product Data for Credit IEQ 4.4: For composite wood products and fabrication adhesives, documentation indicating that products contain no urea formaldehyde.
8. Laboratory Test Reports for Credit IEQ 4.4: For composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: Show location of paneling, large-scale details, attachment devices, and other components. Include dimensioned plans and elevations.

1. Show details full size.
2. Show locations and sizes of furring and blocking, including concealed blocking specified in other Sections.
3. For paneling produced from premanufactured sets, show finished panel sizes, set numbers, sequence numbers within sets, and method of cutting panels to produce indicated sizes.
4. For paneling veneered in fabrication shop, show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
- 5.

D. Samples for Initial Selection:

1. Shop-applied transparent finishes.
2. Shop-applied opaque finishes.

E. Samples for Verification:

1. Lumber for transparent finish, not less than [5 inches (125 mm) wide by 12 inches (300 mm) long] [5 inches (125 mm) wide by 24 inches (600 mm) long], for each species and cut, finished on one side and one edge.
2. Veneer leaves representative of and selected from flitches to be used for transparent-finished paneling.
3. Veneer-faced panel products for transparent finish, [8 by 10 inches (200 by 250 mm)] [12 by 12 inches (300 by 300 mm)] [12 by 24 inches (300 by 600 mm)], for each species and cut. Include at least one face-veneer seam and finish as specified.
4. Lumber and panel products with shop-applied opaque finish, 5 inches (125 mm) wide by 12 inches (300 mm) long for lumber and [8 by 10 inches (200 by 250 mm)] [12 by 12 inches (300 by 300 mm)] for panels, for each finish system and color, with [one-half of] exposed surface finished.
5. Corner pieces for stile and rail paneling, 18 inches (450 mm) high by 18 inches (450 mm) wide by 6 inches (150 mm) deep.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For [Installer] [Fabricator].
- B. Quality Certification: Submit woodwork Manufacturer's (Fabricator's) certification, stating that fabricated woodwork complies with quality grades and other requirements indicated.
- C. Product Certificates: For each type of product.
- D. Wall panel certificate: Submit certificate that wall panel backing adhesive and laminate comply with reference fire-resistance requirements.
- E. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates. .

- F. Certificate from the fabricator providing proof of not less than five (5) years experience in the fabrication of the types of products specified.
- G. Certificate from the installer providing proof of not less than five (5) years of successful experience in the installation of similar types of products and shall have completed at least 3 jobs of similar size and scope.
- H. Maintenance Data: Submit manufacturer's care and maintenance data, including care and cleaning instructions.
- I. Evaluation Reports: For **[fire-retardant-treated materials]** **[and]** **[fire-retardant-treated paneling]**, from ICC-ES.
- J. Provide warranty for two (2) years from date of final acceptance materials, fabrication, and installation of all items.

1.7 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.
- B. Installer Qualifications: **[Fabricator of products]** **[Certified participant in AWI's Quality Certification Program]** .
- C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockups of **[typical paneling as shown on Drawings]** **<Insert description>**.
 - 2. Mock-up a minimum 200 sq. ft. of stile and rail wood panel. Demonstrate panel removal to the DEN Project Manager.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soiling, and deterioration.
- B. Do not deliver paneling until painting and similar operations that could damage paneling have been completed in installation areas. If paneling must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.10 FIELD CONDITIONS

- A. Conditioning: Woodwork Manufacturer and Installer shall advise Contractor of temperature and humidity requirements for woodwork installation and storage areas. Do not install woodwork until required temperature and relative humidity have been stabilized and will be maintained in installation areas.
- B. Maintain temperature and humidity in installation area as required to maintain moisture content of installed woodwork within a 1.0 percent tolerance of optimum moisture content, from date of installation through remainder of construction period. Require Woodwork Manufacturer to establish optimum moisture content and required temperature and humidity conditions.
- C. Environmental Limitations: Do not deliver or install paneling until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.
- D. Environmental Limitations: Do not deliver or install paneling until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature between **60 and 90 deg F** (16 and 32 deg C) and relative humidity between **[25 and 55] [17 and 50] <Insert humidity range>** percent during the remainder of the construction period.
- E. Field Measurements: Where paneling is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support paneling by field measurements before being enclosed and indicate measurements on Shop Drawings.
- F. Established Dimensions: Where paneling is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.11 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that paneling can be installed as indicated.

1.12 WARRANTY

- A. Warranty: Fabricator/installer to warrant for minimum two (2) **<Insert number>** years from date of final acceptance materials, fabrication, and installation of all items.

1.13 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 FABRICATION, GENERAL

- A. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber at time of fabrication and for relative humidity conditions in the installation areas.
- B. Fabricate woodwork to dimensions, profiles, and details indicated with openings and mortises precut, where possible, to receive hardware and other items and work.
- C. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- D. Pre Cut Openings: Fabricate architectural woodwork with precut openings, where possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately and use templates or roughing in diagrams for proper size and shape. Smooth edges of cutoffs and, where located in countertops and similar exposures seal edges of cutouts with a water resistant coating.
- E. Measurements: Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain field measurements and verify dimensions and shop drawing details as required for accurate fit.

2.2 PANELING FABRICATORS

- A. Source Limitations: Engage a qualified woodworking firm to assume undivided

responsibility for production of paneling **[and] [wood-veneer-faced architectural cabinets] [ornamental woodwork] [wood trim] [wood frames] [and] [wood doors faced with veneers from same flitches as paneling]**.

- B. Fabricators: Subject to compliance with requirements, provide products by one of the following:
1. **<Insert, in separate subparagraphs, names and possibly contact information for preapproved woodworking firms>**.
 2. or approved equal.

2.3 PANELING, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of stile and rail wood paneling (stile and rail wall surfacing) indicated for construction, finishes, installation, and other requirements.
1. Provide **[labels] [and] [certificates]** from AWI certification program indicating that paneling[, **including installation,**] complies with requirements of grades specified.
 2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.
- B. Regional Materials: Paneling shall be manufactured within **500 miles** (800 km) of Project site.
1. Composite wood materials used for paneling shall be manufactured within **500 miles** (800 km) of Project site from materials that have been extracted, harvested, or recovered within **500 miles** (800 km) of Project site.
 2. Veneers used for paneling shall be manufactured within **500 miles** (800 km) of Project site from materials that have been extracted, harvested, or recovered within **500 miles** (800 km) of Project site.
 3. Lumber used for paneling shall be manufactured within **500 miles** (800 km) of Project site from materials that have been extracted, harvested, or recovered within **500 miles** (800 km) of Project site.

2.4 STILE AND RAIL WOOD PANELING FOR TRANSPARENT FINISH

- A. Grade: Premium.
- B. Certified Wood: Wood and composite wood components of stile and rail paneling for transparent finish shall be certified as "FSC Pure"[**or "FSC Mixed Credit"**] according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

- C. Wood Species: [**White oak, rift sawn/sliced**] [**Figured English ash, quarter sawn/sliced**] [**Butternut, plain sawn/sliced**] [**Figured red gum, plain-sawn/sliced panels, quarter-sawn/sliced stiles and rails**] <Insert species and cut>.
- D. Stiles and Rails: At fabricator's option, stiles and rails may be either lumber or veneered construction with edges banded or with lumber moldings, as indicated, to conceal core and veneer joints.
- E. Panels: [**Flat panels**] [**Raised panels with veneered faces and solid-lumber rims**] [**Raised panels with veneered faces extending across rims**] [**Raised panels made from edge-glued solid lumber**].
- F. Insert Panels: Blueprint matched in a horizontal sequence for adjacent panels and doors, with continuous vertical matching between adjacent panels. [**Book and balance**] [**Book, balance, and center**] match face-veneer leaves within each panel.
1. Refer to Section 012100 "Allowances" for allowances covering purchase of wood face veneers for stile and rail paneling.
 2. Refer to Section 011000 "Summary" for requirements concerning fitches reserved by DEN Project Manager.
- G. Insert Panels: Cut panels from premanufactured, sequence-matched sets of book-matched veneered panels. Cut panels with an [**even**] [**even or odd**] number of veneer leaves centered in each panel[**and with each of the remainders at least half as wide as the full veneer leaves**]. Cut panels with continuous matching between vertically adjacent panels; veneer leaves of upper panels are continuations of veneer leaves of panels below them.
- H. Insert Panels: Book and balance match face veneers within panels. No matching is required between adjacent panels; select and arrange panels for similarity of grain pattern and color between adjacent panels.
- I. Shop assemble stile and rail paneling into largest units practical for delivery and installation. Provide shop-prepared detachable joints for necessary field connections. Sand and pull joints tight in shop so field joints will comply with joint tolerances for specified grade. Unless otherwise indicated, provide continuous mortise-and-tenon joints between panel units and provide removable temporary protection for joints during handling and delivery.
1. Outside Corner of Stile and Rail Paneling: Shop prepare using lock-mitered[**or mitered-and-splined**] construction. Assemble, sand, and glue in shop if site conditions permit.
- 2.5 STILE AND RAIL WOOD PANELING FOR OPAQUE FINISH
- A. Grade: Premium.
- B. Certified Wood: Wood and composite wood components of stile and rail paneling for opaque finish shall be certified as "FSC Pure"[**or "FSC Mixed Credit"**] according to

FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

- C. Wood Species: **[Any closed-grain hardwood] [Eastern white pine, ponderosa pine, sugar pine, or western white pine] <Insert species>**.
- D. Stiles and Rails: Either solid lumber or particleboard, shop filled on face, with veneered or lumber-banded edges, at paneling fabricator's option.
- E. Flat Insert Panels: Medium-density fiberboard or particleboard with shop-filled face.
- F. Raised Insert Panels: **[Medium-density overlaid softwood plywood (exterior), machined to profile indicated and shop filled on exposed machined surfaces] [Medium-density fiberboard, machined to profile indicated]**.
- G. Provide fire-retardant treatment of stile and rail paneling as indicated below. For components of paneling fabricated from solid lumber, mill pieces before treatment.
 - 1. Stiles and Rails: **[Fire-retardant-treated lumber] [fire-retardant medium-density fiberboard] [or] [fire-retardant particleboard with fire-retardant lumber edge bands]**.
 - 2. Insert Panels: **[Fire-retardant medium-density fiberboard] [or] [fire-retardant particleboard with closed-grain hardwood veneer on face and back]**.
- H. Shop assemble stile and rail paneling into largest units practical for delivery and installation. Provide shop-prepared detachable joints for necessary field connections. Sand and pull joints tight in shop so field joints will comply with joint tolerances for specified grade. Unless otherwise indicated, provide continuous mortise-and-tenon joints between panel units and provide removable temporary protection for joints during handling and delivery.
 - 1. Outside Corner of Stile and Rail Paneling: Shop prepare using lock-mitered[**or mitered-and-splined**] construction. Assemble, sand, and glue in shop if site conditions permit.

2.6 MATERIALS

- A. Materials, General: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.
- B. Wood Moisture Content: **[5 to 10] [4 to 9]** percent.
- C. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.
 - 1. Recycled Content of Medium-Density Fiberboard and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.

2. Composite Wood and Agrifiber Products: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
3. Medium-Density Fiberboard: ANSI A208.2, [**Grade 130**] <Insert grade>[, **made with binder containing no urea formaldehyde**].
4. Particleboard: ANSI A208.1, [**Grade M-2**] [**Grade M-2, made with binder containing no urea formaldehyde**] [**Grade M-2-Exterior Glue**].
5. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Environ Biocomposites Manufacturing LLC; Biofiber Wheat.
 - 2) Sorm Incorporated; Primeboard Premium Wheat.
 - 3) <Insert manufacturer's name; product name or designation>.
 - 4) or approved equal.
6. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1[, **made with adhesive containing no urea formaldehyde**].

D. Adhesives: Do not use adhesives that contain urea formaldehyde.

E. Adhesives: Use adhesives that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.7 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

1. Use treated materials that comply with requirements of referenced woodworking standard. Do not use materials that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant

progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 feet** (3.2 m) beyond the centerline of the burners at any time during the test.

1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
2. For items indicated to receive a stained or natural finish, use organic resin chemical formulation.
3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
4. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.

C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.

1. For panels **3/4 inch** (19 mm) thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, **1600 psi** (11 MPa); modulus of elasticity, **300,000 psi** (2070 MPa); internal bond, **80 psi** (550 kPa); and screw-holding capacity on face and edge, **250 and 225 lbf** (1100 and 1000 N), respectively.
2. For panels **13/16 to 1-1/4 inches** (20 to 32 mm) thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, **1300 psi** (9 MPa); modulus of elasticity, **250,000 psi** (1720 MPa); linear expansion, 0.50 percent; and screw-holding capacity on face and edge, **250 and 175 lbf** (1100 and 780 N), respectively.
3. Products: Subject to compliance with requirements, provide one of the following:
 - a. Flakeboard Company Limited; Duraf Flake FR.
 - b. SierraPine; Encore FR.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.

D. Fire-Retardant Fiberboard: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Panel Source International, Inc., McKillican America, Inc.; Pyroblock Platinum.
 - b. SierraPine; Medite FR.
 - c. or approved equal.

2.8 INSTALLATION MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: [**Softwood or hardwood lumber**] [**Fire-retardant-treated softwood lumber**], kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls.
- C. VOC Limits for Installation Adhesives: Use products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Wood Glues: 30 g/L.
 - 2. Multipurpose Construction Adhesives: 70 g/L.
 - 3. Contact Adhesive: 80 g/L.
 - 4. Special-Purpose Contact Adhesive (contact adhesive that is used to bond melamine-covered board, metal, unsupported vinyl, rubber, or wood veneer **1/16 inch** (1.6 mm) or less in thickness to any surface): 250 g/L.

2.9 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Arrange paneling in shop or other suitable space in proposed sequence for examination by DEN Project Manager. Mark units with temporary sequence numbers to indicate position in proposed layout.
 - 1. Lay out one elevation at a time if approved by DEN Project Manager..
 - 2. Notify DEN Project Manager seven days in advance of the date and time when layout will be available for viewing.
 - 3. Provide lighting of similar type and level as that of final installation for viewing layout unless otherwise approved by DEN Project Manager.
 - 4. Rearrange paneling as directed by DEN Project Manager until layout is approved.
 - 5. Do not trim end units and other nonmodular-size units to less than modular size until after DEN Project Manager's approval of layout.[**Indicate trimming by masking edges of units with nonmarking material.**]
 - 6. Obtain DEN Project Manager's approval of layout before start of assembly. Mark units and Shop Drawings with assembly sequence numbers based on approved layout.
- C. Complete fabrication, including assembly[**and finishing**], to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify DEN Project Manager seven (7) days in advance of the dates and times paneling fabrication will be complete.
 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.
- D. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

2.10 SHOP FINISHING

- A. General: Finish paneling at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. General: Shop finish transparent-finished paneling at fabrication shop as specified in this Section. Refer to Section 099123 "Interior Painting" for field finishing of opaque-finished paneling.
- C. General: Drawings indicate paneling that is required to be shop finished. Finish such paneling at fabrication shop as specified in this Section. Refer to **[Section 099123 "Interior Painting"] [and] [Section 099300 "Staining and Transparent Finishing"]** for field finishing paneling not indicated to be shop finished.
- D. Shop Priming: Shop apply the prime coat including backpriming, if any, for **transparent-finished** paneling specified to be field finished. Refer to **[Section 099123 "Interior Painting"] [and] [Section 099300 "Staining and Transparent Finishing"]** for material and application requirements.
- E. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing paneling, as applicable to each unit of work.
1. Backpriming: Apply two coats of sealer or primer, compatible with finish coats, to concealed surfaces of paneling.
- F. Transparent Finish:
1. Grade: **[Premium] [Custom] [Same as item to be finished]**.
 2. Finish: System - 1, nitrocellulose lacquer.
 3. Finish: System - 2, precatalyzed lacquer.
 4. Finish: System - 3, postcatalyzed lacquer.
 5. Finish: System - 4, water-based latex acrylic.
 6. Finish: System - 5, conversion varnish.
 7. Finish: System - 6, synthetic penetrating oil.
 8. Finish: System - 7, catalyzed vinyl.

9. Finish: System - 8, water-based cross-linking acrylic.
10. Finish: System - 9, UV-curable acrylated epoxy, polyester, or urethane.
11. Finish: System - 10, water-based UV curable.
12. Finish: System - 11, catalyzed polyurethane.
13. Finish: System - 12, water-based polyurethane.
14. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
15. Staining: [**None required**] [**Match approved sample for color**] [**Match DEN Project Manager's sample**].
16. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
17. Filled Finish for Open-Grain Woods:[**After staining, apply wash-coat sealer and allow to dry.**] Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
18. Sheen: [**Flat, 15-30**] [**Satin, 31-45**] [**Semigloss, 46-60**] [**Gloss, 61-100**] gloss units measured on 60-degree gloss meter per ASTM D 523.

G. Opaque Finish:

1. Grade: [**Premium**] [**Custom**] [**Same as item to be finished**].
2. Finish: System - 1, nitrocellulose lacquer.
3. Finish: System - 2, precatalyzed lacquer.
4. Finish: System - 3, postcatalyzed lacquer.
5. Finish: System - 4, water-based latex acrylic.
6. Finish: System - 5, conversion varnish.
7. Finish: System - 7, catalyzed vinyl.
8. Finish: System - 8, water-based cross-linking acrylic.
9. Finish: System - 9, UV-curable acrylated epoxy, polyester, or urethane.
10. Finish: System - 10, water-based UV curable.
11. Finish: System - 11, catalyzed polyurethane.
12. Finish: System - 12, water-based polyurethane.
13. Finish: System - 13, catalyzed polyester.
14. Colors: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**].
15. Sheen: [**Flat, 15-30**] [**Satin, 31-45**] [**Semigloss, 46-60**] [**Gloss, 61-100**] gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition paneling to average prevailing humidity conditions in installation areas.
- B. Before installing paneling, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Grade: Install paneling to comply with same grade as paneling to be installed.
- B. Treated Wood: Handle, store, and install pressure treated wood in compliance with recommendations of chemical treatment manufacturer including those for adhesives, where required for installation.
- C. Install paneling level, plumb, true, and straight with no distortions. Shim as required with concealed shims. Install level and plumb to a tolerance of **1/8 inch in 96 inches** (3 mm in 2400 mm). Install with no more than **1/16 inch in 96-inch** (1.6 mm in 2400-mm) vertical cup or bow and **1/8 inch in 96-inch** (3 mm in 2400-mm) horizontal variation from a true plane.
- D. Scribe and cut paneling to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor paneling to supporting substrate with concealed panel-hanger clips. Do not use face fastening unless [**covered by trim**] [**otherwise indicated**].
- F. Complete finishing work specified in this Section to extent not completed at shop or before installation of paneling. Fill nail holes with matching filler where exposed.
 - 1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are applied in shop.
- G. Refer to [**Section 099123 "Interior Painting"**] [**and**] [**Section 099300 "Staining and Transparent Finishing"**] for final finishing of installed paneling.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective paneling, where possible, to eliminate defects; where not possible to repair, replace paneling. Adjust for uniform appearance.
- B. Clean paneling on exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 064213

SECTION 064216 - FLUSH WOOD PANELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Flush wood paneling (wood-veneer wall surfacing).
2. Wood furring, blocking, shims, and hanging strips for installing flush wood paneling unless concealed within other construction before paneling installation.
3. Shop finishing of flush wood paneling.

- B. Related Requirements:

1. Section 057000 "Decorative Metal" for metal reveals at wood paneling.
2. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing paneling and that are concealed within other construction before paneling installation.
3. Section 064213 "Stile and Rail Wood Paneling" for raised wood paneling.
4. Section 099300 "Staining and Transparent Finishing" for final finishing of installed paneling.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ALLOWANCES

- A. Veneer for paneling is part of veneer allowance. Allowance includes the cost of veneer that is wasted due to selection, cutting, and trimming.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]**
- B. **<Insert location>**.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product[, **including**] **[panel products]** **[adhesives]** **[fire-retardant-treated materials]** **[and]** **[finishing materials and processes]**.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
2. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured[**and regionally extracted and manufactured**] materials. Include statement indicating cost for each regionally manufactured material.
 - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
 - b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
4. Certificates for **[Credit MR 6]** **[Credit MR 7]**: Chain-of-custody certificates indicating that paneling complies with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.
5. Product Data for Credit IEQ 4.1: For installation adhesives, documentation including printed statement of VOC content.
6. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
7. Product Data for Credit IEQ 4.4: For composite wood products and fabrication adhesives, documentation indicating that products contain no urea formaldehyde.
8. Laboratory Test Reports for Credit IEQ 4.4: For composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Shop Drawings: Show location of paneling, large-scale details, attachment devices, and other components. Include dimensioned plans and elevations.
1. Show details full size.
 2. Show locations and sizes of furring and blocking, including concealed blocking specified in other Sections.
 3. For paneling produced from premanufactured sets, show finished panel sizes, set numbers, sequence numbers within sets, and method of cutting panels to produce indicated sizes.
 4. For paneling veneered in fabrication shop, show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
- D. Samples for Initial Selection:
1. Shop-applied transparent finishes.
 2. Shop-applied opaque finishes.
- E. Samples for Verification:
1. Lumber for transparent finish, not less than **[5 inches (125 mm) wide by 12 inches (300 mm) long] [5 inches (125 mm) wide by 24 inches (600 mm) long]**, for each species and cut, finished on one side and one edge.
 2. Veneer leaves representative of and selected from flitches to be used for transparent-finished paneling.
 3. Veneer-faced panel products for transparent finish, **[8 by 10 inches (200 by 250 mm)] [12 by 12 inches (300 by 300 mm)] [12 by 24 inches (300 by 600 mm)]**, for each species and cut. Include at least one face-veneer seam and finish as specified.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[Installer] [Fabricator]**.
- B. Product Certificates: For each type of product.
- C. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.
- D. Wall panel certificate: Submit certificate that wall panel backing adhesive and laminate comply with reference fire-resistance requirements.
- E. Certificate from the fabricator providing proof of not less than five (5) years experience in the fabrication of the types of products specified.
- F. Certificate from the installer providing proof of not less than five (5) years of successful experience in the installation of similar types of products and shall have completed at least 3 jobs of similar size and scope.
- ? Evaluation Reports: For **[fire-retardant-treated materials] [and]**

[fire-retardant-treated paneling], from ICC-ES.

- G. Maintenance Data: Submit manufacturer's care and maintenance data, including care and cleaning instructions.
- H. Provide warranty for two (2) years from date of final acceptance materials.

1.7 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.
- B. Installer Qualifications: **[Fabricator of products] [Certified participant in AWI's Quality Certification Program]** .
- C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockups of **[typical paneling as shown on Drawings]** <Insert **description**>.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Distribute copies of casework shop drawings to stainless steel supplier and coordinate fabrication and installation.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soiling, and deterioration.
- B. Do not deliver paneling until painting and similar operations that could damage paneling have been completed in installation areas. If paneling must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.10 FIELD CONDITIONS

- A. Conditioning: Woodwork Manufacturer and Installer shall advise Contractor of temperature and humidity requirements for woodwork installation and storage areas. Do not install woodwork until required temperature and relative humidity have been stabilized and will be maintained in installation areas.
- B. Maintain temperature and humidity in installation area as required to maintain moisture content of installed woodwork within a 1.0 percent tolerance of optimum moisture content, from date of installation through remainder of construction period. Require Woodwork Manufacturer to establish optimum moisture content and required temperature and humidity conditions.
- C. Environmental Limitations: Do not deliver or install paneling until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.
- D. Environmental Limitations: Do not deliver or install paneling until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature between **60 and 90 deg F** (16 and 32 deg C) and relative humidity between **[25 and 55] [17 and 50] <Insert humidity range>** percent during the remainder of the construction period.
- E. Field Measurements: Where paneling is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support paneling by field measurements before being enclosed and indicate measurements on Shop Drawings.
- F. Established Dimensions: Where paneling is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.11 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that paneling can be installed as indicated.

1.12 WARRANTY

- A. Warranty: Fabricator/installer to warrant for minimum two (2) **<Insert number>** years from date of final acceptance materials, fabrication, and installation of all items.

1.13 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 FABRICATION, GENERAL

- A. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber at time of fabrication and for relative humidity conditions in the installation areas.
- B. Fabricate woodwork to dimensions, profiles, and details indicated with openings and mortises precut, where possible, to receive hardware and other items and work.
- C. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- D. Pre Cut Openings: Fabricate architectural woodwork with precut openings, where possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately and use templates or roughing in diagrams for proper size and shape. Smooth edges of cutoffs and, where located in countertops and similar exposures seal edges of cutouts with a water resistant coating.
- E. Measurements: Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain field measurements and verify dimensions and shop drawing details as required for accurate fit.

2.2 PANELING FABRICATORS

- A. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of paneling **[and] [wood-veneer-faced architectural cabinets] [ornamental woodwork] [wood trim] [wood frames] [and] [wood doors faced with veneers from same flitches as paneling]**.
- B. Fabricators: Subject to compliance with requirements, provide products by one of the following:
 - 1. **<Insert, in separate subparagraphs, names and possibly contact information for preapproved woodworking firms>**.
 - 2. or approved equal.

2.3 PANELING, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of flush wood paneling (wood-veneer wall surfacing) indicated for construction, finishes, installation, and other requirements.
1. Provide **[labels] [and] [certificates]** from **AWI** certification program indicating that paneling[, **including installation,**] complies with requirements of grades specified.
 2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.
- B. Regional Materials: Paneling shall be manufactured within **500 miles** (800 km) of Project site.
1. Composite wood materials used for paneling shall be manufactured within **500 miles** (800 km) of Project site from materials that have been extracted, harvested, or recovered within **500 miles** (800 km) of Project site.
 2. Veneers used for paneling shall be manufactured within **500 miles** (800 km) of Project site from materials that have been extracted, harvested, or recovered within **500 miles** (800 km) of Project site.
 3. Lumber used for paneling shall be manufactured within **500 miles** (800 km) of Project site from materials that have been extracted, harvested, or recovered within **500 miles** (800 km) of Project site.

2.4 FLUSH WOOD PANELING (WOOD-VENEER WALL SURFACING)

- A. Grade: **[Premium] [Custom]**.
- B. Certified Wood: Wood and composite wood components of flush wood paneling shall be certified as "FSC Pure"[**or "FSC Mixed Credit"**] according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- C. Wood Species and Cut: **[White oak, rift sliced] [Select white ash, plain sliced] [Sycamore, plain sliced] [Cherry, plain sliced] [Butternut, plain sliced] [Avodire, quarter sliced] <Insert species and cut>**.
- D. Matching of Adjacent Veneer Leaves: **[Book] [Slip]** match.
- E. Matching within Panel Face: **[Running] [Balance] [Center-balance]** match.
- F. Matching of Adjacent Veneer Leaves and within Panel Face: Slip, center, book match.
- G. Panel-Matching Method: No matching is required between panels. Select and arrange panels for similarity of grain pattern and color between adjacent panels.

- H. Panel-Matching Method: **[Premanufactured panel sets used full width]** **[Premanufactured panel sets selectively reduced in width]** **[Made-to-order, sequence-matched panels]** **[Made-to-order, blueprint-matched panels and components]** within each separate area.
1. Refer to Section 011000 "Summary" for requirements concerning flitches reserved by DEN Project Manager.
- I. Vertical Panel-Matching Method: **[Continuous end match; veneer leaves of upper panels are continuations of veneer leaves of lower panels]** **[Architectural end book match; veneer leaves are individually book matched from lower panels to upper panels]** **[Architectural end slip match; veneer leaves are individually slip matched from lower panels to upper panels]** **[Panel end book match; panels are book matched from lower panels to upper panels]** **[Panel end slip match; panels are slip matched from lower panels to upper panels]**.
- J. Panel Core Construction: **[Hardwood veneer-core plywood]** **[Particleboard or medium-density fiberboard]** **[Fire-retardant particleboard or fire-retardant, medium-density fiberboard]**.
1. Thickness: **[3/4 inch (19 mm)]** **[As indicated]**.
- K. Exposed Panel Edges: **[Inset solid-wood or wood-veneer matching faces]** **[Legs of metal channels forming reveals]** **[Applied solid-wood banding 11/16 inch (18 mm) thick by depth of panels]** **[Applied bronze flat bars 1/16 inch (1.6 mm) thick by depth of panels]** <Insert description>.
- L. Panel Reveals: **[Matte black plastic laminate]** **[Bronze sheet]** **[Stainless-steel sheet]** **[Bronze channels, 1 by 1 by 1/8 inch (25.4 by 25.4 by 3.2 mm) thick]** **[Stainless-steel channels, 1 by 1 by 1/16 inch (25.4 by 25.4 by 1.6 mm) thick]** <Insert description>.
- M. Fire-Retardant-Treated Paneling: Panels shall consist of wood-veneer and fire-retardant particleboard or fire-retardant, medium-density fiberboard. Panels shall have a flame-spread index of **25** or less and a smoke-developed index of 450 or less per ASTM E 84 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
- N. Assemble panels by gluing and concealed fastening.

2.5 MATERIALS

- A. Materials, General: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.
- B. Wood Moisture Content: **[5 to 10]** **[4 to 9]** percent.
- C. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.

1. Recycled Content of Medium-Density Fiberboard and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
2. Composite Wood and Agrifiber Products: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
3. Medium-Density Fiberboard: ANSI A208.2, [**Grade 130**] **<Insert grade>**[, **made with binder containing no urea formaldehyde**].
4. Particleboard: ANSI A208.1, [**Grade M-2**] [**Grade M-2, made with binder containing no urea formaldehyde**] [**Grade M-2-Exterior Glue**].
5. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Environ Biocomposites Manufacturing LLC; Biofiber Wheat.
 - 2) Sorm Incorporated; Primeboard Premium Wheat.
 - 3) **<Insert manufacturer's name; product name or designation>**.
 - 4) or approved equal.
6. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1[, **made with adhesive containing no urea formaldehyde**].

D. STAINLESS STEEL

1. Bar Stock: ASTM A 276, Type 302 or 304.
2. Plate: ASTM A 167, Type 302 or 304.
3. Stainless steel finish: AISI number 4, brushed, directional with grain oriented along the length of the material or vertical on planar surfaces or as denoted by the DEN Project Manager.
4. Gauge: As noted on drawings.
5. Fasteners: Stainless steel, conceal to greatest extent possible.
6. Hinges: Stainless steel, concealed from view.
7. Comply with Section 057000 "Decorative Metal" for metal reveals at wood paneling.

E. Adhesives: Do not use adhesives that contain urea formaldehyde.

F. Adhesives: Use adhesives that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable

to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

1. Use treated materials that comply with requirements of referenced woodworking standard. Do not use materials that are warped, discolored, or otherwise defective.
 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 feet** (3.2 m) beyond the centerline of the burners at any time during the test.
1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
 2. For items indicated to receive a stained or natural finish, use organic resin chemical formulation.
 3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
 4. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
- C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.
1. For panels **3/4 inch** (19 mm) thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, **1600 psi** (11 MPa); modulus of elasticity, **300,000 psi** (2070 MPa); internal bond, **80 psi** (550 kPa); and screw-holding capacity on face and edge, **250 and 225 lbf** (1100 and 1000 N), respectively.
 2. For panels **13/16 to 1-1/4 inches** (20 to 32 mm) thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, **1300 psi** (9 MPa); modulus of elasticity, **250,000 psi** (1720 MPa); linear expansion, 0.50 percent; and screw-holding capacity on face and edge, **250 and 175 lbf** (1100 and 780 N), respectively.
 3. Products: Subject to compliance with requirements, provide one of the following:
 - a. Flakeboard Company Limited; Duraf Flake FR.

- b. SierraPine; Encore FR.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
- D. Fire-Retardant Fiberboard: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Panel Source International, Inc., McKillican America, Inc.; Pyroblock Platinum.
 - b. SierraPine; Medite FR.
 - c. **<Insert manufacturer's name>**
 - d. or approved equal.

2.7 INSTALLATION MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: [**Softwood or hardwood lumber**] [**Fire-retardant-treated softwood lumber**], kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls.
- C. VOC Limits for Installation Adhesives: Use products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Wood Glues: 30 g/L.
 - 2. Multipurpose Construction Adhesives: 70 g/L.
 - 3. Contact Adhesive: 80 g/L.
 - 4. Special-Purpose Contact Adhesive (contact adhesive that is used to bond melamine covered board, metal, unsupported vinyl, rubber, or wood veneer **1/16 inch** (1.6 mm) or less in thickness to any surface): 250 g/L.

2.8 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Arrange paneling in shop or other suitable space in proposed sequence for examination by DEN Project Manager. Mark units with temporary sequence numbers to indicate position in proposed layout.
 - 1. Lay out one elevation at a time if approved by DEN Project Manager.

2. Notify DEN Project Manager seven (7) days in advance of the date and time when layout will be available for viewing.
 3. Provide lighting of similar type and level as that of final installation for viewing layout unless otherwise approved by DEN Project Manager.
 4. Rearrange paneling as directed by DEN Project Manager until layout is approved.
 5. Do not trim end units and other nonmodular-size units to less than modular size until after DEN Project Manager's approval of layout. [**Indicate trimming by masking edges of units with nonmarking material.**]
 6. Obtain DEN Project Manager approval of layout before start of assembly. Mark units and Shop Drawings with assembly sequence numbers based on approved layout.
- C. Complete fabrication, including assembly [**and finishing**], to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
1. Notify DEN Project Manager seven (7) days in advance of the dates and times paneling fabrication will be complete.
- D. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

2.9 SHOP FINISHING

- A. General: Finish paneling at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. Shop Priming: Shop apply the prime coat including backpriming for [**transparent-finished**] paneling specified to be field finished. Refer to Section 099300 "Staining and Transparent Finishing" for material and application requirements.
- C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing paneling, as applicable to each unit of work.
1. Backpriming: Apply two coats of sealer or primer, compatible with finish coats, to concealed surfaces of paneling.
- D. Transparent Finish:
1. Grade: [**Premium**] [**Custom**] [**Same as item to be finished**].
 2. Finish: System - 1, nitrocellulose lacquer.
 3. Finish: System - 2, precatalyzed lacquer.
 4. Finish: System - 3, postcatalyzed lacquer.
 5. Finish: System - 4, water-based latex acrylic.

6. Finish: System - 5, conversion varnish.
7. Finish: System - 6, synthetic penetrating oil.
8. Finish: System - 7, catalyzed vinyl.
9. Finish: System - 8, water-based cross-linking acrylic.
10. Finish: System - 9, UV-curable acrylated epoxy, polyester, or urethane.
11. Finish: System - 11, catalyzed polyurethane.
12. Finish: System - 10, water-based UV curable.
13. Finish: System - 12, water-based polyurethane.
14. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
15. Staining: **[None required] [Match approved sample for color] [Match DEN Project Manager's sample]**.
16. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
17. Filled Finish for Open-Grain Woods: **[After staining, apply wash-coat sealer and allow to dry.]** Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
18. Sheen: **[Flat, 15-30] [Satin, 31-45] [Semigloss, 46-60] [Gloss, 61-100]** gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition paneling to average prevailing humidity conditions in installation areas.
- B. Before installing paneling, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Grade: Install paneling to comply with same grade as paneling to be installed.
- B. Treated Wood: Handle, store, and install pressure treated wood in compliance with recommendations of chemical treatment manufacturer including those for adhesives, where required for installation.
- C. Install paneling level, plumb, true, and straight with no distortions. Shim as required with concealed shims. Install level and plumb to a tolerance of **1/8 inch in 96 inches** (3 mm in 2400 mm). Install with no more than **1/16 inch in 96-inch** (1.6 mm in 2400-mm) vertical cup or bow and **1/8 inch in 96-inch** (3 mm in 2400-mm) horizontal variation from a true plane.
 1. For flush paneling with revealed joints, install with variations in reveal width, alignment of top and bottom edges, and flushness between adjacent panels not exceeding **[1/32 inch (0.8 mm)] [1/16 inch (1.5 mm)]**.

- D. Anchor paneling to supporting substrate with concealed panel-hanger clips. Do not use face fastening unless [**covered by trim**] [**otherwise indicated**].
- E. Complete finishing work specified in this Section to extent not completed at shop or before installation of paneling. Fill nail holes with matching filler where exposed.
 - 1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are applied in shop.
- F. Refer to Section 099300 "Staining and Transparent Finishing" for final finishing of installed paneling.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective paneling, where possible, to eliminate defects; where not possible to repair, replace paneling. Adjust for uniform appearance.
- B. Clean paneling on exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 064216

SECTION 064219 - PLASTIC-LAMINATE-FACED WOOD PANELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Plastic-laminate-faced wood paneling (decorative laminate surfacing).
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced wood paneling unless concealed within other construction before paneling installation.

- B. Related Requirements:

1. Section 057000 "Decorative Metal" for metal reveals at plastic-laminate-faced wood paneling.
2. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing paneling and that are concealed within other construction before paneling installation.
3. Section 064213 "Stile and Rail Wood Paneling" for raised wood paneling.
4. Section 064216 "Flush Wood Paneling" for flush wood paneling.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DIA Project Manager] <Insert location>**.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product[, **including**] **[panel products] [high-pressure decorative laminate] [adhesives] [and] [fire-retardant-treated materials]**.
 1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
 2. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured[**and regionally extracted and manufactured**] materials. Include statement indicating cost for each regionally manufactured material.
 - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
 - b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
4. Certificates for [**Credit MR 6**] [**Credit MR 7**]: Chain-of-custody certificates indicating that paneling complies with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.
5. Product Data for Credit IEQ 4.1: For installation adhesives, documentation including printed statement of VOC content.
6. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
7. Laboratory Test Reports for Credit IEQ 4.4: For composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: Show location of paneling, large-scale details, attachment devices, and other components. Include dimensioned plans and elevations.

1. Show details full size.
2. Show locations and sizes of furring and blocking, including concealed blocking specified in other Sections.

D. Samples for initial selection for high-pressure decorative laminates.

- E. Samples for verification for plastic laminates, **[8 by 10 inches (200 by 250 mm)] [12 by 12 inches (300 by 300 mm)]**, for each type, color, pattern, and surface finish[, **with one sample applied to core material] [and specified edge material applied to one edge]**.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[Installer] [Fabricator]**.
- B. Product Certificates: For each type of product.
- C. Quality Certification: Submit woodwork Manufacturer's (Fabricator's) certification, stating that fabricated woodwork complies with quality grades and other requirements indicated.
- D. Wall panel certificate: Submit certificate that wall panel backing adhesive and laminate comply with reference fire-resistance requirements.
- E. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.
- F. Certificate from the fabricator providing proof of not less than 5 years experience in the fabrication of the types of products specified.
- G. Certificate from the installer providing proof of not less than 5 years of successful experience in the installation of similar types of products and shall have completed at least 3 jobs of similar size and scope.
- H. Evaluation Reports: For **[fire-retardant-treated materials] [and] [fire-retardant-treated paneling]**, from ICC-ES.
- I. Maintenance Data: Submit manufacturer's care and maintenance data, including care and cleaning instructions.
- J. Provide warranty for two (2) years from date of final acceptance materials, fabrication, and installation of all items.

1.6 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality

Certification Program.

- B. Installer Qualifications: [**Fabricator of products**] [**Certified participant in AWI's Quality Certification Program**] .
- C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockups of [**typical paneling as shown on Drawings**] <Insert **description**>.
 - 2. Mock-up a minimum 200 sq. ft. of plastic laminate faced wall panel. Demonstrate panel removal to the DIA Project Manager.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Distribute copies of shop drawings to stainless steel supplier and coordinate fabrication and installation.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soiling, and deterioration.
- B. Do not deliver paneling until painting and similar operations that could damage paneling have been completed in installation areas. If paneling must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.9 FIELD CONDITIONS

- A. Conditioning: Woodwork Manufacturer and Installer shall advise Contractor of temperature and humidity requirements for woodwork installation and storage areas. Do not install woodwork until required temperature and relative humidity have been stabilized and will be maintained in installation areas.
- B. Maintain temperature and humidity in installation area as required to maintain moisture content of installed woodwork within a 1.0 percent tolerance of optimum moisture content, from date of installation through remainder of construction period. Require Woodwork Manufacturer to establish optimum moisture content and required temperature and humidity conditions.
- C. Environmental Limitations: Do not deliver or install paneling until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature

and relative humidity at occupancy levels during the remainder of the construction period.

- D. Environmental Limitations: Do not deliver or install paneling until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature between **60 and 90 deg F** (16 and 32 deg C) and relative humidity between **[25 and 55] [17 and 50]** <Insert humidity range> percent during the remainder of the construction period.
- E. Field Measurements: Where paneling is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support paneling by field measurements before being enclosed and indicate measurements on Shop Drawings.
- F. Established Dimensions: Where paneling is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.10 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that paneling can be installed as indicated.

1.11 WARRANTY

- A. Warranty: Fabricator/installer to warrant for minimum two (2) <Insert number> years from date of final acceptance materials, fabrication, and installation of all items.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 FABRICATION, GENERAL

- A. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber at time of fabrication and for relative humidity conditions in

the installation areas.

- B. Fabricate woodwork to dimensions, profiles, and details indicated with openings and mortises precut, where possible, to receive hardware and other items and work.
- C. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- D. Pre Cut Openings: Fabricate architectural woodwork with precut openings, where possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately and use templates or roughing in diagrams for proper size and shape. Smooth edges of cutoffs and, where located in countertops and similar exposures seal edges of cutouts with a water resistant coating.
- E. Measurements: Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain field measurements and verify dimensions and shop drawing details as required for accurate fit.

2.2 PANELING FABRICATORS

- A. Fabricators: Subject to compliance with requirements, provide products by one of the following:
 - 1. **<Insert, in separate subparagraphs, names and possibly contact information for preapproved woodworking firms>.**
 - 2. or approved equal.

2.3 PANELING, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of plastic-laminate-faced wood paneling (decorative laminate surfacing) indicated for construction, finishes, installation, and other requirements.
 - 1. Provide **[labels] [and] [certificates]** from AWI certification program indicating that paneling[, **including installation,**] complies with requirements of grades specified.
 - 2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.
- B. Regional Materials: Paneling shall be manufactured within **500 miles** (800 km) of Project site.
 - 1. Composite wood materials used for paneling shall be manufactured within **500 miles** (800 km) of Project site from materials that have been extracted, harvested,

- or recovered within **500 miles** (800 km) of Project site.
2. Lumber used for paneling shall be manufactured within **500 miles** (800 km) of Project site from materials that have been extracted, harvested, or recovered within **500 miles** (800 km) of Project site.

2.4 PLASTIC-LAMINATE-FACED WOOD PANELING

- A. Grade: [**Premium**] [**Custom**] [**Economy**].
- B. Certified Wood: Wood and composite wood components of plastic-laminate-clad flush paneling shall be certified as "FSC Pure"[or "**FSC Mixed Credit**"] according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- C. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3 and the following requirements:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Abet Laminati, Inc.
 - b. Arborite; Division of ITW Canada, Inc.
 - c. Formica Corporation.
 - d. Lamin-Art, Inc.
 - e. Panolam Industries International Incorporated.
 - f. Wilsonart International.
 - g. <**Insert manufacturer's name**>.
 - h. or approved equal.
 2. Faces: [**Grade SGF**] [**Grade HGS**] [**Grade HGF**] .
 3. Backs: [**Grade BKH**] [**Grade BKV**] [**Grade VGF**] .
 4. Exposed Edges: Same as faces.
- D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed surfaces complying with the following requirements:
 1. As indicated by manufacturer's designations.
 2. Match DIA Project Manager's samples.
 3. As selected by DIA Project Manager from laminate manufacturer's full range in the following categories:
 - a. Solid colors, [**gloss**] [**matte**] finish.
 - b. Solid colors with core same color as surface, [**gloss**] [**matte**] finish.
 - c. Wood grains, [**gloss**] [**matte**] finish.
 - d. Patterns, [**gloss**] [**matte**] finish.
 4. Grain Direction: [**Vertical**] [**Horizontal**].
- E. Panel Core: [**Particleboard or medium-density fiberboard**] [**Fire-retardant particleboard or fire-retardant, medium-density fiberboard**].

1. Thickness: [**3/4 inch (19 mm)**] [**As indicated**].
- F. Exposed Panel Edges: [**Plastic-laminate matching faces**] [**Legs of metal channels forming reveals**] [**Applied solid-wood banding 11/16 inch (18 mm) thick by depth of panels**] [**Applied bronze flat bars 1/16 inch (1.6 mm) thick by depth of panels**] <Insert description>.
- G. Panel Reveals: [**Matte black plastic laminate**] [**Bronze sheet**] [**Stainless-steel sheet**] [**Bronze channels, 1 by 1 by 1/8 inch (25.4 by 25.4 by 3.2 mm) thick**] [**Stainless-steel channels, 1 by 1 by 1/16 inch (25.4 by 25.4 by 1.6 mm) thick**] <Insert description>.
- H. Adhesives for Bonding Plastic Laminate: [**Unpigmented contact cement**] [**Contact cement**] [**PVA**] [**Urea formaldehyde**] [**Resorcinol**].
 1. Adhesive for Bonding Edges: Hot-melt adhesive[**or adhesive specified above for faces**].
- I. Fire-Retardant-Treated Paneling: Panels shall consist of fire-retardant plastic laminate and fire-retardant particleboard or fire-retardant, medium-density fiberboard. Panels shall have a flame-spread index of [**25**] or less and a smoke-developed index of 450 or less per ASTM E 84 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
- J. Assemble panels by gluing and concealed fastening.

2.5 MATERIALS

- A. Materials, General: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.
- B. Wood Moisture Content: [**5 to 10**] [**4 to 9**] percent.
- C. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.
 1. Recycled Content of Medium-Density Fiberboard and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent.
 2. Composite Wood and Agrifiber Products: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 3. Medium-Density Fiberboard: ANSI A208.2, [**Grade 130**] <Insert grade>[, **made with binder containing no urea formaldehyde**].
 4. Particleboard: ANSI A208.1, [**Grade M-2**] [**Grade M-2, made with binder containing no urea formaldehyde**] [**Grade M-2-Exterior Glue**].

5. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Environ Biocomposites Manufacturing LLC; Biofiber Wheat.
 - 2) Sorm Incorporated; Primeboard Premium Wheat.
 - 3) **<Insert manufacturer's name; product name or designation>**.
 - 4) or approved equal.

D. STAINLESS STEEL

1. Bar Stock: ASTM A 276, Type 302 or 304.
2. Plate: ASTM A 167, Type 302 or 304.
3. Stainless steel finish: AISI number 4, brushed, directional with grain oriented along the length of the material or vertical on planar surfaces or as denoted by the DIA Project Manager.
4. Gauge: As noted on drawings.
5. Fasteners: Stainless steel, conceal to greatest extent possible.
6. Hinges: Stainless steel, concealed from view.
7. Reference Section 057000 "Decorative Metal" for metal reveals at wood paneling.

E. Adhesives: Do not use adhesives that contain urea formaldehyde.

F. Adhesives: Use adhesives that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

1. Use treated materials that comply with requirements of referenced woodworking standard. Do not use materials that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

- B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 feet** (3.2 m) beyond the centerline of the burners at any time during the test.
1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
 2. For items indicated to receive a stained or natural finish, use organic resin chemical formulation.
 3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
 4. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
- C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.
1. For panels **3/4 inch** (19 mm) thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, **1600 psi** (11 MPa); modulus of elasticity, **300,000 psi** (2070 MPa); internal bond, **80 psi** (550 kPa); and screw-holding capacity on face and edge, **250 and 225 lbf** (1100 and 1000 N), respectively.
 2. For panels **13/16 to 1-1/4 inches** (20 to 32 mm) thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, **1300 psi** (9 MPa); modulus of elasticity, **250,000 psi** (1720 MPa); linear expansion, 0.50 percent; and screw-holding capacity on face and edge, **250 and 175 lbf** (1100 and 780 N), respectively.
 3. Products: Subject to compliance with requirements, provide one of the following:
 - a. Flakeboard Company Limited; Duraf Flake FR.
 - b. SierraPine; Encore FR.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
- D. Fire-Retardant Fiberboard: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Panel Source International, Inc., McKillican America, Inc.; Pyroblock Platinum.
 - b. SierraPine; Medite FR.

- c. <Insert manufacturer>
- d. or approved equal.

2.7 INSTALLATION MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: [**Softwood or hardwood lumber**] [**Fire-retardant-treated softwood lumber**], kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls.
- C. VOC Limits for Installation Adhesives: Use products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Wood Glues: 30 g/L.
 - 2. Multipurpose Construction Adhesives: 70 g/L.
 - 3. Contact Adhesive: 80 g/L.
 - 4. Special-Purpose Contact Adhesive (contact adhesive that is used to bond melamine-covered board, metal, unsupported vinyl, rubber, or wood veneer **1/16 inch** (1.6 mm) or less in thickness to any surface): 250 g/L.

2.8 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Complete fabrication, including assembly, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify DIA Project Manager seven (7) days in advance of the dates and times paneling fabrication will be complete.
- C. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition paneling to average prevailing humidity conditions in installation areas.
- B. Before installing paneling, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Grade: Install paneling to comply with same grade as paneling to be installed.
- B. Treated Wood: Handle, store, and install pressure treated wood in compliance with recommendations of chemical treatment manufacturer including those for adhesives, where required for installation.
- C. Install paneling level, plumb, true, and straight with no distortions. Shim as required with concealed shims. Install level and plumb to a tolerance of **1/8 inch in 96 inches** (3 mm in 2400 mm). Install with no more than **1/16 inch in 96-inch** (1.6 mm in 2400-mm) vertical cup or bow and **1/8 inch in 96-inch** (3 mm in 2400-mm) horizontal variation from a true plane.
 - 1. For flush paneling with revealed joints, install with variations in reveal width, alignment of top and bottom edges, and flushness between adjacent panels not exceeding **1/32 inch (0.8 mm)** [**1/16 inch (1.5 mm)**].
- D. Anchor paneling to supporting substrate with concealed panel-hanger clips. Do not use face fastening unless **[covered by trim]** **[otherwise indicated]**.
- E. Installing Stainless Steel Items:
 - 1. Coordinate work with work by other trades.
 - 2. Comply with the intent of details.
 - 3. External corners: Ease 1/32" unless otherwise noted.
 - 4. Anchor all items securely. Adhere stainless steel to plywood where indicated per Manufacturer's recommendations.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective paneling, where possible, to eliminate defects; where not possible to repair, replace paneling. Adjust for uniform appearance.
- B. Clean paneling on exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 064219

SECTION 064400 - ORNAMENTAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Exterior ornamental woodwork.
2. Interior ornamental woodwork.
3. Wood furring, blocking, shims, and hanging strips for installing ornamental work items unless concealed within other construction before woodwork installation.
4. Shop priming of exterior ornamental woodwork.
5. Shop priming of interior ornamental woodwork.
6. Shop finishing of exterior ornamental woodwork.
7. Shop finishing of interior ornamental woodwork.

- B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing ornamental woodwork and concealed within other construction before ornamental woodwork installation.
2. Section 062023 "Interior Finish Carpentry" for interior carpentry exposed to view that is not specified in this Section.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] <[location and time as determined by DEN Project Manager] Insert location>**.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product[, **including**] **[panel products]** **[fire-retardant-treated materials]** **[and]** **[finishing materials and processes]**.

1. Include data for wood-preservative treatment from chemical-treatment

- manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical-treatment manufacturer's written instructions for finishing treated material.
2. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
 3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 4. Include copies of warranties from chemical-treatment manufacturers for each type of treatment.
 5. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured[**and regionally extracted and manufactured**] materials. Include statement indicating cost for each regionally manufactured material.
 - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
 - b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
4. Certificates for [**Credit MR 6**] [**Credit MR 7**]: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.
5. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
6. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that products contain no urea formaldehyde.
7. Laboratory Test Reports for Credit IEQ 4.4: For composite wood products, documentation indicating that products comply with the testing and product

requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
1. Show details full size.
 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 3. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
 4. Apply AWI Quality Certification Program label to Shop Drawings.
- D. Samples for Initial Selection:
1. Shop-applied transparent finishes.
 2. Shop-applied opaque finishes.
- E. Samples for Verification:
1. Lumber for exterior wood-stain finish, not less than **5 inches** (125 mm) wide by **12 inches** (300 mm) long, for each species, with one-half of exposed surface finished.
 2. Lumber for transparent finish, not less than [**5 inches** (125 mm) wide by **12 inches** (300 mm) long] [**5 inches** (125 mm) wide by **24 inches** (600 mm) long], for each species and cut, finished on one side and one edge.
 3. Veneer leaves representative of and selected from flitches to be used for transparent-finished ornamental woodwork.
 4. Lumber and panel products with shop-applied opaque finish, **5 inches** (125 mm) wide by **12 inches** (300 mm) long for lumber and [**8 by 10 inches** (200 by 250 mm)] [**12 by 12 inches** (300 by 300 mm)] for panels, for each finish system and color, with [**one-half of**] exposed surface finished.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For [**Installer**] [**fabricator**].
- B. Quality Certification: Submit woodwork Manufacturer's (Fabricator's) certification, stating that fabricated woodwork complies with quality grades and other requirements indicated.
- C. Product Certificates: For [**each type of product.**] [**the following:**]
1. Composite wood and agrifiber products.
 2. Adhesives.
- D. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

- E. Certificate from the fabricator providing proof of not less than five (5) years experience in the fabrication of the types of products specified.
- F. Certificate from the installer providing proof of not less than five (5) years of successful experience in the installation of similar types of products and shall have completed at least 3 jobs of similar size and scope.
- G. Evaluation Reports: For [**wood-preserved-treated wood**] [**and**] [**fire-retardant-treated materials**], from ICC-ES.

1.6 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.
- B. Installer Qualifications: [**Fabricator of products**] [**Certified participant in AWI's Quality Certification Program**].
- C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
- D. Warranty: Fabricator/installer to warrant for two (2) years from date of final acceptance materials, fabrication, and installation of all items.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soiling and deterioration.
- B. Do not deliver interior ornamental woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If ornamental woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.9 FIELD CONDITIONS

- A. Conditioning: Woodwork Manufacturer and Installer shall advise Contractor of temperature and humidity requirements for woodwork installation and storage areas. Do not install woodwork until required temperature and relative humidity have been stabilized and will be maintained in installation areas.
- B. Maintain temperature and humidity in installation area as required to maintain moisture content of installed woodwork within a 1.0 percent tolerance of optimum moisture content, from date of installation through remainder of construction period. Require Woodwork Manufacturer to establish optimum moisture content and required temperature and humidity conditions.
- C. Weather Limitations for Exterior Work: Proceed with installation of exterior ornamental woodwork only when existing and forecasted weather conditions permit work to be performed and at least one coat of specified finish to be applied without exposure to rain, snow, or dampness.
- D. Environmental Limitations for Interior Work: Do not deliver or install interior ornamental woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- E. Environmental Limitations for Interior Work: Do not deliver or install interior ornamental woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between **60 and 90 deg F** (16 and 32 deg C) and relative humidity between **[25 and 55] [17 and 50] <Insert humidity range>** percent during the remainder of the construction period.
- F. Field Measurements: Where ornamental woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
- G. Established Dimensions: Where ornamental woodwork is indicated to fit to other construction, establish field dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.10 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that ornamental woodwork can be supported and installed as indicated.

1.11 WARRANTY

- A. Provide warranty for minimum two (2) **<Insert number>** years from date of final acceptance of materials, fabrication, and installation of all items.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 FABRICATION, GENERAL

- A. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber at time of fabrication and for relative humidity conditions in the installation areas.
- B. Fabricate woodwork to dimensions, profiles, and details indicated with openings and mortises precut, where possible, to receive hardware and other items and work.
- C. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- D. Pre Cut Openings: Fabricate architectural woodwork with precut openings, where possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately and use templates or roughing in diagrams for proper size and shape. Smooth edges of cutoffs and, where located in countertops and similar exposures seal edges of cutouts with a water resistant coating.
- E. Measurements: Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain field measurements and verify dimensions and shop drawing details as required for accurate fit.

2.2 ORNAMENTAL WOODWORK FABRICATORS

- A. Fabricators: Subject to compliance with requirements, provide products by one of the following:
 - 1. **<Insert, in separate subparagraphs, names and possibly contact information for preapproved woodworking firms>**.
 - 2. or approved equal.

2.3 ORNAMENTAL WOODWORK, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of ornamental woodwork indicated for construction, finishes, installation, and other requirements.
1. Provide **[labels] [and] [certificates]** from AWI certification program indicating that woodwork[, **including installation,**] complies with requirements of grades specified.
 2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

2.4 EXTERIOR ORNAMENTAL WORK FOR TRANSPARENT FINISH

- A. Exterior ornamental work for transparent finish includes the following:
1. Balustrades.
 2. Columns.
 3. Cupolas.
 4. Pediment heads.
 5. Pilasters.
 6. **<Insert description>**.
- B. Grade: **[Premium] [Custom]** .
- C. Regional Materials: Exterior ornamental work for transparent finish shall be manufactured within **500 miles** (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** (800 km) of Project site.
- D. Certified Wood: Wood and composite wood components of exterior ornamental work for transparent finish shall be certified as "FSC Pure"[**or "FSC Mixed Credit"**] according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- E. Wood Species: **[Teak] [African mahogany] [All-heart redwood] [Western red cedar] [Ponderosa pine or sugar pine] <Insert species>**.

2.5 EXTERIOR ORNAMENTAL WORK FOR OPAQUE FINISH

- A. Exterior ornamental work for opaque finish includes the following:
1. Balustrades.
 2. Columns.
 3. Cupolas.
 4. Pediment heads.
 5. Pilasters.

6. <Insert description>.

B. Grade: [**Premium**] [**Custom**].

C. Regional Materials: Exterior ornamental work for opaque finish shall be manufactured within **500 miles** (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** (800 km) of Project site.

D. Certified Wood: Wood and composite wood components of exterior ornamental work for opaque finish shall be certified as "FSC Pure"[or "**FSC Mixed Credit**"] according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

E. Wood Species: [**All-heart redwood**] [**Western red cedar**] [**Ponderosa pine**] [**Ponderosa pine or sugar pine**] [**Eastern white pine, sugar pine, or western white pine**] [**Any closed-grain hardwood**] [**Softwood plywood**] <Insert species>.

2.6 INTERIOR ORNAMENTAL WORK FOR TRANSPARENT FINISH

A. Interior ornamental work for transparent finish includes the following:

1. Balustrades.
2. Columns.
3. Grilles.
4. Lectern.
5. Mantels.
6. Pediment heads.
7. Pilasters.
8. <Insert description>.

B. Grade: [**Premium**] [**Custom**].

C. Regional Materials: Interior ornamental work for transparent finish shall be manufactured within **500 miles** (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** (800 km) of Project site.

D. Regional Materials: Interior ornamental work for transparent finish shall be manufactured within **500 miles** (800 km) of Project site.

E. Certified Wood: Interior ornamental work for transparent finish shall be produced from wood certified as "FSC Pure"[or "**FSC Mixed Credit**"] according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

F. Wood Species and Cut:[**Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.**]

1. Species: [**Red oak**] <Insert species>.
2. Cut: [**Plain sliced/plain sawn**] [**Rift cut/rift sawn**] [**Quarter cut/quarter sawn**] [**Any cut**].

2.7 INTERIOR ORNAMENTAL WORK FOR OPAQUE FINISH

- A. Interior ornamental work for opaque finish includes the following:
1. Balustrades.
 2. Columns.
 3. Grilles.
 4. Lectern.
 5. Mantels.
 6. Pediment heads.
 7. Pilasters.
 8. <Insert description>.
- B. Grade: [**Premium**] [**Custom**] .
- C. Regional Materials: Interior ornamental work for opaque finish shall be manufactured within **500 miles** (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** (800 km) of Project site.
- D. Regional Materials: Interior ornamental work for opaque finish shall be manufactured within **500 miles** (800 km) of Project site.
- E. Certified Wood: Interior ornamental work for opaque finish shall be produced from wood certified as "FSC Pure"[or "**FSC Mixed Credit**"] according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- F. Wood Species: [**Any closed-grain hardwood**] [**Eastern white pine, sugar pine, or western white pine**] <Insert species>.

2.8 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of ornamental woodwork and quality grade specified unless otherwise indicated.
1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than **3 inches** (75 mm) wide.
 2. Wood Moisture Content for Exterior Materials: [**9 to 15**] [**7 to 12**] percent.
 3. Wood Moisture Content for Interior Materials: [**5 to 10**] [**4 to 9**] percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of ornamental woodwork and quality grade specified unless otherwise indicated.

1. Recycled Content of Medium-Density Fiberboard and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
 2. Composite Wood and Agrifiber Products: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 3. Medium-Density Fiberboard: ANSI A208.2, [**Grade 130**] **<Insert grade>**[, **made with binder containing no urea formaldehyde**].
 4. Particleboard: ANSI A208.1, [**Grade M-2**] [**Grade M-2, made with binder containing no urea formaldehyde**] [**Grade M-2-Exterior Glue**].
 5. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.
 - 1) Products: Subject to compliance with requirements, provide one of the following:
 - 2) Environ Biocomposites Manufacturing LLC; Biofiber Wheat.
 - 3) Sorm Incorporated; Primeboard Premium Wheat.
 - 4) **<Insert manufacturer's name; product name or designation>**.
 - 5) or approved equal.
 6. Softwood Plywood: DOC PS 1[, **exterior**] [, **medium-density overlay**].
 7. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1[, **made with adhesive containing no urea formaldehyde**].
- C. Water-Repellent Preservative Treated Materials: Comply with AWWA N1 (dip, spray, flood, or vacuum-pressure treatment) for exterior ornamental woodwork items indicated to receive water-repellent preservative treatment.
1. Preservative Chemicals: 3-iodo-2-propynyl butyl carbamate (IPBC)[, **combined with an insecticide containing chlorpyrifos (CPF)**].
 2. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.
 3. Extent of Water-Repellent Preservative Treatment: Treat [**exterior ornamental woodwork indicated**] [**all exterior ornamental woodwork unless otherwise indicated**].
 4. Items fabricated from the following wood species need not be treated:
 - a. [**Redwood**] [**All-heart redwood**].
 - b. [**Western red cedar**] [**All-heart western red cedar**].
 - c. White oak.
 - d. African mahogany.
 - e. Honduras mahogany.
 - f. Ipe.
 - g. Dark red meranti.
 - h. Teak.

2.9 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
1. Use treated materials that comply with requirements of referenced woodworking standard. Do not use materials that are warped, discolored, or otherwise defective.
 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 feet (3.2 m)** beyond the centerline of the burners at any time during the test.
1. For exterior applications, use materials that comply with testing requirements after being subjected to accelerated weathering according to ASTM D 2898.
 2. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
 3. For items indicated to receive a stained or natural finish, use organic resin chemical formulation.
 4. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
 5. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
- C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.
1. For panels **3/4 inch (19 mm)** thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, **1600 psi (11 MPa)**; modulus of elasticity, **300,000 psi (2070 MPa)**; internal bond, **80 psi (550 kPa)**; and screw-holding capacity on face and edge, **250 and 225 lbf (1100 and 1000 N)**, respectively.
 2. For panels **13/16 to 1-1/4 inches (20 to 32 mm)** thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture,

1300 psi (9 MPa); modulus of elasticity, 250,000 psi (1720 MPa); linear expansion, 0.50 percent; and screw-holding capacity on face and edge, 250 and 175 lbf (1100 and 780 N), respectively.

3. Products: Subject to compliance with requirements, provide one of the following:
 - a. Flakeboard Company Limited; Duraflake FR.
 - b. SierraPine; Encore FR.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.

D. Fire-Retardant Fiberboard: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Panel Source International, Inc.; Pyroblock Platinum.
 - b. SierraPine; Medite FR.
 - c. **<Insert manufacturer>**
 - d. or approved equal.

2.10 MISCELLANEOUS MATERIALS

A. Exterior Blocking, Shims, and Nailers: Softwood or hardwood lumber[, **pressure-preservative treated**] [, **fire-retardant treated**], kiln dried to less than 15 percent moisture content.

1. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC3b.
 - a. Kiln dry lumber after treatment to a maximum moisture content of 19 percent.
 - b. Preservative Chemicals: Acceptable to authorities having jurisdiction[**and containing no arsenic or chromium**].
 - c. Mark lumber with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee's (ALSC) Board of Review.

B. Interior Furring, Blocking, Shims, and Hanging Strips: [**Softwood or hardwood lumber**] [**Fire-retardant-treated softwood lumber**], kiln dried to less than 15 percent moisture content.

C. Nails for Exterior Use: [**hot-dip galvanized**] [**or**] [**stainless steel**].

D. Screws for Exterior Use: [**bronze**] [**hot-dip galvanized**] [**or**] [**stainless steel**].

E. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.

F. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed

anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

- G. Adhesives: Do not use adhesives that contain urea formaldehyde.
- H. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- I. VOC Limits for Installation Adhesives and Sealants: Use products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Wood Glues: 30 g/L.
 - 2. Multipurpose Construction Adhesives: 70 g/L.
 - 3. Structural Wood Member Adhesive: 140 g/L.
 - 4. Architectural Sealants: 250 g/L.

2.11 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Fabricate ornamental woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 - 1. Edges of Solid-Wood (Lumber) Members: **1/16 inch** (1.5 mm) unless otherwise indicated.
 - 2. Edges of Rails and Similar Members More Than **3/4 Inch** (19 mm) Thick: **1/8 inch** (3 mm).
- C. Complete fabrication, including assembly[**and finishing**], to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify DEN Project Manager seven (7) days in advance of the dates and times ornamental woodwork fabrication will be complete.
 - 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

2.12 SHOP PRIMING

- A. Exterior Ornamental Woodwork for Opaque Finish: Shop prime with one coat of wood primer specified in Section 099113 "Exterior Painting."

- B. Exterior Ornamental Woodwork for Transparent Finish: Shop seal with stain (if required), other required pretreatments, and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."
- C. Interior Ornamental Woodwork for Opaque Finish: Shop prime with one coat of wood primer specified in Section 099123 "Interior Painting."
- D. Interior Ornamental Woodwork for Transparent Finish: Shop seal with stain (if required), other required pretreatments, and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."
- E. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing ornamental woodwork, as applicable to each unit of work.
 - 1. Backpriming: Apply minimum one coat of sealer or primer, compatible with finish coats, to all concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

2.13 SHOP FINISHING

- A. General: Finish ornamental woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. General: Shop finish transparent-finished ornamental woodwork at fabrication shop as specified in this Section. Refer to [**Section 099113 "Exterior Painting"**] [**and**] [**Section 099123 "Interior Painting"**] for field finishing opaque-finished architectural woodwork.
- C. General: Drawings indicate items that are required to be shop finished. Finish such items at fabrication shop as specified in this Section. Refer to [**Section 099113 "Exterior Painting"**] [**Section 099123 "Interior Painting"**] [**and**] [**Section 099300 "Staining and Transparent Finishing"**] for field finishing ornamental woodwork not indicated to be shop finished.
- D. Finish Materials: Use finish materials that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing ornamental woodwork, as applicable to each unit of work.
 - 1. Backpriming: Apply minimum one coat of sealer or primer, compatible with finish coats, to concealed surfaces of ornamental woodwork. Apply two coats to end-grain surfaces.
- F. Transparent Finish for Exterior Items: Comply with Section 099300 "Staining and Transparent Finishing."

- G. Opaque Finish for Exterior Items: Comply with Section 099113 "Exterior Painting."
- H. Transparent Finish for Interior Items:
1. Grade: **[Premium]** **[Custom]** **[Same as item to be finished]**.
 2. Finish: System - 1, nitrocellulose lacquer.
 3. Finish: System - 2, precatalyzed lacquer.
 4. Finish: System - 3, postcatalyzed lacquer.
 5. Finish: System - 4, water-based latex acrylic.
 6. Finish: System - 5, conversion varnish.
 7. Finish: System - 6, synthetic penetrating oil.
 8. Finish: System - 7, catalyzed vinyl.
 9. Finish: System - 8, water-based cross-linking acrylic.
 10. Finish: System - 9, UV curable acrylated epoxy, polyester, or urethane.
 11. Finish: System - 10, water-based UV curable.
 12. Finish: System - 11, catalyzed polyurethane.
 13. Finish: System - 12, water-based polyurethane.
 14. Finish: System - 13, catalyzed polyester.
 15. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
 16. Staining: **[None required]** **[Match approved sample for color]** **[Match DEN Project Manager's sample]**.
 17. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
 18. Filled Finish for Open-Grain Woods:**[After staining, apply wash-coat sealer and allow to dry.]** Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
 19. Sheen: **[Flat, 15-30]** **[Satin, 31-45]** **[Semigloss, 46-60]** **[Gloss, 61-100]** gloss units measured on 60-degree gloss meter per ASTM D 523.
- I. Opaque Finish for Interior Items:
1. Grade: **[Premium]** **[Custom]** **[Same as item to be finished]**.
 2. Finish: System - 1, nitrocellulose lacquer.
 3. Finish: System - 2, precatalyzed lacquer.
 4. Finish: System - 3, postcatalyzed lacquer.
 5. Finish: System - 4, water-based latex acrylic.
 6. Finish: System - 5, conversion varnish.
 7. Finish: System - 7, catalyzed vinyl.
 8. Finish: System - 8, water-based cross-linking acrylic.
 9. Finish: System - 9, UV curable acrylated epoxy, polyester, or urethane.
 10. Finish: System - 10, water-based UV curable.
 11. Finish: System - 11, catalyzed polyurethane.
 12. Finish: System - 12, water-based polyurethane.
 13. Finish: System - 13, catalyzed polyester.
 14. Color: **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from manufacturer's full range]**.
 15. Sheen: **[Flat, 15-30]** **[Satin, 31-45]** **[Semigloss, 46-60]** **[Gloss, 61-100]** gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition ornamental woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing ornamental woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming of all concealed wood surfaces.

3.2 INSTALLATION

- A. Grade: Install ornamental woodwork to comply with same grade as item to be installed.
- B. Assemble ornamental woodwork and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Install ornamental woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of **1/8 inch in 96 inches** (3 mm in 2400 mm).
- D. Scribe and cut ornamental woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Backprime and seal all concealed wood surfaces that are exposed due to cutting and other installation activities.
- F. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- G. Preservative-Treated Wood: Where cut or drilled in field, treat cut ends and drilled holes according to AWPA M4.
- H. Anchor ornamental woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails[**or finishing screws**] for exposed fastening, countersunk and filled flush with ornamental woodwork.
 - 1. For shop-finished items, use filler matching finish of items being installed.
- I. Touch up finishing work specified in this Section after installation of ornamental woodwork. Fill nail holes with matching filler where exposed.
 - 1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are applied in shop.
- J. Refer to [**Section 099113 "Exterior Painting"**] [**Section 099123 "Interior Painting"**]

[and] [Section 099300 "Staining and Transparent Finishing"] for final finishing of installed ornamental woodwork[**not indicated to be shop finished**].

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective ornamental woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace ornamental woodwork. Adjust joinery for uniform appearance.
- B. Clean ornamental woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 064400

SECTION 064600 - WOOD TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Exterior standing and running trim.
2. Interior standing and running trim.
3. Closet and utility shelving.
4. Wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.
5. Shop priming of wood trim.
6. Shop finishing of wood trim.

- B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, and shims required for installing wood trim and concealed within other construction before wood trim installation.
2. Section 064400 "Ornamental Woodwork" for miscellaneous shop-assembled woodwork items.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product[, **including**] [**panel products**] [**fire-retardant-treated materials**] [**and**] [**finishing materials and processes**].

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

- B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product

- having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
 3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured[**and regionally extracted and manufactured**] materials. Include statement indicating cost for each regionally manufactured material.
 - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
 - b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
 4. Certificates for [**Credit MR 6**] [**Credit MR 7**]: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.
 5. Product Data for Credit IEQ 4.1: For installation adhesives, including printed statement of VOC content.
 6. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 7. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that products contain no urea formaldehyde.
 8. Laboratory Test Reports for Credit IEQ 4.4: For composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
1. Show details full size.
 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 3. Apply AWI Quality Certification Program label to Shop Drawings.
- D. Samples for Initial Selection:
1. Shop-applied transparent finishes.
 2. Shop-applied opaque finishes.

3. PVC edge material.
4. Thermoset decorative panels.

E. Samples for Verification:

1. Lumber for transparent finish, not less than [5 inches (125 mm) wide by 12 inches (300 mm) long] [5 inches (125 mm) wide by 24 inches (600 mm) long], for each species and cut, finished on one side and one edge.
2. Lumber and panel products with shop-applied opaque finish, 5 inches (125 mm) wide by 12 inches (300 mm) long for lumber and [8 by 10 inches (200 by 250 mm)] [12 by 12 inches (300 by 300 mm)] for panels, for each finish system and color, with [one-half of] exposed surface finished.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For [Installer] [fabricator].
- B. Quality Certification: Submit woodwork Manufacturer's (Fabricator's) certification, stating that fabricated woodwork complies with quality grades and other requirements indicated.
- C. Product Certificates: For [each type of product.] [the following:]
 1. Composite wood and agrifiber products.
 2. Thermoset decorative panels.
 3. Adhesives.
- D. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.
- E. Certificate from the fabricator providing proof of not less than five (5) years experience in the fabrication of the types of products specified.
- F. Certificate from the installer providing proof of not less than five (5) years of successful experience in the installation of similar types of products and shall have completed at least 3 jobs of similar size and scope.
- G. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.
- H. Provide warranty for two (2) years from date of final acceptance materials, fabrication and installation of all items.

1.5 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.
- B. Installer Qualifications: **[Fabricator of products] [Certified participant in AWI's Quality Certification Program]**.
- C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockups of **[typical wood trim as shown on Drawings] <Insert description>**.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Warranty: Fabricator/installer to warrant for two (2) years from date of final acceptance of materials, fabrication, and installation of all items.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soiling, and deterioration.
- B. Do not deliver wood trim until operations that could damage wood trim have been completed in installation areas. If wood trim must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

- A. Conditioning: Woodwork Manufacturer and Installer shall advise Contractor of temperature and humidity requirements for woodwork installation and storage areas. Do not install woodwork until required temperature and relative humidity have been stabilized and will be maintained in installation areas.
- B. Maintain temperature and humidity in installation area as required to maintain moisture content of installed woodwork within a 1.0 percent tolerance of optimum moisture content, from date of installation through remainder of construction period. Require Woodwork Manufacturer to establish optimum moisture content and required temperature and humidity conditions.

- C. Weather Limitations for Exterior Work: Proceed with installation of exterior wood trim only when existing and forecasted weather conditions permit work to be performed and at least one coat of specified finish to be applied without exposure to rain, snow, or dampness.
- D. Environmental Limitations for Interior Work: Do not deliver or install interior wood trim until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- E. Environmental Limitations for Interior Work: Do not deliver or install interior wood trim until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between **60 and 90 deg F** (16 and 32 deg C) and relative humidity between **[25 and 55] [17 and 50] <Insert humidity range>** percent during the remainder of the construction period.

1.9 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that wood trim can be supported and installed as indicated.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 FABRICATION, GENERAL

- A. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber at time of fabrication and for relative humidity conditions in the installation areas.
- B. Fabricate woodwork to dimensions, profiles, and details indicated with openings and mortises precut, where possible, to receive hardware and other items and work.
- C. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- D. Pre Cut Openings: Fabricate architectural woodwork with precut openings, where possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately and use templates or roughing in diagrams

for proper size and shape. Smooth edges of cutoffs and, where located in countertops and similar exposures seal edges of cutouts with a water resistant coating.

- E. Measurements: Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain field measurements and verify dimensions and shop drawing details as required for accurate fit.

2.2 WOOD TRIM FABRICATORS

- A. Fabricators: Subject to compliance with requirements, provide products by one of the following:
 1. **<Insert, in separate subparagraphs, names and possibly contact information for preapproved woodworking firms>.**
 2. or approved equal.

2.3 WOOD TRIM, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of wood trim indicated for construction, finishes, installation, and other requirements.
 1. Provide **[labels] [and] [certificates]** from **[AWI]** certification program indicating that woodwork[, **including installation,**] complies with requirements of grades specified.
 2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

2.4 EXTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Grade: **[Premium] [Custom]**.
- B. Regional Materials: Exterior trim for transparent finish shall be manufactured within **500 miles** (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** (800 km) of Project site.
- C. Certified Wood: Exterior trim for transparent finish shall be certified as "FSC Pure"[**or "FSC Mixed Credit"**] according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- D. Wood Species: **[All-heart redwood] [Western red cedar] [Ponderosa pine or sugar pine] [Eastern white pine] <Insert species>.**

2.5 EXTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

- A. Grade: [**Premium**] [**Custom**].
- B. Regional Materials: Exterior trim for opaque finish shall be manufactured within **500 miles** (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** (800 km) of Project site.
- C. Certified Wood: Exterior trim for opaque finish shall be certified as "FSC Pure"[or "**FSC Mixed Credit**"] according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- D. Wood Species: [**All-heart redwood**] [**Western red cedar**] [**Ponderosa pine or sugar pine**] [**Eastern white pine, sugar pine, or western white pine**] [**Any closed-grain hardwood**] <Insert species>.

2.6 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Grade: [**Premium**] [**Custom**] .
- B. Regional Materials: Interior trim for transparent finish shall be manufactured within **500 miles** (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** (800 km) of Project site.
- C. Regional Materials: Interior trim for transparent finish shall be manufactured within **500 miles** (800 km) of Project site.
- D. Certified Wood: Interior trim for transparent finish shall be certified as "FSC Pure"[or "**FSC Mixed Credit**"] according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- E. Wood Species and Cut:[**Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.**]
 - 1. Species: [**Red oak**] [**White oak**] [**White ash**] [**Hickory**] <Insert species>.
 - 2. Cut: [**Plain sliced/plain sawn**] [**Rift cut/rift sawn**] [**Quarter cut/quarter sawn**].
 - 3. Provide split species on trim that faces areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.
- F. For trim items[**other than base**] wider than available lumber, use veneered construction. Do not glue for width.
 - 1. For veneered base, use hardwood lumber core, glued for width.
- G. For base wider than available lumber, glue for width. Do not use veneered construction.

- H. For rails thicker than available lumber, use veneered construction. Do not glue for thickness.

2.7 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

- A. Grade: [**Premium**] [**Custom**] .
- B. Regional Materials: Interior trim for opaque finish shall be manufactured within **500 miles** (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** (800 km) of Project site.
- C. Regional Materials: Interior trim for opaque finish shall be manufactured within **500 miles** (800 km) of Project site.
- D. Certified Wood: Interior trim for opaque finish shall be certified as "FSC Pure"[**or "FSC Mixed Credit"**] according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- E. Wood Species: [**Any closed-grain hardwood**] [**Eastern white pine, sugar pine, or western white pine**] <Insert species>.

2.8 CLOSET AND UTILITY SHELVING

- A. Grade: [**Premium**] [**Custom**].
- B. Shelf Material: **3/4-inch** (19-mm) [**solid lumber**] [**veneer-faced panel product with solid-lumber edge**] [**veneer-faced panel product with veneer edge banding**] [**thermoset decorative panel with solid-lumber edge**] [**thermoset decorative panel with PVC T-mold edge**] [**medium-density fiberboard with solid-lumber edge**] [**particleboard with solid-lumber edge**] [**medium-density fiberboard with radiused edge**] [**particleboard with radiused and filled edge**].
- C. Cleats: **3/4-inch** (19-mm) [**solid lumber**] [**thermoset decorative panel**] [**panel product**].
- D. Wood Species: [**Red oak**] [**Match species indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated**] [**Match species indicated for door to closet where shelving is located**] [**Any closed-grain hardwood**] [**Eastern white pine, sugar pine, or western white pine**] <Insert species>.
- E. Closet Rods: **1-5/16-inch-** (33-mm-) diameter, [**aluminum**] [**chrome-plated-steel**] [**color-coated-steel**] [**stainless-steel**] tubes complying with BHMA A156.16, L03131.
- F. Rod Flanges: [**Aluminum**] [**Chrome-plated steel**] [**Stainless steel**].

2.9 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of wood trim and quality grade specified unless otherwise indicated.
1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than **3 inches** (75 mm) wide.
 2. Wood Moisture Content for Exterior Materials: **[9 to 15] [7 to 12]** percent.
 3. Wood Moisture Content for Interior Materials: **[5 to 10] [4 to 9]** percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of wood trim and quality grade specified unless otherwise indicated.
1. Recycled Content of Medium-Density Fiberboard and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
 2. Composite Wood and Agrifiber Products: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 3. Medium-Density Fiberboard: ANSI A208.2, **[Grade 130] <Insert grade>**[, **made with binder containing no urea formaldehyde**].
 4. Particleboard: ANSI A208.1, **[Grade M-2] [Grade M-2, made with binder containing no urea formaldehyde] [Grade M-2-Exterior Glue]**.
 5. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Environ Biocomposites Manufacturing LLC; Biofiber Wheat.
 - 2) Sorm Incorporated; Primeboard Premium Wheat.
 - 3) **<Insert manufacturer's name; product name or designation>**.
 - 4) or approved equal.
 6. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1[, **made with adhesive containing no urea formaldehyde**].
 7. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.
- C. Water-Repellent Preservative Treated Materials: Comply with AWPA N1 (dip, spray, flood, or vacuum-pressure treatment) for exterior wood trim indicated to receive water-repellent preservative treatment.
1. Preservative Chemicals: 3-iodo-2-propynyl butyl carbamate (IPBC)[, **combined with an insecticide containing chlorpyrifos (CPF)**].

2. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.
3. Extent of Water-Repellent Preservative Treatment: Treat **[exterior wood trim indicated]** **[all exterior wood trim unless otherwise indicated]**.
4. Items fabricated from the following wood species need not be treated:
 - a. **[Redwood]** **[All-heart redwood]**.
 - b. **[Western red cedar]** **[All-heart western red cedar]**.
 - c. White oak.
 - d. African mahogany.
 - e. Honduras mahogany.
 - f. Ipe.
 - g. Dark red meranti.
 - h. Teak.

2.10 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
 1. Use treated materials that comply with requirements of referenced woodworking standard. Do not use materials that are warped, discolored, or otherwise defective.
 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant-Treated Lumber: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 feet** (3.2 m) beyond the centerline of the burners at any time during the test.
 1. For exterior applications, use materials that comply with testing requirements after being subjected to accelerated weathering according to ASTM D 2898.
 2. Kiln dry lumber after treatment to a maximum moisture content of 19 percent.
 3. For items indicated to receive a stained or natural finish, use organic resin chemical formulation.
 4. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.

5. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.

2.11 HARDWARE AND ACCESSORIES

- A. Adjustable Shelf Standards and Supports: **[BHMA A156.9, B04071; with shelf rests, B04081] [BHMA A156.9, B04102; with shelf brackets, B04112]**.
- B. Shelf Rests: BHMA A156.9, B04013; **[metal] [metal, two-pin type with shelf hold-down clip]**.

2.12 MISCELLANEOUS MATERIALS

- A. Exterior Blocking, Shims, and Nailers: Softwood or hardwood lumber[, **pressure-preservative treated**] [, **fire-retardant treated**], kiln dried to less than 15 percent moisture content.
 1. Preservative Treatment by Pressure Process: AWWA U1; Use Category UC3b.
 - a. Kiln dry lumber after treatment to a maximum moisture content of 19 percent.
 - b. Preservative Chemicals: Acceptable to authorities having jurisdiction[**and containing no arsenic or chromium**].
 - c. Mark lumber with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee's (ALSC) Board of Review.
- B. Interior Furring, Blocking, Shims, and Hanging Strips: **[Softwood or hardwood lumber] [Fire-retardant-treated softwood lumber]**, kiln dried to less than 15 percent moisture content.
- C. Nails for Exterior Use: **[hot-dip galvanized] [or] [stainless steel]**.
- D. Screws for Exterior Use: **[bronze] [hot-dip galvanized] [or] [stainless steel]**.
- E. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.
- F. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- G. Handrail Brackets: **[Cast] [Extruded] [Stamped]** from **[malleable iron] [aluminum] [bronze] [stainless steel]** with wall flange drilled **[for exposed anchor] [and tapped for concealed hanger bolt]** and with support arm for screwing to underside of rail. Sized to provide **1-1/2-inch** (38-mm) clearance between handrail and wall.

- H. Handrail/Bumper Rail Brackets: Pairs of extruded-aluminum channels; one for fastening to back of rail and one for fastening to face of wall. They are then assembled in overlapping fashion and fastened together top and bottom with self-tapping screws. Sized to provide 1-1/2-inch (38-mm) clearance between handrail and wall.
- I. Adhesives: Do not use adhesives that contain urea formaldehyde.
- J. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- K. VOC Limits for Installation Adhesives and Sealants: Use products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Wood Glues: 30 g/L.
 - 2. Multipurpose Construction Adhesives: 70 g/L.
 - 3. Structural Wood Member Adhesive: 140 g/L.
 - 4. Architectural Sealants: 250 g/L.

2.13 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Fabricate wood trim to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 - 1. Edges of Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.
 - 2. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch (3 mm).
- C. Backout or groove backs of flat trim members and kerf backs of other wide, flat members except for members with ends exposed in finished work.
- D. Assemble casings in shop except where shipping limitations require field assembly.
- E. Assemble moldings in shop to maximum extent possible. Miter corners in shop and prepare for field assembly with bolted fittings designed to pull connections together.

2.14 SHOP PRIMING

- A. Exterior Wood Trim for Opaque Finish: Shop prime with one coat of wood primer specified in Section 099113 "Exterior Painting."

- B. Exterior Wood Trim for Transparent Finish: Shop seal with stain (if required), other required pretreatments, and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."
- C. Interior Wood Trim for Opaque Finish: Shop prime with one coat of wood primer specified in Section 099123 "Interior Painting."
- D. Interior Wood Trim for Transparent Finish: Shop seal with stain (if required), other required pretreatments, and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."
- E. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing wood trim, as applicable to each unit of work.
 - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood trim. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

2.15 SHOP FINISHING

- A. General: Finish wood trim at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. General: Shop finish transparent-finished wood trim at fabrication shop as specified in this Section. Refer to [**Section 099113 "Exterior Painting"**] [**and**] [**Section 099123 "Interior Painting"**] for field finishing opaque-finished wood trim.
- C. General: Drawings indicate items that are required to be shop finished. Finish such items at fabrication shop as specified in this Section. Refer to [**Section 099113 "Exterior Painting"**] [**Section 099123 "Interior Painting"**] [**and**] [**Section 099300 "Staining and Transparent Finishing"**] for field finishing wood trim not indicated to be shop finished.
- D. Finish Materials: Use finish materials that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing wood trim, as applicable to each unit of work.
 - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood trim. Apply two coats to end-grain surfaces.
- F. Transparent Finish for Exterior Trim: Comply with Section 099300 "Staining and Transparent Finishing."
- G. Opaque Finish for Exterior Trim: Comply with Section 099113 "Exterior Painting."

H. Transparent Finish for Interior Trim:

1. Grade: **[Premium] [Custom] [Same as item to be finished]**.
2. Finish: System - 1, nitrocellulose lacquer.
3. Finish: System - 2, precatalyzed lacquer.
4. Finish: System - 3, postcatalyzed lacquer.
5. Finish: System - 4, water-based latex acrylic.
6. Finish: System - 5, conversion varnish.
7. Finish: System - 6, synthetic penetrating oil.
8. Finish: System - 7, catalyzed vinyl.
9. Finish: System - 8, water-based cross linking acrylic.
10. Finish: System - 9, UV curable acrylated epoxy, polyester, or urethane.
11. Finish: System - 10, water-based UV curable.
12. Finish: System - 11, catalyzed polyurethane.
13. Finish: System - 12, water-based polyurethane.
14. Finish: System - 13, catalyzed polyester.
15. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
16. Staining: **[None required] [Match approved sample for color] [Match DEN Project Manager's sample]**.
17. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
18. Filled Finish for Open-Grain Woods: **[After staining, apply wash-coat sealer and allow to dry.]** Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
19. Sheen: **[Flat, 15-30] [Satin, 31-45] [Semigloss, 46-60] [Gloss, 61-100]** gloss units measured on 60-degree gloss meter per ASTM D 523.

I. Opaque Finish for Interior Trim:

1. Grade: **[Premium] [Custom] [Same as item to be finished]**.
2. Finish: System - 1, nitrocellulose lacquer.
3. Finish: System - 2, precatalyzed lacquer.
4. Finish: System - 3, postcatalyzed lacquer.
5. Finish: System - 4, water-based latex acrylic.
6. Finish: System - 5, conversion varnish.
7. Finish: System - 7, catalyzed vinyl.
8. Finish: System - 8, water-based cross linking acrylic.
9. Finish: System - 9, UV curable acrylated epoxy, polyester, or urethane.
10. Finish: System - 10, water-based UV curable.
11. Finish: System - 11, catalyzed polyurethane.
12. Finish: System - 12, water-based polyurethane.
13. Finish: System - 13, catalyzed polyester.
14. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range]**.
15. Sheen: **[Flat, 15-30] [Satin, 31-45] [Semigloss, 46-60] [Gloss, 61-100]** gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition wood trim to average prevailing humidity conditions in installation areas.
- B. Before installing architectural wood trim, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Grade: Install wood trim to comply with same grade as item to be installed.
- B. Assemble wood trim and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Install wood trim level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of **1/8 inch in 96 inches** (3 mm in 2400 mm).
- D. Scribe and cut wood trim to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- F. Preservative-Treated Wood: Where cut or drilled in field, treat cut ends and drilled holes according to AWPA M4.
- G. Backprime and seal all concealed wood surfaces that are exposed due to cutting and other installation activities.
- H. Anchor wood trim to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails [**or finishing screws**] for exposed fastening, countersunk and filled flush with woodwork.
 - 1. For shop-finished items, use filler matching finish of items being installed.
- I. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than [**36 inches** (900 mm)] [**60 inches** (1500 mm)] [**96 inches** (2400 mm)] long except where shorter single-length pieces are necessary. [**Scarf running joints and stagger in adjacent and related members.**]
 - 1. Fill gaps, if any, between top of base and wall with [**plastic wood filler; sand smooth; and finish same as wood base if finished**] [**latex sealant, painted to match wall**].

2. Install standing and running trim with no more variation from a straight line than **1/8 inch in 96 inches** (3 mm in 2400 mm).
3. Install wall railings on indicated metal brackets securely fastened to wall framing.
 - a. Space rail brackets not more than **<Insert dimension>** o.c.
- J. Touch up finishing work specified in this Section after installation of wood trim. Fill nail holes with matching filler where exposed.
 1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are applied in shop.
- K. Refer to [**Section 099113 "Exterior Painting"**] [**Section 099123 "Interior Painting"**] [**and**] [**Section 099300 "Staining and Transparent Finishing"**] for final finishing of installed wood trim[**not indicated to be shop finished**].

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective wood trim, where possible, to eliminate functional and visual defects; where not possible to repair, replace wood trim. Adjust joinery for uniform appearance.
- B. Clean wood trim on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 064600

SECTION 066400 - PLASTIC PANELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes glass-fiber reinforced plastic (FRP) wall paneling[**and trim accessories**].
- B. Related Sections:
 - 1. Section 061000 "Rough Carpentry" for wood furring for installing plastic paneling.
 - 2. Section 102600 "Wall and Door Protection" for corner guards installed over plastic paneling.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For [**adhesives**] [**and**] [**sealants**], documentation including printed statement of VOC content.
 - 2. Product Data for Credit IEQ 4.4: For laminating adhesive[**and composite wood products**] used in factory-laminated plastic panels, documentation indicating that product contains no urea formaldehyde.
 - 3. Laboratory Test Reports for Credit IEQ 4: For [**adhesives**] [**sealants**] [**and**] [**wall panels**], documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Samples for Initial Selection: For plastic paneling[**and trim accessories**].

- D. Samples for Verification: For plastic paneling[**and trim accessories**], in manufacturer's standard sizes.

1.4 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plastic paneling[**and trim accessories**] from single manufacturer.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: **[25]** <Insert value> or less.
 2. Smoke-Developed Index: **[450]** <Insert value> or less.
 3. Testing Agency: **[Acceptable to authorities having jurisdiction] [FM Approvals] [UL]**.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.7 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PLASTIC SHEET PANELING

- A. General: Gelcoat-finished, glass-fiber reinforced plastic panels complying with ASTM D 5319.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Kemlite Company Inc.
 - b. Marlite.
 - c. Nudo Products, Inc.
 - d. <Insert manufacturer's name>.
 - e. or approved equal.
2. Low-Emitting Materials: Paneling shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 3. Nominal Thickness: Not less than [**0.075 inch (1.9 mm)**] [**0.09 inch (2.3 mm)**] [**0.12 inch (3.0 mm)**].
 4. Surface Finish: [**Smooth**] [**Molded pebble texture**] [**Smooth surface with filled grooves at 4 inches (102 mm) o.c. to resemble tile**] [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**].
 5. Color: [**White**] [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**].

2.2 FACTORY-LAMINATED PLASTIC PANELS

- A. General: Gelcoat-finished, glass-fiber reinforced plastic panels complying with ASTM D 5319, laminated to [**plywood**] [**oriented strand board**] [**fire-retardant particleboard**] [**gypsum board**] [**high-impact gypsum board**] [**moisture- and mold-resistant gypsum board**].
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kemlite Company Inc.
 - b. Nudo Products, Inc.
 - c. <Insert manufacturer's name>.
 - d. or approved equal.
 2. Low-Emitting Materials: Paneling shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 3. Glass-Fiber Reinforced Plastic Panel Nominal Thickness: Not less than [**0.03 inch (0.76 mm)**] [**0.05 inch (1.3 mm)**] [**0.075 inch (1.9 mm)**] [**0.09 inch (2.3 mm)**].
 4. Surface Finish: [**Smooth**] [**Molded pebble texture**] [**Smooth surface with filled grooves at 4 inches (102 mm) o.c. to resemble tile**] [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**].
 5. Color: [**White**] [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**].

6. Plywood: DOC PS 1, Exterior B-C, [**1/4 inch (6.4 mm)**] [**3/8 inch (9.5 mm)**] [**1/2 inch (12.7 mm)**] [**5/8 inch (15.9 mm)**] [**3/4 inch (19.1 mm)**] thick.
7. Oriented Strand Board: DOC PS 2, [**1/4 inch (6.4 mm)**] [**3/8 inch (9.5 mm)**] [**1/2 inch (12.7 mm)**] [**3/4 inch (19.1 mm)**] thick.
8. Fire-Retardant Particleboard: Product complying with ANSI A208.1, Grade M-S, except for modulus of rupture; with flame-spread index of 25 or less per ASTM E 84; and [**3/8 inch (9.5 mm)**] [**1/2 inch (12.7 mm)**] thick.
9. Gypsum Board: ASTM C 1396/C 1396M, [**Regular, 1/2 inch (12.7 mm)**] [**Type X, 5/8 inch (15.9 mm)**].
10. High-Impact Gypsum Board: ASTM C 1396/C 1396M, **5/8 inch (15.9 mm)**, with Type X core, and [**0.010-inch (0.254-mm)**] [**0.020-inch (0.508-mm)**] [**0.030-inch (0.762-mm)**] [**0.081-inch (2.057-mm)**] plastic film laminated to back side for greater resistance to through penetration (impact resistance).
11. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M or ASTM C 1178/C 1178M, **5/8 inch (15.9 mm)**, Type X, with moisture- and mold-resistant core and surfaces.
12. Laminating Adhesive: Manufacturer's standard adhesive that [**does not contain urea formaldehyde.**][**complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."**]

2.3 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, [**outside corners,**] and caps as needed to conceal edges.
 1. Color: [**White**] [**Match panels**] [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**].
- B. Trim Accessories: Manufacturer's standard two-piece, snap-on vinyl extrusions designed to cover edges of panels. Provide division bars, inside corners, [**outside corners,**] and caps as needed to conceal edges.
 1. Color: [**White**] [**Match panels**] [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**].
- C. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.
- D. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.
- E. Adhesive: As recommended by plastic paneling manufacturer.
 1. Adhesive shall have a VOC content of [**50**] **<Insert value>** g/L or less when

- calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. Sealant: [**Single-component, mildew-resistant, neutral-curing silicone**] [**Single-component, mildew-resistant, acid-curing silicone**] [**Latex**] sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 "Joint Sealants."
- G. Retain first subparagraph below if required for LEED-NC, LEED-CI or LEED-CS Credit IEQ 4.1.
1. Sealant shall have a VOC content of [**250**] <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.
- B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- C. Clean substrates of substances that could impair bond of adhesive, including oil, grease, dirt, and dust.
- D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- E. Lay out paneling before installing. Locate panel joints [**where indicated**] [**to provide equal panels at ends of walls not less than half the width of full panels**] [**so that trimmed panels at corners are not less than 12 inches** (300 mm) **wide**].

1. Mark plumb lines on substrate at **[trim accessory]** **[panel joint]** locations for accurate installation.
2. Locate **[trim accessories]** **[panel joints]** to allow clearance at panel edges according to manufacturer's written instructions.

3.3 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Install panels in a full spread of adhesive.
- C. Install panels with fasteners. Layout fastener locations and mark on face of panels so that fasteners are accurately aligned.
 1. Drill oversized fastener holes in panels and center fasteners in holes.
 2. Apply sealant to fastener holes before installing fasteners.
- D. Install factory-laminated panels using concealed mounting splines in panel joints.
- E. Install trim accessories with **[adhesive]** **[and]** **[nails]** **[or]** **[staples]**.**[Do not fasten through panels.]**
- F. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.
- G. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- H. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.
- I. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 066400

SECTION 070150.19 - PREPARATION FOR RE-ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Roof tear-off.
 - 2. Partial roof tear-off.
 - 3. Temporary roofing membrane.
 - 4. Roof re-cover preparation.
 - 5. Removal of base flashings.
- B. Related Sections:
 - 1. Section 011000 "Summary" for use of the premises and phasing requirements.
 - 2. Section 015000 "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for reroofing preparation.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site and brought to DEN approved landfill as designated by Owner.

1.4 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.
- B. Existing Membrane Roofing System: **[Built-up asphalt] [Built-up coal-tar] [EPDM] [CSPE] [PVC] [TPO] [APP-modified bituminous] [SBS-modified bituminous]**

<Insert roof type> roofing membrane, roof insulation, surfacing, and components and accessories between deck and roofing membrane.

- C. Roof Re-Cover Preparation: Existing roofing membrane that is to remain and be prepared for reuse.
- D. Roof Tear-Off: Removal of existing membrane roofing system from deck.
- E. Partial Roof Tear-Off: Removal of a portion of existing membrane roofing system from deck or removal of selected components and accessories from existing membrane roofing system.
- F. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and reinstalled.
- G. Existing to Remain: Existing items of construction that are not indicated to be removed.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include data substantiating that materials comply with requirements.
- B. Temporary Roofing: Include Product Data and description of temporary roofing system, including specifications, installation instructions, and general recommendations from manufacturers of roofing system materials, for types of temporary roofing materials required. Include data substantiating that materials comply with requirements.
 - 1. If temporary roof will remain in place, submit surface preparation requirements needed to receive permanent roof, and submit a letter from roofing membrane manufacturer stating acceptance of the temporary membrane and that its inclusion will not adversely affect the roofing system's resistance to fire and wind[**or its FM Global rating**].

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer[**including certificate that Installer is licensed to perform asbestos abatement**] [and] [**is approved by warrantor of existing roofing system**].
- B. Fastener pull-out test report.
- C. Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including exterior and interior finish surfaces that might be misconstrued as having been damaged by reroofing operations. Submit before Work begins.

- D. Landfill Records: Indicate receipt and acceptance of hazardous wastes, such as asbestos-containing material, by a DEN approved landfill facility licensed to accept hazardous wastes.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. A firm with not less than five (5) years of successful experience in re-roofing work similar to those required for this project and which is acceptable to or licensed by manufacturer of temporary roofing materials.
2. Installer of new membrane roofing system[, **licensed to perform asbestos abatement in the State of Colorado**] **[and] [approved by warrantor of existing roofing system to work on existing roofing].**

- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning membrane roofing removal. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Reroofing Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>**.

1. Meet with Owner; DEN Project Manager, Owner's insurer if applicable, testing and inspecting agency representative; roofing system manufacturer's representative; deck Installer; roofing Installer including project manager, superintendent, and foreman; and installers whose work interfaces with or affects reroofing including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing system tear-off and replacement including, but not limited to, the following:
 - a. Reroofing preparation, including membrane roofing system manufacturer's written instructions.
 - b. Temporary protection requirements for existing roofing system that is to remain during and after installation.
 - c. Existing roof drains and roof drainage during each stage of reroofing, and roof drain plugging and plug removal requirements.
 - d. Construction schedule and availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - e. Existing deck removal procedures and Owner notifications.
 - f. Condition and acceptance of existing roof deck and base flashing substrate for reuse.
 - g. Structural loading limitations of deck during reroofing.
 - h. Base flashings, special roofing details, drainage, penetrations, equipment curbs, and condition of other construction that will affect reroofing.
 - i. HVAC shutdown and sealing of air intakes.
 - j. Shutdown of fire-suppression, -protection, and -alarm and -detection systems.
 - k. Asbestos removal and discovery of asbestos-containing materials.

- I. Governing regulations and requirements for insurance and certificates if applicable.
- m. Existing conditions that may require notification of DEN Project Manager before proceeding.
- n. Record discussions and agreements and furnish copy to each participant.
- o. Provide at least 72 hours advance notice to participants prior to convening pre roofing conference.

1.8 PROJECT CONDITIONS

- A. Owner will occupy portions of building immediately below reroofing area. Conduct reroofing so Owner's operations will not be disrupted. Provide DEN Project Manager with not less than [72] <Insert number> hours' notice of activities that may affect Owner's operations.
 1. Coordinate work activities daily with DEN Project Manager so Owner can place protective dust or water leakage covers over sensitive equipment or furnishings, shut down HVAC and fire-alarm or -detection equipment if needed, and evacuate occupants from below the work area.
 2. Before working over structurally impaired areas of deck, notify DEN Project Manager to evacuate occupants from below the affected area. Verify that occupants below the work area have been evacuated before proceeding with work over the impaired deck area.
- B. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.
- C. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
- D. Conditions existing at time of inspection for bidding will be maintained by Owner as far as practical.
 1. A roof moisture survey of existing membrane roofing system is available for Contractor's reference.
 2. The results of an analysis of test cores from existing membrane roofing system are available for Contractor's reference.
 3. Construction Drawings[and Project Manual] for existing roofing system are provided for Contractor's reference. Contractor is responsible for conclusions derived from existing documents.
- E. Limit construction loads on roof to <Insert load> rooftop equipment wheel loads and <Insert load> for uniformly distributed loads.
- F. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.

- G. Hazardous Materials: It is not expected that hazardous materials such as asbestos-containing materials will be encountered in the Work.
1. Hazardous materials will be removed by Owner before start of the Work. Existing roof will be left no less watertight than before removal.
 2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify DEN Project Manager. Hazardous materials will be removed by Owner under a separate contract.
- H. Hazardous Materials: Present in building to be reroofed. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
1. Hazardous material remediation is specified elsewhere in the Contract Documents.
 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except according to procedures specified elsewhere in the Contract Documents.
 3. Coordinate with hazardous material remediation subcontractor to prevent water from entering existing roofing system or building.

1.9 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during reroofing, by methods and with materials so as not to void existing roofing system warranty. Notify warrantor before proceeding.
1. Notify warrantor of existing roofing system on completion of reroofing, and obtain documentation verifying that existing roofing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Performance: Provide roofing materials recognized to be of generic type indicated and tested to show compliance with indicated performances, or provide other similar materials certified in writing by manufacturer to be equal or better than specified in every significant respect and acceptable to DEN Project Manager.
- B. Compatibility: Provide products which are recommended by manufacturers to be fully

compatible with indicated substrates, or provide separation materials as required to eliminate contact between incompatible materials.

2.2 INFILL MATERIALS

A. Use infill materials matching existing membrane roofing system materials unless otherwise indicated.

1. Infill materials are specified in Section <Insert Section number> "<Insert title of applicable roofing membrane Section>."

2.3 TEMPORARY ROOFING MATERIALS

- A. Sheathing Paper: Red-rosin type, minimum 3 lb/100 sq. ft. (0.16 kg/sq. m).
- B. Base Sheet: ASTM D 4601, Type II, nonperforated, asphalt-impregnated and -coated, glass-fiber sheet.
- C. Glass-Fiber Felts: ASTM D 2178, Type IV, asphalt-impregnated, glass-fiber felt.
- D. Asphalt Primer: ASTM D 41.
- E. Roofing Asphalt: ASTM D 312, Type III or IV.

2.4 RECOVER BOARDS

- A. Recover Board: ASTM C 208, Type II, Grade [1] [2], cellulosic-fiber insulation board; 1/2 inch (13 mm) thick.
- B. Recover Board: Fan-folded, unfaced, extruded-polystyrene board insulation; [3/16-inch (5-mm)] [1/4-inch (6-mm)] [3/8-inch (10-mm)] nominal thickness.
- C. Recover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate; [1/4 inch (6 mm)] [1/2 inch (13 mm)] [Type X, 5/8 inch (16 mm)] thick.
- D. Recover Board: ASTM C 1278/C 1278M, cellulosic-fiber-reinforced, water-resistant gypsum substrate; [1/4 inch (6 mm)] [3/8 inch (10 mm)] [1/2 inch (13 mm)] [5/8 inch (16 mm)] thick.
- E. Recover Board: ASTM C 728, perlite board; [1/2 inch (13 mm)] [3/4 inch (19 mm)] [1 inch (25 mm)] thick.
- F. Fasteners: Factory-coated steel fasteners, No. [12] [or] [14], and metal or plastic plates listed in FM Approval's "Approval Guide," designed for fastening recover boards to deck.

2.5 AUXILIARY REROOFING MATERIALS

- A. General: Auxiliary reroofing preparation materials recommended by roofing system manufacturer for intended use and compatible with components of **[existing and]**new membrane roofing system.
- B. Base Sheet Fasteners: Capped head, factory-coated steel fasteners, listed in FM Approval's "Approval Guide."
- C. Metal Flashing Sheet: Metal flashing sheet is specified in Section 076200 "Sheet Metal Flashing and Trim."

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect existing membrane roofing system that is indicated not to be reroofed.
 - 1. Loosely lay **1-inch-** (25-mm-) minimum thick, molded expanded polystyrene (MEPS) insulation over the roofing membrane in areas indicated. Loosely lay **15/32-inch** (12-mm) plywood or OSB panels over MEPS. Extend MEPS past edges of plywood or OSB panels a minimum of **1 inch** (25 mm).
 - 2. Limit traffic and material storage to areas of existing roofing membrane that have been protected.
 - 3. Maintain temporary protection and leave in place until replacement roofing has been completed. Remove temporary protection on completion of reroofing.
- B. Coordinate with DEN Project Manager to shut down air-intake equipment in the vicinity of the Work. Cover air-intake louvers before proceeding with reroofing work that could affect indoor air quality or activate smoke detectors in the ductwork.
- C. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.
- D. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday. Prevent debris from entering or blocking roof drains and conductors. Use roof-drain plugs specifically designed for this purpose. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.
 - 1. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new membrane roofing system, provide alternative drainage method to remove water and eliminate ponding. Do not permit water to enter into or under existing membrane roofing system components that are to remain.
- E. Verify that rooftop utilities and service piping have been shut off before beginning the Work.

3.2 ROOF TEAR-OFF

- A. General: Notify DEN Project Manager each day of extent of roof tear-off proposed for the following day and obtain prior authorization from DEN Project Manager to proceed.
- B. Remove aggregate ballast from roofing membrane.[**Store aggregate ballast for reuse.**]
- C. Remove loose aggregate from aggregate-surfaced built-up bituminous roofing using a power broom.
- D. Remove pavers and accessories from roofing membrane.[**Store and protect pavers and accessories for reuse. Discard cracked pavers.**]
- E. Remove protection mat and extruded-polystyrene insulation from protected roofing membrane.
 - 1. Discard extruded-polystyrene insulation that is wet and exceeds [8 lb/cu. ft. (128 kg/cu. m)] **<Insert maximum wet weight>**.
 - 2. Store extruded-polystyrene insulation for reuse and protect from physical damage.
- F. Roof Tear-Off: Remove existing roofing membrane and other membrane roofing system components down to the deck.
 - 1. Remove [**cover boards**] [**roof insulation**] [**and**] [**substrate boards**].
 - 2. Bitumen and felts that are firmly bonded to concrete decks are permitted to remain if felts are dry. Remove unadhered bitumen and felts and wet felts.
 - 3. Remove excess asphalt from steel deck. A maximum of 15 lb/100 sq. ft. (0.72 kg/sq. m) of asphalt is permitted to remain on steel decks.
 - 4. Remove fasteners from deck[**or cut fasteners off slightly above deck surface**].
- G. Partial Roof Tear-Off: Where indicated, remove existing roofing membrane and other membrane roofing system components down to the deck.
 - 1. Remove [**cover boards**] [**roof insulation**] [**and**] [**substrate boards**].
 - 2. Bitumen and felts that are firmly bonded to concrete decks are permitted to remain if felts are dry. Remove unadhered bitumen and felts and wet felts.
 - 3. Remove excess asphalt from steel deck. A maximum of 15 lb/100 sq. ft. (0.72 kg/sq. m) of asphalt is permitted to remain on steel decks.
 - 4. Remove fasteners from deck[**or cut fasteners off slightly above deck surface**].
- H. Partial Roof Tear-Off: Remove existing roofing membrane and immediately check for presence of moisture by visually observing [**cover boards**] [**roof insulation**] [**substrate boards**] that will remain.
 - 1. Coordinate with DEN Project Manager and Owner's inspector to schedule times for tests and inspections immediately after membrane removal.

2. With an electrical capacitance moisture-detection meter, spot check [**cover boards**] [**roof insulation**] [**substrate boards**] that will remain.
3. Remove wet or damp boards and roof insulation. [**Removal will be paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.**]
4. Bitumen and felts that are firmly bonded to concrete decks are permitted to remain if felts are dry. Remove unadhered bitumen and felts and wet felts.
5. Remove excess asphalt from steel deck. A maximum of **15 lb/100 sq. ft.** (0.72 kg/sq. m) of asphalt is permitted to remain on steel decks.
6. Remove fasteners from deck [**or cut fasteners off slightly above deck surface**].

3.3 DECK PREPARATION

- A. Inspect deck after [**partial**] tear-off of membrane roofing system.
- B. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263 or by pouring **1 pint** (0.5 L) of hot roofing asphalt on deck at start of each day's work and at start of each roof area or plane. Do not proceed with roofing work if moisture condenses under the plastic sheet or if asphalt test sample foams or can be easily and cleanly stripped after cooling.
- C. If broken or loose fasteners that secure deck panels to one another or to structure are observed or if deck appears or feels inadequately attached, immediately notify DEN Project Manager. Do not proceed with installation until directed by DEN Project Manager.
- D. If deck surface is not suitable for receiving new roofing or if structural integrity of deck is suspect, immediately notify DEN Project Manager. Do not proceed with installation until directed by DEN Project Manager.
- E. Provide additional deck securement as indicated on Drawings.
- F. Replace deck as indicated on Drawings. Replacement deck is specified in Section **<Insert Section number> "<Insert Section title>."**

3.4 INFILL MATERIALS INSTALLATION

- A. Immediately after removal of selected portions of existing membrane roofing system, and inspection and repair, if needed, of deck, fill in the tear-off areas to match existing membrane roofing system construction.
 1. Installation of infill materials is specified in Section **<Insert Section number> "<Insert Section title>."**
 2. Install new roofing membrane patch over roof infill area. If new roofing membrane is installed the same day tear-off is made, roofing membrane patch is not required.

3.5 TEMPORARY ROOFING MEMBRANE

- A. Install approved temporary roofing membrane over area to be reroofed.
- B. Install temporary roofing membrane over area to be reroofed. [**Install two glass-fiber felts**] [**Mechanically fasten base sheet and install a glass-fiber felt**], lapping each sheet **19 inches** (483 mm) over preceding sheet. Embed glass-fiber felt in a solid mopping of hot roofing asphalt applied within equiviscous temperature range. Glaze-coat completed surface with hot roofing asphalt.
- C. Remove temporary roofing membrane before installing new roofing membrane.
- D. Prepare the temporary roof to receive new roofing membrane [**according to approved temporary roofing membrane proposal**] [**by patching and repairing temporary roofing membrane**] <Insert preparation method>. Restore temporary roofing membrane to watertight condition. Obtain approval for temporary roof substrate from roofing membrane manufacturer and DEN Project Manager before installing new roof.

3.6 ROOF RE-COVER PREPARATION

- A. Remove blisters, ridges, buckles, [**mechanically attached roofing membrane fastener buttons projecting above the membrane,**] and other substrate irregularities from existing roofing membrane that inhibit new recover boards from conforming to substrate.
 - 1. Remove loose aggregate from aggregate-surfaced built-up bituminous roofing with a power broom.
 - 2. Scarify the surface of sprayed polyurethane foam as necessary to achieve a sufficiently uniform plane to receive new recover boards.
 - 3. Broom clean existing substrate.
 - 4. Coordinate with Owner's inspector to schedule times for tests and inspections before proceeding with installation of recover boards.
 - 5. Verify that existing substrate is dry before proceeding with installation of recover boards. Spot check substrates with an electrical capacitance moisture-detection meter.
 - 6. Remove materials that are wet or damp. Removal will be paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.
- B. Remove blisters, ridges, buckles, [**mechanically attached roofing membrane fastener buttons projecting above the membrane,**] and other substrate irregularities from existing roofing membrane that inhibit new [**recover boards**] [**roofing membrane**] from conforming to substrate.
 - 1. Remove loose aggregate from aggregate-surfaced built-up bituminous roofing with a power broom.
 - 2. Scarify the surface of sprayed polyurethane foam as necessary to achieve a sufficiently uniform plane to receive new [**recover boards**] [**roofing membrane**].
 - 3. Broom clean existing substrate.

4. Coordinate with DEN Project Manager and Owner's inspector to schedule times for tests and inspections.
 5. Verify that existing substrate is dry before proceeding with installation. Spot check substrates with an electrical capacitance moisture-detection meter.
 6. Remove materials that are wet and damp. Removal will be paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.
- C. Remove blisters and areas of membrane not fully adhered.
- D. Remove[**mechanically attached roofing membrane fastener buttons projecting above the membrane and other**] substrate irregularities that inhibit new recover boards from conforming to substrate.
1. Remove loose aggregate from aggregate-surfaced built-up bituminous roofing with a power broom.
 2. Clean substrate of contaminants such as dirt, debris, oil, and grease that can affect adhesion of coated foamed roofing.
 3. Power vacuum the existing roof surface. If recommended by foam manufacturer, prime dried surface at recommended rate with recommended primer.
 4. Scarify the surface of coated polyurethane roofing as necessary to achieve a suitable substrate for new roofing.
 5. Provide additional uplift securement for existing roofing system with new screws and plates applied to each roof zone at the following densities:
 - a. Field of roof, one fastener for each **<Insert area>**.
 - b. Corners of roof, one fastener for each **<Insert area>**.
 - c. Perimeters of roof, one fastener for each **<Insert area>**. Width of perimeter zone of roof is **<Insert dimension>**.
 6. Verify that surface is dry by pressing litmus paper to surface areas most likely to retain moisture, such as shaded areas and low spots. If paper changes color, surface is too wet to apply foam.
 7. Build up isolated low spots on existing roofing membrane with sprayed foam specified in Section 075700 "Coated Foamed Roofing" to prevent ponding.
- 3.7 EXISTING BASE FLASHINGS
- A. Remove existing base flashings around parapets, curbs, walls, and penetrations.
1. Clean substrates of contaminants such as asphalt, sheet materials, dirt, and debris.
- B. Do not damage metal counterflashings that are to remain. Replace metal counterflashings damaged during removal with counterflashings [**of same metal, weight or thickness, and finish.**] [**specified in Section 076200 "Sheet Metal Flashing and Trim."**] [**specified in Section 077100 "Roof Specialties."**]
- C. Inspect parapet sheathing for deterioration and damage. If parapet sheathing has deteriorated, immediately notify DEN Project Manager.

- D. Remove existing parapet sheathing and replace with new [**pressure-preservative**] [**exterior fire-retardant**]-treated plywood sheathing, [**19/32 inch (15 mm)**] <Insert **thickness**> thick. If parapet framing has deteriorated, immediately notify DEN Project Manager.
- E. Plywood parapet sheathing is specified in [**Section 061000 "Rough Carpentry."**] [**Section 061053 Miscellaneous Rough Carpentry."**]

3.8 FASTENER PULL-OUT TESTING

- A. [**Perform**] [**Retain independent testing and inspecting agency to conduct**] fastener pull-out tests according to SPRI FX-1, and submit test report to DEN Project Manager and roofing membrane manufacturer before installing new membrane roofing system.
 - 1. Obtain DEN Project Manager's and roofing membrane manufacturer's approval to proceed with specified fastening pattern. DEN Project Manager and roofing membrane manufacturer may furnish revised fastening pattern commensurate with pullout test results.

3.9 RECOVER BOARD INSTALLATION

- A. Install recover boards over [**roof insulation**] [**roofing membrane**] with long joints in continuous straight lines and end joints staggered between rows. Loosely butt recover boards together[**and fasten to deck**].
 - 1. Tape joints of recover boards if required by roofing membrane manufacturer.
- B. Fasten recover boards to resist wind-uplift pressure at corners, perimeter, and field of roof specified in [**Section 075113 "Built-up Asphalt Roofing."**] [**Section <Insert Section number> "<Insert Section title>."**]
 - 1. Install additional fasteners near board corners and edges as necessary to conform boards to substrate and to adjacent boards.

3.10 DISPOSAL

- A. Collect demolished materials and place in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
 - 1. Storage or sale of demolished items or materials on-site is not permitted.
- B. Transport and legally dispose of demolished materials off Owner's property in landfill approved by DEN.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

1. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 070150.19

SECTION 071113 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Hot-applied asphalt dampproofing.
 - 2. Cold-applied, cut-back-asphalt dampproofing.
 - 3. Cold-applied, emulsified-asphalt dampproofing.
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete" for bituminous vapor retarders.
 - 2. **[Section 042000 "Unit Masonry"] [Section 042200 "Concrete Unit Masonry"]** for mortar parge coat on masonry surfaces.
 - 3. **[Section 071326 "Self-Adhering Sheet Waterproofing"] [Section 071353 "Elastomeric Sheet Waterproofing"] [Section 071354 "Thermoplastic Sheet Waterproofing"] [Section 071413 "Hot Fluid-Applied Rubberized Asphalt Waterproofing"] [Section 071416 "Cold Fluid-Applied Waterproofing"]** for waterproofing.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Submit manufacturer's technical product data, installation instructions, and recommendations for each dampproofing material required.
 - 1. Include data substantiating that materials comply with specified requirements.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.2: For dampproofing, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit IEQ 4: For dampproofing, documentation indicating that products comply with the testing and product requirements of the

California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.4 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Installer shall provide a certificate that he is approved by the manufacturer for this installation.
2. Installer to provide a certificate indicating that dampproofing has been installed per requirements of this Section.
3. Manufacturer shall submit a certificate indicating that he has not less than five (5) years experience in the manufacturing of the types of products specified.

1.5 FIELD CONDITIONS

- A. Substrate: Proceed with dampproofing work only after substrate construction and penetrating work have been completed.
- B. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.
- C. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

1.6 QUALITY ASSURANCE

- A. General: For each type of work, obtain primary materials from single manufacturer, to greatest extent possible. Provide secondary materials only as recommended by manufacturer of primary materials.
- B. Installer Qualifications: A firm which has specialized for not less than three (3) years in installation of types of dampproofing required for project and which is acceptable to manufacturer of primary materials.

1.7 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Provide bituminous dampproofing materials that comply with the following requirements, or provide other similar products that are certified in writing by manufacturer of primary dampproofing materials to be superior in performance for application indicated.
- B. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide[**protection course**] [**molded-sheet drainage panels**] [and]auxiliary materials recommended in writing by manufacturer of primary materials.
- C. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction unless otherwise required.

2.2 HOT-APPLIED ASPHALT DAMPPROOFING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Owens Corning Roofing and Asphalt, LLC; Trumbull Division.
 - 2. **<Insert manufacturer's name>**.
 - 3. or approved equal.
- B. Hot-Applied Asphalt: ASTM D 449, [**Type II**] [**Type III**].
- C. VOC Content: [**250**] **<Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Low-Emitting Materials: Dampproofing shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 COLD-APPLIED, CUT-BACK-ASPHALT DAMPPROOFING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. APOC, Inc.; a division of Gardner-Gibson.
 - 2. BASF Construction Chemicals - Building Systems; Sonneborn Brand Products.
 - 3. Brewer Company (The).
 - 4. ChemMasters, Inc.
 - 5. Euclid Chemical Company (The); an RPM company.
 - 6. Henry Company.
 - 7. Karnak Corporation.

8. Koppers Inc.
 9. Malarkey Roofing Products.
 10. Meadows, W. R., Inc.
 11. **<Insert manufacturer's name>**.
 12. or approved equal.
- B. Trowel Coats: ASTM D 4586, Type I, Class 1, fibered.
- C. Brush and Spray Coats: ASTM D 4479, Type I, fibered[**or nonfibered**].
- D. VOC Content: [**250**] [**300**] **<Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Low-Emitting Materials: Dampproofing shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. APOC, Inc.; a division of Gardner-Gibson.
 2. BASF Construction Chemicals - Building Systems; Sonneborn Brand Products.
 3. Brewer Company (The).
 4. ChemMasters, Inc.
 5. Euclid Chemical Company (The); an RPM company.
 6. Gardner-Gibson, Inc.
 7. Henry Company.
 8. Karnak Corporation.
 9. Koppers Inc.
 10. Malarkey Roofing Products.
 11. Meadows, W. R., Inc.
 12. **<Insert manufacturer's name>**.
 13. or approved equal.
- B. Trowel Coats: ASTM D 1227, Type II, Class 1.
- C. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.
- D. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.
- E. VOC Content: [**Zero**] [**30 g/L or less**] **<Insert value>**.
- F. Low-Emitting Materials: Dampproofing shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.
- B. Cut-Back-Asphalt Primer: ASTM D 41.
- C. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.
 - 1. Primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.
- E. Patching Compound: [**Epoxy or latex-modified repair mortar**] [**Asbestos-free fibered mastic**] of type recommended in writing by dampproofing manufacturer.
- F. Protection Course: ASTM D 6506, **1/8-inch**- (3-mm-) thick, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners.
- G. Protection Course: Fan folded, with a core of extruded-polystyrene board insulation faced on [**one side**] [**or**] [**both sides**] with plastic film, nominal thickness **1/4 inch** (6 mm), with a compressive strength of not less than **8 psi** (55 kPa) per ASTM D 1621, and maximum water absorption by volume of 0.6 percent per ASTM C 272.
- H. Protection Course: Extruded-polystyrene board insulation, unfaced, ASTM C 578, Type X, **1/2 inch** (13 mm) thick.
- I. Protection Course: Smooth-surfaced roll roofing complying with ASTM D 6380, Class S, Type III.

2.6 MOLDED-SHEET DRAINAGE PANELS

- A. Molded-Sheet Drainage Panel: Comply with Section 334600 "Subdrainage."
- B. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding **No. 70** (0.21-mm) sieve laminated to one side of the core; and with a vertical flow rate of **9 to 15 gpm per ft.** (112 to 188 L/min. per m).
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Hydrotech, Inc.
 - b. Carlisle Coatings & Waterproofing Inc.

- c. Grace, W. R., & Co. - Conn.
- d. Protecto Wrap Company.
- e. **<Insert manufacturer's name>**.
- f. or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions with Applicator present, for compliance with requirements for surface smoothness, surface moisture, and other conditions affecting performance of bituminous dampproofing work.
 - 1. Test for surface moisture according to ASTM D 4263.
- B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- B. Clean substrates of projections and substances detrimental to the dampproofing work; fill voids, seal joints, and remove bond breakers if any, as recommended in writing by prime material manufacturer.
- C. Install accessories recommended by prime materials manufacturer.
- D. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections[; **cover with asphalt-coated glass fabric**].

3.3 APPLICATION, GENERAL

- A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless more stringent requirements are indicated.
 - 1. Apply dampproofing to provide continuous plane of protection.
 - 2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.
- B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of **6 inches (150 mm)** over outside face of footing.

1. Extend dampproofing **12 inches** (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
 2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an **8-inch-** (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.
- C. Where dampproofing exterior face of inner wythe of exterior masonry cavity walls, lap dampproofing at least **1/4 inch** (6 mm) onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.
1. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe.
 2. Lap dampproofing at least **1/4 inch** (6 mm) onto shelf angles supporting veneer.
- D. Where dampproofing interior face of above-grade, exterior [**concrete**] [**and**] [**masonry**] [**single-wythe masonry**] walls, continue dampproofing through intersecting walls by keeping vertical mortar joints at intersection temporarily open or by dampproofing wall before constructing intersecting walls.

3.4 HOT-APPLIED ASPHALT DAMPPROOFING

- A. Do not apply hot asphalt when substrate condition causes foaming.
- B. Kettle Temperature: Comply with dampproofing-material manufacturer's written instructions, and keep at least **25 deg F** (14 deg C) below the flash point.
- C. Prime masonry and other porous substrates.
- D. Apply a uniform coat of hot asphalt by mopping or spraying at not less than **20 lb or 2.5 gal./100 sq. ft.** (1 kg or 1 L/sq. m).
 1. Apply a second coat [**to below-grade foundation walls**] [**and**] [**where first application has failed to produce a smooth surface and uninterrupted coverage**]. Apply second coat at the rate specified for first coat.

3.5 COLD-APPLIED, CUT-BACK-ASPHALT DAMPPROOFING

- A. Concrete Foundations[**and Parged Masonry Foundation Walls**]: Apply [**two brush or spray coats at not less than 1.25 gal./100 sq. ft.** (0.5 L/sq. m) **for first coat and 1 gal./100 sq. ft.** (0.4 L/sq. m) **for second coat**] [**or**] [**one trowel coat at not less than 4 gal./100 sq. ft.** (1.6 L/sq. m)].
- B. Unparged Masonry Foundation Walls: Apply [**primer and two brush or spray coats at not less than 1.25 gal./100 sq. ft.** (0.5 L/sq. m) **for first coat and 1 gal./100 sq. ft.** (0.4 L/sq. m) **for second coat**] [**or**] [**primer and one trowel coat at not less than 4 gal./100 sq. ft.** (1.6 L/sq. m)].

- C. Unexposed Face of Concrete Retaining Walls: Apply one brush or spray coat at not less than **1.25 gal./100 sq. ft.** (0.5 L/sq. m).
- D. Unexposed Face of Masonry Retaining Walls: Apply primer and one brush or spray coat at not less than **1.25 gal./100 sq. ft.** (0.5 L/sq. m).
- E. Concrete Backup for **[Brick Veneer Assemblies] [Stone Veneer Assemblies] [and] [Dimension Stone Cladding]**: Apply one brush or spray coat at not less than **1 gal./100 sq. ft.** (0.4 L/sq. m).
- F. Masonry Backup for **[Brick Veneer Assemblies] [Stone Veneer Assemblies] [and] [Dimension Stone Cladding]**: Apply primer and one brush or spray coat at not less than **1 gal./100 sq. ft.** (0.4 L/sq. m).
- G. Exterior Face of Inner Wythe of Cavity Walls: Apply primer and one brush or spray coat at not less than **1 gal./100 sq. ft.** (0.4 L/sq. m).

3.6 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Concrete Foundations[**and Parged Masonry Foundation Walls**]: Apply **[two brush or spray coats at not less than 1.5 gal./100 sq. ft.** (0.6 L/sq. m) **for first coat and 1 gal./100 sq. ft.** (0.4 L/sq. m) **for second coat]** **[one fibered brush or spray coat at not less than 3 gal./100 sq. ft.** (1.2 L/sq. m)] **[or] [one trowel coat at not less than 4 gal./100 sq. ft.** (1.6 L/sq. m)].
- B. Unparged Masonry Foundation Walls: Apply **[primer and two brush or spray coats at not less than 1.5 gal./100 sq. ft.** (0.6 L/sq. m) **for first coat and 1 gal./100 sq. ft.** (0.4 L/sq. m) **for second coat]** **[primer and one fibered brush or spray coat at not less than 3 gal./100 sq. ft.** (1.2 L/sq. m)] **[or] [primer and one trowel coat at not less than 5 gal./100 sq. ft.** (2 L/sq. m)].
- C. Unexposed Face of Concrete Retaining Walls: Apply one brush or spray coat at not less than **1.25 gal./100 sq. ft.** (0.5 L/sq. m).
- D. Unexposed Face of Masonry Retaining Walls: Apply primer and one brush or spray coat at not less than **1.25 gal./100 sq. ft.** (0.5 L/sq. m).
- E. Concrete Backup for **[Brick Veneer Assemblies] [Stone Veneer Assemblies] [and] [Dimension Stone Cladding]**: Apply one brush or spray coat at not less than **1 gal./100 sq. ft.** (0.4 L/sq. m).
- F. Masonry Backup for **[Brick Veneer Assemblies] [Stone Veneer Assemblies] [and] [Dimension Stone Cladding]**: Apply primer and one brush or spray coat at not less than **1 gal./100 sq. ft.** (0.4 L/sq. m).
- G. Exterior Face of Inner Wythe of Cavity Walls: Apply primer and one brush or spray coat at not less than **1 gal./100 sq. ft.** (0.4 L/sq. m).

- H. Interior Face of Exterior Concrete Walls: Where above grade and indicated to be furred and finished, apply one brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).
- I. Interior Face of [**Single-Wythe**] Exterior Masonry Walls: Where above grade and indicated to be furred and finished, apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

3.7 INSTALLATION OF PROTECTION COURSE

- A. Where indicated, install protection course over completed-and-cured dampproofing. Comply with dampproofing-material and protection-course manufacturers' written instructions for attaching protection course.
 - 1. Support protection course over cured coating with spot application of adhesive type recommended in writing by protection-board manufacturer.
 - 2. Install protection course [**on same day**] [**within 24 hours**] of installation of dampproofing (while coating is tacky) to ensure adhesion.

3.8 INSTALLATION OF MOLDED-SHEET DRAINAGE PANELS

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall substrate, according to manufacturer's written instructions. Use adhesives or other methods that do not penetrate dampproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.
 - 1. Install protection course before installing drainage panels.

3.9 CLEANING

- A. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 071113

SECTION 071326 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Modified bituminous sheet waterproofing.
2. Modified bituminous sheet waterproofing, fabric reinforced.
3. Modified bituminous deck-paving sheet waterproofing.
4. Bonded HDPE or polyethylene sheet waterproofing.

- B. Related Requirements:

1. Section 079500 "Expansion Control" for plaza- or foundation-wall expansion-joint assemblies that interface with waterproofing.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.

1. Pre Application Conference: Approximately two (2) weeks prior to actual commencement of waterproofing installation, meet at project site with Installer, installers of deck or substrate construction to receive work, installers of other work in and around waterproofing work which must precede, follow or penetrate waterproofing work (including mechanical work if any), DEN Project Manager, the Contractor's Quality Control Manager and waterproofing material manufacturer's representative. Record (Contractor) discussions of conference, together with decisions and agreements (or disagreements) reached. Furnish copy of record to each party attending. Review methods and procedures related to work, including but not necessarily limited to the following:
 - a. Tour jobsite areas to be waterproofed. Inspect and discuss condition of substrate, drains, curbs, penetrations, and other preparatory work performed by other trades.

- b. Review waterproofing requirements (drawings, specifications and other contract documents), including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.
- c. Review required submittals. Work cannot begin until all submittals are approved by Owner.
- d. Review and finalize construction schedule related to waterproofing work and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- e. Review required inspection, testing, and certifying procedures, safety, and hazardous control programs.
- f. Review protection and repair procedures.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
3. Include data substantiating that materials comply with specified requirements.

B. LEED Submittals:

1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

C. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

D. Samples: For each exposed product and for each color and texture specified, including the following products, in minimum 1' x 1' sizes unless otherwise indicated:

1. Waterproofing and flashing sheet.
2. Insulation.
3. Drainage panel.
4. Plaza-deck paver, [4-by-4-inch (100-by-100-mm) square] [full sized], in each color and texture required.
5. Paver pedestal assembly.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Installer shall provide a certificate that he is approved by the manufacturer for this installation.
- C. Installer to submit a certificate evidencing not less than five (5) years of successful experience installing similar types to products specified.
- D. Installer to provide a certificate indicating that waterproofing has been installed per requirements of this section.
- E. Manufacturer shall submit a certificate indicating that he has not less than five (5) years experience in the manufacturing of the types of products specified.
- F. Manufacturer to submit a report that all work is being done per contract requirements.
- G. Field quality-control reports.
- H. Provide a certificate that bellows are jet fuel resistant.
- I. Provide a certificate stating that waterproofing and protection board to be used at the horizontal and vertical surfaces of the basement extension has been tested for jet fuel resistance and that the required warranty applies to this work. Provide the actual test report.
 - 1. Minimum Requirements: For waterproofing, expansion joint covers and any associated joints, no loss in waterproofing ability within 48 hours after ponding jet fuel for 72 hours. For protection board, no loss in protection within 48 hours after being immersed in jet fuel for 72 hours.
- J. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. General: For each type of work, obtain primary materials from single manufacturer, with not less than three (5) years of successful experience in supplying principal materials for waterproofing work. Provide secondary materials only as recommended by manufacturer of primary materials.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1. A firm that has specialized for not less than five (5) years in installation of types of dampproofing required for project and which is acceptable to manufacturer of primary materials.
 2. Assign work closely associated with waterproofing, including (but not limited to) waterproofing accessories, and flashings used in conjunction with waterproofing, expansion joints in membrane, insulation and protection course on membrane, to installer of waterproofing, for single, undivided responsibility.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for installation.
1. Build for each typical waterproofing installation including[**pavers and**] accessories to demonstrate surface preparation, crack and joint treatment, corner treatment, and protection.
 - a. Size: [**100 sq. ft. (9.3 sq. m) in area**] [**As shown on Drawings**].
 - b. Description: Each type of [**wall**] [**deck**] [**and**] [**plaza**] <Insert description> installation.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 FIELD CONDITIONS

- A. Substrate: Proceed with dampproofing work only after substrate construction and penetrating work have been completed.
- B. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
1. Do not apply waterproofing in snow, rain, fog, or mist.
- C. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.9 WARRANTY

- A. Manufacturer's Warranty: Manufacturer's standard materials-only warranty in which manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
1. Warranty Period: Minimum [**Five**] <Insert number> years from date of Substantial Completion.

- B. Installer's Special Warranty: Specified form, [**on warranty form at end of this Section**,]signed by Installer, covering Work of this Section, for warranty period of minimum [**five**] <Insert number> years.
1. Warranty includes excavation, removing, and reinstalling protection board, drainage panels, insulation, pedestals, and pavers on plaza decks.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. General Compatibility: Provide products that are recommended by manufacturer to be fully compatible with indicated substrates.
- B. Source Limitations for Waterproofing System: Obtain waterproofing materials[, **protection course,**] [**and**] [**molded-sheet drainage panels**] from single source from single manufacturer.
- C. Source Limitations for Plaza-Deck Paving: Obtain plaza-deck pavers[**and paver pedestals**] from single source from single manufacturer.

2.2 MODIFIED BITUMINOUS SHEET WATERPROOFING

- A. Modified Bituminous Sheet: Minimum **60-mil** (1.5-mm) nominal thickness, self-adhering sheet consisting of **56 mils** (1.4 mm) of rubberized asphalt laminated on one side to a **4-mil-** (0.10-mm-) thick, polyethylene-film reinforcement, and with release liner on adhesive side[; **formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction**].
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. American Hydrotech, Inc.; VM75.
 - b. Carlisle Coatings & Waterproofing Inc.; CCW MiraDRI 860/861.
 - c. CETCO Building Materials Group, a subsidiary of AMCOL International Corp.; Envirosheet.
 - d. Grace, W. R., & Co. - Conn.; [**Bituthene 3000/Low Temperature**] [**or**] [**Bituthene 4000**].
 - e. Henry Company; Blueskin WP 100/200.
 - f. Meadows, W. R., Inc.; SealTight Mel-Rol.
 - g. Nervastral, Inc.; BITU-MEM.
 - h. Polyguard Products, Inc.; Polyguard 650.

- i. Protecto Wrap Company; PW 100/60.
 - j. Tamko Building Products, Inc.; TW-60.
 - k. York Manufacturing, Inc.; HydroGard.
 - l. **<Insert manufacturer's name; product name or designation>**.
 - m. or approved equal.
2. Physical Properties:
- a. Tensile Strength, Membrane: **250 psi** (1.7 MPa) minimum; ASTM D 412, Die C, modified.
 - b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
 - c. Low-Temperature Flexibility: Pass at **minus 20 deg F** (minus 29 deg C); ASTM D 1970.
 - d. Crack Cycling: Unaffected after 100 cycles of **1/8-inch** (3-mm) movement; ASTM C 836.
 - e. Puncture Resistance: **40 lbf** (180 N) minimum; ASTM E 154.
 - f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at **70 deg F** (21 deg C); ASTM D 570.
 - g. Water Vapor Permeance: **0.05 perms** (2.9 ng/Pa x s x sq. m) maximum; ASTM E 96/E 96M, Water Method.
 - h. Hydrostatic-Head Resistance: [**200 feet (60 m)**] **<Insert value>** minimum; ASTM D 5385.
3. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.
- B. Modified Bituminous Sheet, Fabric Reinforced: Minimum **60-mil** (1.5-mm) nominal thickness, self-adhering sheet consisting of rubberized-asphalt membrane with embedded fabric reinforcement, and with release liner on adhesive side.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Protecto Wrap Company; Jiffy Seal 140/60.
 - b. Royston, Div. of Chase Specialty Coatings; [**104AHT Membrane**] [**Royal-Gard Plus Membrane 104ARHT**].
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
 2. Physical Properties:
 - a. Pliability: No cracks when bent 180 degrees over a **1-inch** (25-mm) mandrel at **minus 25 deg F** (minus 32 deg C); ASTM D 146.
 - b. Puncture Resistance: [**40 lbf (180 N)**] [**100 lbf (445 N)**] minimum; ASTM E 154.
 - c. Water Vapor Permeance: **0.05 perms** (2.9 ng/Pa x s x sq. m) maximum; ASTM E 96/E 96M, Water Method.
 3. Sheet Strips: Self-adhering, reinforced, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

2.3 MODIFIED BITUMINOUS DECK-PAVING SHEET WATERPROOFING

- A. Modified Bituminous Deck-Paving Sheet: Minimum **65-mil** (1.6-mm) nominal thickness, self-adhering sheets designed to be overlaid with asphalt paving; consisting of rubberized-asphalt membrane with woven or nonwoven fabric reinforcement laminated to one surface or embedded within the membrane, and with release liner on adhesive side.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.; [**Pre-Pave CCW 711W**] [or] [**Pre-Pave CCW 711NW**].
 - b. Meadows, W. R., Inc.; SealTight Mel-Dek.
 - c. Polyguard Products, Inc.; [**Polyguard 665**] [or] [**Polyguard NW-75**].
 - d. Protecto Wrap Company; Jiffy Seal 400.
 - e. Royston, Div. of Chase Specialty Coatings; [**Bridge Waterproofing Membrane 10A**] [**Bridge Waterproofing Membrane 10A Easy Pave**] [**Bridge Waterproofing Membrane 10A-65**] [**Bridge and Railroad Bridge Membrane 10A 90 MIL**].
 - f. <Insert manufacturer's name; product name or designation>.
 - g. or approved equal.
 2. Physical Properties:
 - a. Tensile Strength, Membrane: [**50 lbf/in. (8.75 kN/m)**] <Insert value> minimum; ASTM D 882.
 - b. Pliability: Unaffected when bent 180 degrees over a **1/4-inch** (6.4-mm) mandrel at **minus 15 deg F** (minus 26 deg C); ASTM D 146.
 - c. Puncture Resistance, Mesh: [**40 lbf (180 N)**] [**100 lbf (445 N)**] [**200 lbf (890 N)**] minimum; ASTM E 154.
 3. Sheet Strips: Self-adhering, reinforced, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

2.4 BONDED HDPE OR POLYETHYLENE SHEET WATERPROOFING

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Vertical Applications:
 - a. Grace, W. R., & Co. - Conn.; Preprufe 160R[**with Preprufe Tie-Back Covers**].
 - b. Polyguard Products, Inc.; Underseal Blindside Membrane.
 - c. <Insert manufacturer's name; product name or designation>.
 - d. or approved equal.
 2. Horizontal Applications:
 - a. Grace, W. R., & Co. - Conn.; Preprufe 300R.
 - b. Polyguard Products, Inc.; Underseal Underslab Membrane.

- c. **<Insert manufacturer's name; product name or designation>**.
- d. or approved equal.

B. Bonded HDPE Sheet for Vertical Applications: Uniform, flexible, multilayered-composite sheet membrane consisting of either a HDPE film coated with a pressure-sensitive adhesive and protective release liner, total **32-mil** (0.8-mm) thickness, or an HDPE film coated with a modified asphalt layer and a nonwoven geotextile-fabric final layer, total **73-mil** (1.9-mm) thickness; with the following physical properties:

1. Tensile Strength, Film: **4000 psi** (27.6 MPa) minimum; ASTM D 412.
2. Low-Temperature Flexibility: Pass at **minus 10 deg F** (minus 23 deg C); ASTM D 1970.
3. Peel Adhesion to Concrete: **5 lbf/in.** (875 N/m) minimum; ASTM D 903, modified.
4. Lap Adhesion: **2.5 lbf/in.** (440 N/m) minimum; ASTM D 1876, modified.
5. Hydrostatic-Head Resistance: **231 feet** (70 m); ASTM D 5385, modified.
6. Puncture Resistance: **100 lbf** (445 N) minimum; ASTM E 154.
7. Water Vapor Permeance: **0.01 perms** (0.6 ng/Pa x s x sq. m) maximum; ASTM E 96/E 96M, Water Method.
8. Water Absorption: 0.5 percent maximum; ASTM D 570.

C. Bonded HDPE or Polyethylene Sheet for Horizontal Applications: Uniform, flexible, multilayered-composite sheet membrane consisting of either an HDPE film coated with pressure-sensitive adhesive and protective release liner, total **46-mil** (1.2-mm) thickness, or a cross-laminated film of low- and medium-density polyethylene, coated with a modified asphalt layer and a nonwoven geotextile-fabric final layer, total **95-mil** (2.4-mm) thickness; with the following physical properties:

1. Tensile Strength, Film: **2000 psi** (13.8 MPa) minimum; ASTM D 412.
2. Low-Temperature Flexibility: Pass at **minus 10 deg F** (minus 23 deg C); ASTM D 1970.
3. Peel Adhesion to Concrete: **5 lbf/in.** (875 N/m) minimum; ASTM D 903, modified.
4. Lap Adhesion: **2.5 lbf/in.** (440 N/m) minimum; ASTM D 1876, modified.
5. Hydrostatic-Head Resistance: **231 feet** (70 m); ASTM D 5385, modified.
6. Puncture Resistance: **200 lbf** (890 N) minimum; ASTM E 154.
7. Water Vapor Permeance: **0.01 perms** (0.6 ng/Pa x s x sq. m) maximum; ASTM E 96/E 96M, Water Method.
8. Water Absorption: 0.5 percent maximum; ASTM D 570.

D. Mastic, Adhesives, and Detail Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.

2.5 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

- B. Primer: Liquid [**waterborne**] [**solvent-borne**] primer recommended for substrate by sheet-waterproofing material manufacturer.
- C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.
- D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.
- E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.
- F. Metal Termination Bars: Aluminum bars, approximately **1 by 1/8 inch** (25 by 3 mm) thick, predrilled at **9-inch** (229-mm) centers.
- G. Protection Course: ASTM D 6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:
1. Thickness: [**1/8 inch (3 mm)**] [**1/4 inch (6 mm)**], nominal.
 2. Thickness: **1/8 inch** (3 mm), nominal, for vertical applications; **1/4 inch** (6 mm), nominal, elsewhere.
 3. Adhesive: Rubber-based solvent type recommended by waterproofing manufacturer for protection course type.
- H. Protection Course: Fan folded, with a core of extruded-polystyrene board insulation faced on [**one side**] [**or**] [**both sides**] with plastic film, nominal thickness **1/4 inch** (6 mm), with compressive strength of not less than **8 psi** (55 kPa) per ASTM D 1621, and maximum water absorption by volume of 0.6 percent per ASTM C 272.
- I. Protection Course: Extruded-polystyrene board insulation, unfaced, ASTM C 578, Type X, **1/2 inch** (13 mm) thick.
- J. Protection Course: Molded-polystyrene board insulation, ASTM C 578, Type I, **0.90-lb/cu. ft.** (15-kg/cu. m) minimum density, **1-inch** (25-mm) minimum thickness.
- K. Bellows: Where bellows are indicated on the drawings as in contact with the waterproof membrane, provide either 24-gauge soft copper or 60 mil flexible sheet membrane that is jet fuel resistant and compatible with waterproof membrane. Bellows shall be as indicated and shall lap waterproof membrane a minimum 6" per side.
- 2.6 MOLDED-SHEET DRAINAGE PANELS
- A. Molded-Sheet Drainage Panel: Comply with Section 334600 "Subdrainage."
- B. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding **No. 70** (0.21-mm) sieve laminated to one side of the core[

and a polymeric film bonded to the other side]; and with a vertical flow rate of **9 to 15 gpm per ft.** (112 to 188 L/min. per m).

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. American Hydrotech, Inc.; [**Hydrodrain 400**] [or] [**Hydrodrain 420**].
 - b. Carlisle Coatings & Waterproofing Inc.; [**CCW MiraDRAIN 6000**] [**CCW MiraDRAIN 6000XL**] [**CCW MiraDRAIN 6200**] [or] [**CCW MiraDRAIN 6200XL**].
 - c. Grace, W. R., & Co. - Conn.; [**Hydroduct 220**] [or] [**Hydroduct 660**].
 - d. Protecto Wrap Company; Protecto Drain 2000-V.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.

- C. Woven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panels consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a woven-geotextile facing with an apparent opening size not exceeding **No. 40** (0.425-mm) sieve laminated to one side of the core[**and a polymeric film bonded to the other side**]; and with a horizontal flow rate not less than **2.8 gpm per ft.** (35 L/min. per m).
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. American Hydrotech, Inc.; Hydrodrain 700.
 - b. Carlisle Coatings & Waterproofing Inc.; [**CCW MiraDRAIN 9000**] [or] [**CCW MiraDRAIN 9900**].
 - c. Grace, W. R., & Co. - Conn.; Hydroduct 225.
 - d. Protecto Wrap Company; Protecto Drain 2000-H.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.

- D. High-Capacity, Molded-Sheet Collector-Panel System: Composite subsurface collector-panel system by same manufacturer as primary molded-sheet drainage panels; consisting of a high-profile, studded, nonbiodegradable, molded-plastic-sheet drainage core; with a woven-geotextile facing with an apparent opening size not exceeding **No. 40** (0.425-mm) sieve laminated to one side of the core[**and a polymeric film bonded to the other side**]; and with a vertical flow rate of **9 to 15 gpm per ft.** (112 to 188 L/min. per m) and a horizontal flow rate [**as indicated on Drawings**] **<Insert requirement>**. Provide system with manufacturer's outlets, connectors, tapes, and other accessories to connect primary molded-sheet drainage panels with piped subdrainage system specified in Section 334600 "Subdrainage."
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.; CCW QuickDRAIN.
 - b. Grace, W. R., & Co. - Conn.; Hydroduct Coil 600.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.

2.7 INSULATION

- A. Insulation, General: Comply with Section 072100 "Thermal Insulation."
- B. Board Insulation: Extruded-polystyrene board insulation complying with ASTM C 578, shiplap edged.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning Insulating Systems LLC.
 - d. Pactiv Building Products.
 - e. T. Clear Corporation, a subsidiary of Fin Pan Inc.
 - f. <Insert manufacturer's name>.
 - g. or approved equal.
 - 2. Type IV, **25-psi** (173-kPa) minimum compressive strength.
 - 3. Type VI, **40-psi** (276-kPa) minimum compressive strength.
 - 4. Type VII, **60-psi** (414-kPa) minimum compressive strength.
 - 5. Type V, **100-psi** (690-kPa) minimum compressive strength.

2.8 INSULATION DRAINAGE PANELS

- A. Unfaced Wall-Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, [**Type IV, 25-psi** (173-kPa)] [**or**] [**Type VI, 40-psi** (276-kPa)] minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. DiversiFoam Products; [**CertiFoam 25 SL**] [**or**] [**CertiFoam 40 (with channel edges)**] Drainage Board.
 - b. Dow Chemical Company (The); Styrofoam Perimate.
 - c. <Insert manufacturer's name; product name or designation>.
 - d. or approved equal.
- B. Geotextile-Faced, Wall-Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, [**Type IV, 25-psi** (173-kPa)] [**or**] [**Type VI, 40-psi** (276-kPa)] minimum compressive strength; fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with nonwoven geotextile filter fabric.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Owens Corning Insulating Systems LLC; Insul-Drain.
 - b. T. Clear Corporation, a subsidiary of Fin Pan Inc.; [**Thermadry 750**] [**or**] [**Thermadry 1250**].
 - c. <Insert manufacturer's name; product name or designation>.

- d. or approved equal.
- C. Unfaced Plaza-Deck Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, [**Type VI, 40-psi (276-kPa)**] [**or**] [**Type VII, 60-psi (414-kPa)**] minimum compressive strength; unfaced; fabricated with shiplapped, channel, or tongue-and-groove edges and with one side having ribbed drainage channels.
1. Products: Subject to compliance with requirements, provide one of the following:
- a. American Hydrotech, Inc.; Hydroguard.
 - b. DiversiFoam Products; CertiFoam Plaza Deck.
 - c. Dow Chemical Company (The); Styrofoam Ribbed Roofmate.
 - d. Owens Corning Insulating Systems LLC; [**Foamular 404 RB**] [**Foamular 604 RB**].
 - e. <Insert manufacturer's name; product name or designation>.
 - f. or approved equal.
- D. Geotextile-Faced, Plaza-Deck Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, [**Type VI, 40-psi (276-kPa)**] [**or**] [**Type VII, 60-psi (414-kPa)**] minimum compressive strength; fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with manufacturer's standard, nonwoven geotextile filter fabric.
1. Products: Subject to compliance with requirements, provide one of the following:
- a. T. Clear Corporation, a subsidiary of Fin Pan Inc.; [**Thermadry 1250**] [**or**] [**Thermadry 1750**].
 - b. <Insert manufacturer's name; product name or designation>.
 - c. or approved equal.

2.9 PLAZA-DECK PAVERS

- A. Plaza-Deck Pavers: [**Brick**] [**Concrete**] [**Asphalt-block**] pavers specified in Section 321400 "Unit Paving."
- B. Stone Plaza-Deck Pavers: [**Granite**] [**Limestone**] [**Marble**] [**Quartz-based stone**] [**Slate**] [**Travertine**] [**Rough-stone**] pavers specified in [**Section 096340 "Stone Flooring."**] [**Section 321400 "Unit Paving"**]
1. Concrete Plaza-Deck Pavers: Solid, hydraulically pressed, standard-weight concrete units, [**square edged**] [**with top edges beveled 3/16 inch (5 mm)**], manufactured for use as plaza-deck pavers; [**7500-psi (52-MPa)**] [**6500-psi (45-MPa)**] <Insert value> minimum compressive strength, ASTM C 140; absorption not greater than 5 percent, ASTM C 140; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C 67.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hanover Architectural Products.
 - b. Roofblok Limited.
 - c. Sunny Brook Pressed Concrete Co.
 - d. Wausau Tile, Inc.
 - e. Westile Roofing Products.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
 3. Regional Materials: Concrete plaza-deck pavers shall be manufactured within **500 miles** (800 km) of Project site from aggregates[**and cement**] that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** (800 km) of Project site.
 4. Thickness: [**1-5/8 inches** (41 mm)] [**1-3/4 inches** (45 mm)] [**2 inches** (51 mm)] [**2-3/8 inches** (60 mm)] **<Insert dimension>**.
 5. Face Size: [**8-7/8 inches** (225 mm) **square**] [**9 inches** (229 mm) **square**] [**9 by 18 inches** (229 by 457 mm)] [**12 inches** (305 mm) **square**] [**12 by 24 inches** (305 by 610 mm)] [**18 inches** (457 mm) **square**] [**24 inches** (610 mm) **square**] [**As indicated**] **<Insert dimension(s) and shape>**.
 6. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] **<Insert color>**.
- C. Setting Bed: Provide [**aggregate**] [**mortar**] [**bituminous**] setting-bed materials specified in Section 321400 "Unit Paving."
- D. Paver Pedestals: Paver manufacturer's standard paver support assembly, including [**fixed-height**] [**adjustable or stackable**] pedestals, shims, and spacer tabs for joint spacing of [**1/8 inch** (3 mm)] [**3/16 inch** (5 mm)] [**1/8 to 3/16 inch** (3 to 5 mm)].
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.
 2. Concrete Fill: ACI 301, compressive strength of **5000 psi** (34 MPa) at 28 days, and air content of 6 percent.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the waterproofing.
 1. Verify that concrete has cured and aged for minimum time period recommended

- in writing by waterproofing manufacturer.
2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 3. Verify that compacted subgrade is dry, smooth, sound, and ready to receive waterproofing sheet.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
1. Install sheet strips of width according to manufacturer's written instructions and center over treated construction and contraction joints and cracks exceeding a width of **[1/16 inch (1.6 mm)] [or] [1/8 inch (3 mm) for modified bituminous deck-paving waterproofing]**.
- F. Bridge and cover **[isolation joints] [expansion joints] [and]** discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips of widths according to manufacturer's written instructions.
1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.
- G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
1. Install membrane strips centered over vertical inside corners. Install **3/4-inch (19-mm)** fillets of liquid membrane on horizontal inside corners and as follows:
 - a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.
 - b. At plaza-deck-to-wall intersections, extend liquid membrane or sheet strips onto deck waterproofing and to finished height of sheet flashing.
- H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and

penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.3 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

- A. General: Comply with manufacturer's instructions, except where more stringent requirements are shown or specified, and except where project conditions require extra precautions or provisions to ensure satisfactory performance of work.
- B. Start installation of waterproofing membrane only in presence and with advice of manufacturer's technical representative.
- C. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D 6135.
- D. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- E. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform **2-1/2-inch-** (64-mm-) minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.
 - 1. When ambient and substrate temperatures range between **25 and 40 deg F** (minus 4 and plus 5 deg C), install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than **60 deg F** (16 deg C).
- F. Two-Ply Application: Install sheets to form a membrane with lap widths not less than 50 percent of sheet widths, to provide a minimum of two thicknesses of sheet membrane over areas to receive waterproofing.
- G. Horizontal Application: Apply sheets from low to high points of decks to ensure that laps shed water.
- H. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.
- I. Seal edges of sheet-waterproofing terminations with mastic.
- J. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.
- K. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending **6 inches** (150 mm) beyond repaired areas in all directions.
- L. Immediately install protection course with butted joints over waterproofing membrane.
 - 1. **[Molded-sheet drainage panels] [Insulation drainage panels] [Board insulation]** may be used in place of a separate protection course to vertical

applications when approved by waterproofing manufacturer and installed immediately.

- M. Bellows: Lap waterproof membrane above and below bellows.

3.4 MODIFIED BITUMINOUS DECK-PAVING SHEET-WATERPROOFING APPLICATION

- A. Install modified bituminous deck-paving sheets according to waterproofing manufacturer's written instructions.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere sheets over areas to receive waterproofing. Accurately align sheets and maintain uniform **2-1/2-inch-** (64-mm-) minimum side-lap widths and **6-inch** (150-mm) end laps. Overlap and seal seams and stagger end laps to ensure watertight installation.
- D. Apply sheet waterproofing from low to high points of decks to ensure that laps shed water.
- E. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.
- F. Seal edges of sheet-waterproofing terminations with mastic.
- G. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.
- H. Repair tears, voids, and lapped seams in waterproofing that do not comply with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending **6 inches** (150 mm) beyond repaired areas in all directions.

3.5 BONDED HDPE OR POLYETHYLENE SHEET-WATERPROOFING APPLICATION

- A. Install bonded HDPE or polyethylene sheets according to manufacturer's written instructions.
- B. Place and secure molded-sheet drainage panels over substrate. Lap edges and ends of geotextile to maintain continuity.
- C. Vertical Applications: Install sheet with HDPE face against substrate. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by membrane manufacturer. Overlap and seal seams, and stagger and tape end laps to ensure watertight installation. Mechanically fasten to substrate.
 - 1. Securely fasten top termination of membrane with continuous metal termination bar anchored into substrate and cover with detailing tape.

- D. Horizontal Applications: Install sheet with HDPE or polyethylene face against substrate. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by membrane manufacturer. Overlap and seal seams, and stagger and tape end laps to ensure watertight installation.
- E. Corners: Seal lapped terminations and cut edges of sheet waterproofing at inside and outside corners with detail tape.
- F. Seal penetrations through sheet waterproofing to provide watertight seal with detail tape patches or wraps and a liquid-membrane troweling.
- G. Install sheet-waterproofing and auxiliary materials to produce a continuous watertight tie into adjacent waterproofing.
- H. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Tape perimeter of damaged or nonconforming area extending **6 inches (150 mm)** beyond repaired areas in all directions. Apply a patch of sheet waterproofing and firmly secure with detail tape.
- I. Bellows: Lap waterproof membrane above and below bellows.

3.6 MOLDED-SHEET DRAINAGE-PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesives or other methods that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.
 - 1. For vertical applications, install [**board insulation**] [**protection course**] before installing drainage panels.

3.7 INSULATION INSTALLATION

- A. Install one or more layers of board insulation to achieve required thickness over waterproofed surfaces. Cut and fit to within **3/4 inch (19 mm)** of projections and penetrations.
- B. On vertical surfaces, set insulation units in adhesive or tape applied according to manufacturer's written instructions.
- C. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.8 INSULATION DRAINAGE-PANEL INSTALLATION

- A. Install insulation drainage panels over waterproofed surfaces; cut and fit to within **3/4 inch (19 mm)** of projections and penetrations.

- B. Ensure that drainage channels are aligned and free of obstructions.
- C. On vertical surfaces, set insulation drainage panels in adhesive or tape applied according to manufacturer's written instructions.
- D. On horizontal surfaces, loosely lay insulation drainage panels according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.9 PLAZA-DECK PAVER INSTALLATION

- A. Install concrete pavers in locations indicated according to manufacturer's written instructions.
- B. Setting Bed: Install setting bed in locations and of thickness indicated. Comply with requirements in [**Section 096340 "Stone Flooring."**] [**Section 321400 "Unit Paving."**]
- C. Accurately install paver pedestals and accessories in locations and to elevations required. Adjust for final level and slope.
 - 1. Fill paver pedestal with concrete mix, strike smooth with top of pedestal, and cure according to ACI 301.
- D. Loosely lay pavers on pedestals, maintaining a uniform open joint width. Tightly seat pavers against spacers to eliminate lateral movement or drift of paving assembly. Align joint patterns parallel in each direction.
 - 1. Lay out pavers to avoid less-than-half-width pavers at perimeter or other terminations.
- E. Install pavers to not vary more than **1/16 inch (1.6 mm)** in elevation between adjacent pavers or more than **1/16 inch (1.6 mm)** from surface plane elevation of individual paver.
- F. Maintain tolerances of paving installation within [**1/4 inch in 10 feet (1:48)**] <Insert **value**> of surface plane in any direction.

3.10 FIELD QUALITY CONTROL

- A. [**Owner will engage**] [**Engage**] a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish daily reports to DEN Project Manager.
- B. Flood Testing: Flood test each deck area for leaks, according to recommendations in ASTM D 5957, after completing waterproofing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

1. Flood to an average depth of **2-1/2 inches** (64 mm) with a minimum depth of **1 inch** (25 mm) and not exceeding a depth of **4 inches** (100 mm). Maintain **2 inches** (51 mm) of clearance from top of sheet flashings.
 2. Flood each area for **[24] [48] [72]** hours.
 3. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.
- C. **[Owner will engage] [Engage]** an independent testing agency to observe flood testing and examine underside of decks and terminations for evidence of leaks during flood testing.
- D. Prepare test and inspection reports.
- 3.11 PROTECTION, REPAIR, AND CLEANING
- A. Do not permit foot or vehicular traffic on unprotected membrane.
 - B. Protect waterproofing from damage and wear during remainder of construction period.
 - C. Protect installed **[board insulation] [and] [insulation drainage panels]** from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
 - D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
 - E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 071326

SECTION 071353 - ELASTOMERIC SHEET WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. EPDM rubber sheet waterproofing.
 - 2. Butyl rubber sheet waterproofing.
- B. Related Requirements:
 - 1. Section 071354 "Thermoplastic Sheet Waterproofing" for PVC sheet waterproofing.
 - 2. Section 079500 "Expansion Control" for plaza- or foundation-wall expansion-joint assemblies that interface with waterproofing.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.
 - 1. Pre Application Conference: Approximately two (2) weeks prior to actual commencement of fluid applied waterproofing installation, meet at project site with Installer, installers of deck or substrate construction to receive work, installers of other work in and around waterproofing work which must precede, follow or penetrate waterproofing work (including mechanical work if any), DEN Project Manager the Contractor's Quality Control Manager and waterproofing material manufacturer's representative. Record (Contractor) discussions of conference, together with decisions and agreements (or disagreements) reached. Furnish copy of record to each party attending. Review methods and procedures related to work, including but not necessarily limited to the following:
 - a. Tour jobsite areas to be waterproofed. Inspect and discuss condition of substrate, drains, curbs, penetrations, and other preparatory work performed by other trades.

- b. Review waterproofing requirements (drawings, specifications and other contract documents) including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs. .
- c. Review required submittals. Work cannot begin until all submittals are approved by Owner.
- d. Review and finalize construction schedule related to waterproofing work and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- e. Review required inspection, testing, and certifying procedures, safety, and hazardous control programs.
- f. Review protection and repair procedures.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
3. Include data substantiating that materials comply with specified requirements.

B. LEED Submittals:

1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

C. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

D. Samples: For each exposed product and for each color and texture specified, including the following products in minimum 1' x 1' sizes unless otherwise indicated:

1. Waterproofing and flashing sheet.
2. Insulation.
3. Drainage panel.
4. Plaza-deck paver, [4-by-4-inch (100-by-100-mm) square] [full sized], in each color and texture required.
5. Paver pedestal assembly.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Installer shall provide a certificate that he is approved by the manufacturer for this installation.
- C. Installer to submit a certificate evidencing not less than five (5) years of successful experience installing similar types to products specified.
- D. Installer to provide a certificate indicating that waterproofing has been installed per requirements of this section.
- E. Manufacturer shall submit a certificate indicating that he has not less than five (5) years experience in the manufacturing of the types of products specified.
- F. Manufacturer to submit a report that all work is being done per contract requirements.
- G. Field quality-control reports.
- H. Provide a certificate stating that waterproofing and protection board to be used at the horizontal and vertical surfaces of the basement extension has been tested for jet fuel resistance and that the required warranty applies to this work. Provide the actual test report.
- I. Minimum Requirements: For waterproofing, expansion joint covers and any associated joints, no loss in waterproofing ability within 48 hours after ponding jet fuel for 72 hours. For protection board, no loss in protection within 48 hours after being immersed in jet fuel for 72 hours.
- J. Provide a certificate that bellows are jet fuel resistant.
- K. Provide a certificate stating that waterproofing and protection board to be used at the horizontal and vertical surfaces of the basement extension has been tested for jet fuel resistance and that the required warranty applies to this work. Provide the actual test report.
 - 1. Minimum Requirements: For waterproofing, expansion joint covers and any associated joints, no loss in waterproofing ability within 48 hours after ponding jet fuel for 72 hours. For protection board, no loss in protection within 48 hours after being immersed in jet fuel for 72 hours.
- L. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. General: For each type of work, obtain primary materials from single manufacturer, with not less than three (5) years of successful experience in supplying principal materials for waterproofing work. Provide secondary materials only as recommended by manufacturer of primary materials.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.
1. A firm that has specialized for not less than five (5) years in installation of types of dampproofing required for project and which is acceptable to manufacturer of primary materials.
 2. Assign work closely associated with waterproofing, including (but not limited to) waterproofing accessories, and flashings used in conjunction with waterproofing, expansion joints in membrane, insulation and protection course on membrane, to installer of waterproofing, for single, undivided responsibility.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for installation.
1. Build for each typical waterproofing installation including[**pavers and**] accessories to demonstrate surface preparation, crack and joint treatment, corner treatment, and protection.
 - a. Size: [**100 sq. ft. (9.3 sq. m) in area**] [**As shown on Drawings**].
 - b. Description: Each type of [**wall**] [**deck**] [**and**] [**plaza**] <Insert description> installation.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 FIELD CONDITIONS

- A. Substrate: Proceed with dampproofing work only after substrate construction and penetrating work have been completed.
- B. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
1. Do not apply waterproofing in snow, rain, fog, or mist.
- C. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.9 WARRANTY

- A. Manufacturer's Warranty: Manufacturer's standard materials-only warranty in which manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
1. Warranty Period: Minimum **[10] [20] <Insert number>** years from date of Substantial Completion.
- B. Installer's Special Warranty: Specified form, **[on warranty form at end of this Section]**, signed by Installer, covering Work of this Section, for warranty period of **[five] <Insert number>** years.
1. Warranty includes excavation, removing, and reinstalling protection board, drainage panels, insulation, pedestals, and pavers on plaza decks.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. General Compatibility: Provide products that are recommended by manufacturer to be fully compatible with indicated substrates.
- B. Source Limitations for Waterproofing System: Obtain waterproofing materials[, **protection course,**] **[and] [molded-sheet drainage panels]** from single source from single manufacturer.
- C. Source Limitations for Plaza-Deck Paving: Obtain plaza-deck pavers[**and paver pedestals**] from single source from single manufacturer.
- D. Provide dampproofing materials that comply with the following requirements, or provide other similar products that are certified in writing by manufacturer of primary dampproofing materials to be superior in performance for application indicated.

2.2 SHEET WATERPROOFING

- A. EPDM Rubber Sheet: ASTM D 6134, Type I, **60-mil-** (1.5-mm-) thick flexible sheet, unreinforced, formed from EPDM.
1. Products: Subject to compliance with requirements, provide one of the following:

- a. Carlisle Coatings & Waterproofing Inc.; Sure-Seal EPDM.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
- B. Butyl Rubber Sheet: ASTM D 6134, Type II, [**60-mil-** (1.5-mm-)] [**90-mil-** (2.3-mm-)] [**120-mil-** (3.0-mm-)] thick flexible sheet, unreinforced, formed from isobutylene-isoprene rubber.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.; Sure-Seal Butyl.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.

2.3 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Concealed Sheet Flashing: Same material, construction, and thickness as sheet waterproofing or **60-mil-** (1.5-mm-) thick, uncured EPDM, as required by manufacturer.
- C. Exposed Sheet Flashing: **60-mil-** (1.5-mm-) thick EPDM, cured or uncured, as required by manufacturer.
- D. Bonding Adhesives: For bonding waterproofing sheets and sheet flashings to substrates and projections.
- E. Splicing Cement and Cleaner: Single-component butyl splicing cement and solvent-based splice cleaner.
1. Butyl Gum Tape: **30-mil-** (0.76-mm-) thick-by-**6-1/4-inch-** (160-mm-) wide, uncured butyl with polyethylene release film.
- F. Lap Sealant: Single-component sealant.
- G. In-Seam Sealant: Single-component sealant.
- H. Water-Cutoff Mastic: Butyl mastic sealant.
- I. Waterproofing and Sheet-Flashing Accessories: Provide sealants, pourable sealers, cone, and vent flashings, inside and outside corner flashings, termination reglets, and other accessories recommended by waterproofing manufacturer for intended use.
- J. Metal Termination Bars: Manufacturer's standard aluminum bars, approximately **1 inch** (25 mm) wide, prepunched, with fasteners.

- K. Protection Course: Semirigid sheets of asphalt-impregnated organic mat, mineral surface, with a nominal thickness of **1/8 inch** (3 mm).
- L. Protection Course: Fan folded, with a core of extruded-polystyrene board insulation, a nominal thickness of **1/4 inch** (6 mm), and a compressive strength of not less than **8 psi** (55 kPa).
- M. Bellows: Where bellows are indicated on the drawings as in contact with the waterproof membrane, provide either 24 gauge soft copper or 60 mil flexible sheet membrane that is jet fuel resistant and compatible with waterproof membrane. Bellows shall be as indicated and shall lap waterproof membrane a minimum 6" per side.

2.4 MOLDED-SHEET DRAINAGE PANELS

- A. Molded-Sheet Drainage Panel: Comply with Section 334600 "Subdrainage."
- B. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding **No. 70** (0.21-mm) sieve laminated to one side of the core[**and a polymeric film bonded to the other side**]; and with a vertical flow rate of **9 to 15 gpm per ft.** (112 to 188 L/min. per m).
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.; [**CCW MiraDRAIN 6000**] [**CCW MiraDRAIN 6000XL**] [**CCW MiraDRAIN 6200**] [or] [**CCW MiraDRAIN 6200XL**].
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
- C. Woven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panels consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a woven-geotextile facing with an apparent opening size not exceeding **No. 40** (0.425-mm) sieve laminated to one side of the core; and with a horizontal flow rate not less than **2.8 gpm per ft.** (35 L/min. per m).
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.; [**CCW MiraDRAIN 9000**] [or] [**CCW MiraDRAIN 9900**].
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
- D. High-Capacity, Molded-Sheet Collector-Panel System: Composite subsurface collector-panel system by same manufacturer as primary molded-sheet drainage panels; consisting of a high-profile, studded, nonbiodegradable, molded-plastic-sheet drainage core; with a woven-geotextile facing with an apparent opening size not exceeding **No. 40** (0.425-mm) sieve laminated to one side of the core; and with a

vertical flow rate of **9 to 15 gpm per ft.** (112 to 188 L/min. per m) and a horizontal flow rate **[as indicated on Drawings] <Insert requirement>**. Provide system with manufacturer's outlets, connectors, tapes, and other accessories to connect primary molded-sheet drainage panels with piped subdrainage system specified in Section 334600 "Subdrainage."

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.; CCW QuickDRAIN.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.

2.5 INSULATION

- A. Insulation, General: Comply with Section 072100 "Thermal Insulation."
- B. Board Insulation: Extruded-polystyrene board insulation complying with ASTM C 578, shiplap edged.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning Insulating Systems LLC.
 - d. Pactiv Building Products.
 - e. T. Clear Corporation; a subsidiary of Fin Pan Inc.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
2. Type IV, **25-psi** (173-kPa) minimum compressive strength.
3. Type VI, **40-psi** (276-kPa) minimum compressive strength.
4. Type VII, **60-psi** (414-kPa) minimum compressive strength.
5. Type V, **100-psi** (690-kPa) minimum compressive strength.

2.6 INSULATION DRAINAGE PANELS

- A. Unfaced Wall-Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, **[Type IV, 25-psi (173-kPa)] [or] [Type VI, 40-psi (276-kPa)]** minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. DiversiFoam Products; **[CertiFoam 25 SL] [or] [CertiFoam 40 (with channel edges)]** Drainage Board.
 - b. Dow Chemical Company (The); Styrofoam Perimate.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.

- B. Geotextile-Faced, Wall-Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, **[Type IV, 25-psi (173-kPa)]** **[or]** **[Type VI, 40-psi (276-kPa)]** minimum compressive strength; fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with nonwoven geotextile filter fabric.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Owens Corning Insulating Systems LLC; Insul-Drain.
 - b. T. Clear Corporation, a subsidiary of Fin Pan Inc.; **[Thermadry 750]** **[or]** **[Thermadry 1250]**.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
- C. Unfaced Plaza-Deck Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, **[Type VI, 40-psi (276-kPa)]** **[or]** **[Type VII, 60-psi (414-kPa)]** minimum compressive strength; unfaced; fabricated with shiplapped, channel, or tongue-and-groove edges and with one side having ribbed drainage channels.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. American Hydrotech, Inc.; Hydroguard.
 - b. DiversiFoam Products; CertiFoam Plaza Deck.
 - c. Dow Chemical Company (The); Styrofoam Ribbed Roofmate.
 - d. Owens Corning Insulating Systems LLC; **[Foamular 404 RB]** **[Foamular 604 RB]**.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
- D. Geotextile-Faced, Plaza-Deck Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, **[Type VI, 40-psi (276-kPa)]** **[or]** **[Type VII, 60-psi (414-kPa)]** minimum compressive strength; fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with manufacturer's standard, nonwoven geotextile filter fabric.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. T. Clear Corporation, a subsidiary of Fin Pan Inc.; **[Thermadry 1250]** **[or]** **[Thermadry 1750]**.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.

2.7 PLAZA-DECK PAVERS

- A. Plaza-Deck Pavers: **[Brick]** **[Concrete]** **[Asphalt-block]** pavers specified in Section 321400 "Unit Paving."

- B. Stone Plaza-Deck Pavers: [**Granite**] [**Limestone**] [**Marble**] [**Quartz-based stone**] [**Slate**] [**Travertine**] [**Rough-stone**] pavers specified in [**Section 096340 "Stone Flooring."**] [**Section 321400 "Unit Paving."**]
- C. Concrete Plaza-Deck Pavers: Solid, hydraulically pressed, standard weight concrete units, [**square edged**] [**with top edges beveled 3/16 inch (5 mm)**], manufactured for use as plaza-deck pavers; [**7500-psi (52-MPa)**] [**6500-psi (45-MPa)**] <Insert value> minimum compressive strength, ASTM C 140; absorption not greater than 5 percent, ASTM C 140; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C 67.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hanover Architectural Products.
 - b. Roofblok Limited.
 - c. Sunny Brook Pressed Concrete Co.
 - d. Wausau Tile, Inc.
 - e. Westile Roofing Products.
 - f. <Insert manufacturer's name>.
 - g. or approved equal.
 2. Regional Materials: Concrete plaza-deck pavers shall be manufactured within **500 miles (800 km)** of Project site from aggregates[**and cement**] that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles (800 km)** of Project site.
 3. Thickness: [**1-5/8 inches (41 mm)**] [**1-3/4 inches (45 mm)**] [**2 inches (51 mm)**] [**2-3/8 inches (60 mm)**] <Insert dimension>.
 4. Face Size: [**8-7/8 inches (225 mm) square**] [**9 inches (229 mm) square**] [**9 by 18 inches (229 by 457 mm)**] [**12 inches (305 mm) square**] [**12 by 24 inches (305 by 610 mm)**] [**18 inches (457 mm) square**] [**24 inches (610 mm) square**] [**As indicated**] <Insert dimension(s) and shape>.
 5. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
- D. Setting Bed: Provide [**aggregate**] [**mortar**] [**bituminous**] setting-bed materials specified in Section 321400 "Unit Paving."
- E. Paver Pedestals: Paver manufacturer's standard paver support assembly, including [**fixed-height**] [**adjustable or stackable**] pedestals, shims, and spacer tabs for joint spacing of [**1/8 inch (3 mm)**] [**3/16 inch (5 mm)**] [**1/8 to 3/16 inch (3 to 5 mm)**].
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. <Insert, in separate subparagraphs, manufacturer's name; product name or designation>.
 - b. or approved equal.
 2. Concrete Fill: ACI 301, compressive strength of **5000 psi (34 MPa)** at 28 days and

air content of 6 percent.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the waterproofing.
 - 1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
 - 2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
- F. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions.

3.3 INSTALLATION, GENERAL:

- A. General: Comply with manufacturer's instructions, except where more stringent requirements are shown or specified, and except where project conditions require extra precautions or provisions to ensure satisfactory performance of work.
- B. Start installation of waterproofing membrane only in presence and with advice of manufacturer's technical representative.

3.4 FULLY ADHERED SHEET INSTALLATION

- A. Install fully adhered sheets over entire area to receive waterproofing according to manufacturer's written instructions and recommendations in ASTM D 5843.
- B. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required. Stagger end laps.
- C. Apply bonding adhesive to substrates at required rate and allow it to partially dry.
- D. Apply bonding adhesive to sheets and firmly adhere sheets to substrates. Do not apply bonding adhesive to splice area of sheet.
- E. Install fully adhered sheets and auxiliary materials to tie into existing waterproofing.
- F. Repair tears, voids, and lapped seams in waterproofing that do not comply with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending beyond repaired areas in all directions.
- G. Horizontal Application: Apply sheets with side laps shingled with slope of deck where possible.
 - 1. Spread sealant bed over deck drain flange at deck drains and securely seal sheet waterproofing in place with clamping ring.
- H. Bellows: Lap waterproof membrane above and below bellows.

3.5 PARTIALLY ADHERED SHEET INSTALLATION

- A. Install partially adhered sheets over entire area to receive waterproofing according to manufacturer's written instructions.
- B. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required. Stagger end laps.
- C. Apply bonding adhesive to the following areas of substrates and to each sheet at required rate and allow to partially dry:
 - 1. Upper 25 percent of length of each sheet and 18 inches (457 mm) around perimeter of each sheet.
- D. Firmly adhere sheets to substrate. Do not apply bonding adhesive to splice area of sheet.
- E. Install partially adhered sheets and auxiliary materials to tie into existing waterproofing.
- F. Repair tears, voids, and lapped seams in waterproofing that do not comply with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending beyond repaired areas in all directions.

- G. Bellows: Lap waterproof membrane above and below bellows.

3.6 COMPARTMENTED, LOOSELY LAID SHEET INSTALLATION

- A. Install compartmented, loosely laid sheets over entire area to receive waterproofing according to manufacturer's written instructions.
- B. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required. Stagger end laps.
- C. Apply continuous beads of water-cutoff mastic, of size recommended in writing by waterproofing manufacturer, to substrates in a **60-by-60-inch** (1500-by-1500-mm) grid pattern before installing sheet.
- D. Apply sheets with side laps shingled with slope of deck where possible.
- E. Spread sealant bed over deck drain flange at deck drains and securely seal sheet waterproofing in place with clamping ring.
- F. Install compartmented, loosely laid sheets and auxiliary materials to tie into existing waterproofing.
- G. Repair tears, voids, and lapped seams in waterproofing that do not comply with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending beyond repaired areas in all directions.

3.7 SEAM INSTALLATION

- A. Cement Splice: Clean splice areas, apply splicing cement and in-seam sealant, and firmly roll side and end laps of overlapping sheets according to manufacturer's written instructions to produce a splice not less than **6 inches** (150 mm) wide and to ensure a watertight seam installation. Apply lap sealant and seal edges of sheet terminations.
- B. Cement and Tape Splice: Clean splice areas, apply splicing cement and butyl gum tape, and firmly roll side and end laps of overlapping sheets according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal edges of sheet terminations.

3.8 SHEET-FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to waterproofing manufacturer's written instructions.
- B. Form wall flashings using exposed sheet flashing.
- C. Extend deck sheet waterproofing to form wall flashings.
 - 1. Flash penetrations and field-formed inside and outside corners with uncured

sheet flashing.

2. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight installation. Apply lap sealant and seal edges of sheet-flashing terminations.
- D. Cover expansion joints and discontinuous deck-to-wall or deck-to-deck joints by extending deck sheet waterproofing over joints.
- E. Terminate and seal top of sheet flashings[**with mechanically anchored termination bars**].

3.9 PROTECTION COURSE INSTALLATION

- A. Install protection course over waterproofing membrane according to manufacturer's written instructions and before beginning subsequent construction operations. Minimize exposure of membrane.
1. **[Molded-sheet drainage panels] [Insulation drainage panels] [Board insulation]** may be used in place of a separate protection course for vertical applications when approved by waterproofing manufacturer.

3.10 MOLDED-SHEET DRAINAGE-PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesives or other methods that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.
1. For vertical applications, install protection course before installing drainage panels.

3.11 INSULATION INSTALLATION

- A. Install one or more layers of board insulation to achieve required thickness over waterproofed surfaces. Cut and fit to within **3/4 inch** (19 mm) of projections and penetrations.
- B. On vertical surfaces, set insulation units in adhesive or tape applied according to manufacturer's written instructions.
- C. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.12 INSULATION DRAINAGE-PANEL INSTALLATION

- A. Install insulation drainage panels over waterproofed surfaces. Cut and fit to within **3/4**

inch (19 mm) of projections and penetrations.

- B. Ensure that drainage channels are aligned and free of obstructions.
- C. On vertical surfaces, set insulation drainage panels in adhesive or tape applied according to manufacturer's written instructions.
- D. On horizontal surfaces, loosely lay insulation drainage panels according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.13 PLAZA-DECK PAVER INSTALLATION

- A. Install concrete pavers in locations indicated according to manufacturer's written instructions.
- B. Setting Bed: Install setting bed in locations and of thickness indicated. Comply with requirements in [**Section 096340 "Stone Flooring."**] [**Section 321400 "Unit Paving."**]
- C. Accurately install paver pedestals and accessories in locations and to elevations required. Adjust for final level and slope.
 - 1. Fill paver pedestal with concrete mix, strike smooth with top of pedestal, and cure according to ACI 301.
- D. Loosely lay pavers on pedestals, maintaining a uniform open joint width. Tightly seat pavers against spacers to eliminate lateral movement or drift of paving assembly. Align joint patterns parallel in each direction.
 - 1. Lay out pavers to avoid less-than-half-width pavers at perimeter or other terminations.
- E. Install pavers to vary not more than **1/16 inch** (1.6 mm) in elevation between adjacent pavers or more than **1/16 inch** (1.6 mm) from surface plane elevation of individual paver.
- F. Maintain tolerances of paving installation within [**1/4 inch in 10 feet (1:48)**] <Insert **value**> of surface plane in any direction.

3.14 FIELD QUALITY CONTROL

- A. Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation; membrane application, flashings, protection, and drainage components, and to furnish daily reports to DEN Project Manager.
- B. Flood Testing: Flood test each deck area for leaks, according to recommendations in ASTM D 5957, after completing waterproofing but before overlying construction is

placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

1. Flood to an average depth of **2-1/2 inches** (64 mm) with a minimum depth of **1 inch** (25 mm) and not exceeding a depth of **4 inches** (100 mm). Maintain **2 inches** (51 mm) of clearance from top of sheet flashings.
2. Flood each area for **[24] [48] [72]** hours.
3. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.

- C. **[Owner will engage] [Engage]** an independent testing agency to observe flood testing and examine underside of decks and terminations for evidence of leaks during flood testing.
- D. Prepare test and inspection reports.

3.15 PROTECTION, REPAIR, AND CLEANING

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Protect installed **[board insulation] [and] [insulation drainage panels]** from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 071353

SECTION 071354 - THERMOPLASTIC SHEET WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes PVC sheet waterproofing for horizontal installations.
- B. Related Requirements:
 - 1. Section 071353 "Elastomeric Sheet Waterproofing" for **[EPDM] [and] [butyl]** sheet waterproofing.
 - 2. Section 075400 "Thermoplastic Membrane Roofing" for thermoplastic membranes used **[for roofing] [and] [beneath vegetated roof assemblies]**.
 - 3. Section 079500 "Expansion Control" for expansion-joint assemblies that interface with waterproofing.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site][location and time as determined by DEN Project Manager] <Insert location>**
 - 1. Pre Application Conference: Approximately two (2) weeks prior to actual commencement of waterproofing installation, meet at project site with Installer, installers of deck or substrate construction to receive work, installers of other work in and around waterproofing work which must precede, follow or penetrate waterproofing work (including mechanical work if any), DEN Project Manager, the Contractor's Quality Control Manager and waterproofing material manufacturer's representative. Record (Contractor) discussions of conference, together with decisions and agreements (or disagreements) reached. Furnish copy of record to each party attending. Review methods and procedures related to work, including but not necessarily limited to the following:
 - a. Tour jobsite areas to be waterproofed. Inspect and discuss condition of substrate, drains, curbs, penetrations, and other preparatory work performed by other trades.
 - b. Review waterproofing requirements (drawings, specifications and other

contract documents), including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

- c. Review required submittals. Work cannot begin until all submittals are approved by Owner.
- d. Review and finalize construction schedule related to waterproofing work and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- e. Review required inspection, testing, and certifying procedures, safety, and hazardous control programs.
- f. Review protection and repair procedures.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
3. Include data substantiating that materials comply with specified requirements.

B. LEED Submittals:

1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

C. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1. Include layout drawings showing locations of submembrane containment strips[**and control test drains**].
2. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

D. Samples: For each exposed product and for each color and texture specified, including the following products, in minimum 1' x 1' sizes unless otherwise indicated:

1. Waterproofing and flashing sheet.
2. Insulation.
3. Drainage panel.
4. Plaza-deck paver, [**4-by-4-inch (100-by-100-mm) square**] [**full sized**], in each color and texture required.
5. Paver pedestal assembly.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Installer shall provide a certificate that he is approved by the manufacturer for this installation.
- C. Installer to submit a certificate evidencing not less than five (5) years of successful experience installing similar types to products specified.
- D. Installer to provide a certificate indicating that waterproofing has been installed per requirements of this section.
- E. Manufacturer shall submit a certificate indicating that he has not less than five (5) years experience in the manufacturing of the types of products specified.
- F. Manufacturer to submit a report that all work is being done per contract requirements.
- G. Field quality-control reports.
- H. Provide a certificate that bellows are jet fuel resistant.
- I. Provide a certificate stating that waterproofing and protection board to be used at the horizontal and vertical surfaces of the basement extension has been tested for jet fuel resistance and that the required warranty applies to this work. Provide the actual test report.
 - 1. Minimum Requirements: For waterproofing, expansion joint covers and any associated joints, no loss in waterproofing ability within 48 hours after ponding jet fuel for 72 hours. For protection board, no loss in protection within 48 hours after being immersed in jet fuel for 72 hours.
- J. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. General: For each type of work, obtain primary materials from single manufacturer, with not less than three (5) years of successful experience in supplying principal materials for waterproofing work. Provide secondary materials only as approved in writing by manufacturer of primary materials.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1. A firm that has specialized for not less than three (3) years in installation of types of dampproofing required for project and which is acceptable to manufacturer of primary materials.
 2. Assign work closely associated with waterproofing, including (but not limited to) waterproofing accessories, and flashings used in conjunction with waterproofing, expansion joints in membrane, insulation and protection course on membrane, to installer of waterproofing, for single, undivided responsibility.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for installation.
1. Build for each typical waterproofing installation including[**pavers and**] accessories to demonstrate surface preparation, crack and joint treatment, corner treatment, and protection.
 - a. Size: [**100 sq. ft. (9.3 sq. m) in area**] [**As shown on Drawings**].
 - b. Description: Each type of [**deck**] [**and**] [**plaza**] <Insert description> installation.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer's standard warranty in which [**manufacturer agrees to furnish replacement waterproofing material for**] [**manufacturer and Installer agree to repair or replace**] waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
1. Warranty Period: Minimum [**10**] <Insert number> years from date of Substantial Completion.
- B. Installer's Special Warranty: Specified form, [**on warranty form at end of this Section**,]signed by Installer, covering Work of this Section, for warranty period of minimum [**five**] <Insert number> years.
1. Warranty includes excavation, removing, and reinstalling protection board, drainage panels, insulation, pedestals, and pavers on plaza decks.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. General Compatibility: Provide products that are recommended by manufacturer to be fully compatible with indicated substrates.
- B. Source Limitations for Waterproofing System: Obtain waterproofing materials[, **protection course,**] [**and**] [**molded-sheet drainage panels**] from single source from single manufacturer.
- C. Source Limitations for Plaza-Deck Paving: Obtain plaza-deck pavers[**and paver pedestals**] from single source from single manufacturer.

2.2 PVC SHEET WATERPROOFING

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Sika Sarnafil Inc.; Sarnafil G476 Membrane.
 - 2. **<Insert manufacturer's name; product name or designation>**.
 - 3. or approved equal.
- B. PVC Sheet: **60-mil-** (1.5-mm-) [**80-mil-** (2.0-mm-)] [**96-mil-** (2.4-mm-)] thick, PVC membrane with integral pigments, stabilizers, UV absorbers, biocide, and nonwoven fiberglass reinforcement; with the following properties measured according to standard test methods referenced:
 - 1. Tensile Strength: **1500 psi** (10.3 MPa) minimum; ASTM D 638.
 - 2. Elongation at Break: 240 percent minimum, machine direction; ASTM D 638.
 - 3. Seam Strength: 90 percent minimum of tensile strength; ASTM D 638.
 - 4. Retention of Properties after Heat Aging: 95 percent minimum retention of tensile strength and elongation; ASTM D 638 after 168 hours at **194 deg F** (90 deg C); ASTM D 3045.
 - 5. Tear Resistance: **21 lbf** (95 N) minimum; ASTM D 1004.
 - 6. Low-Temperature Bend: Pass at **minus 40 deg F** (minus 40 deg C); ASTM D 2136.
 - 7. Linear Dimension Change: 0.002 percent maximum after 6 hours at **176 deg F** (80 deg C); ASTM D 1204.
 - 8. Water Absorption: 2.5 percent maximum weight gain after 168 hours' immersion at **158 deg F** (70 deg C); ASTM D 570.
 - 9. Dynamic Puncture Resistance: **117.7 ft-pdl** (5 J) minimum; ASTM D 5635.
- C. Self-Adhered PVC Sheet: **120-mil-** (3.0-mm-) thick, composite sheet composed of **60-mil-** (1.5-mm-) thick, PVC membrane with integral pigments, stabilizers, biocide, and nonwoven fiberglass reinforcement; a **60-mil-** (1.5-mm-) thick, nonpermeable, closed-cell-foam backing layer; and a pressure-sensitive adhesive coating; with the following properties measured according to standard test methods referenced:
 - 1. Tensile Strength: **1500 psi** (10.3 MPa) minimum; ASTM D 638.
 - 2. Elongation at Break: 240 percent minimum, machine direction; ASTM D 638.

3. Seam Strength: 90 percent minimum of tensile strength; ASTM D 638.
4. Retention of Properties after Heat Aging: 95 percent minimum retention of tensile strength and elongation; ASTM D 638 after 168 hours at **194 deg F** (90 deg C); ASTM D 3045.
5. Tear Resistance: **21 lbf** (95 N) minimum; ASTM D 1004.
6. Linear Dimension Change: 0.002 percent maximum after 6 hours at **176 deg F** (80 deg C); ASTM D 1204.
7. Dynamic Puncture Resistance: **949.2 ft-pdl** (40 J) minimum; ASTM D 5635.

2.3 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
 1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Concealed Sheet Flashing: Same material, construction, and thickness as sheet waterproofing.
- C. Exposed Sheet Flashing: PVC-sheet flashing [**60 mils** (1.5 mm)] [**80 mils** (2.0 mm)] [**96 mils** (2.4 mm)] thick; PVC with integral pigments, stabilizers, UV absorbers, and biocide; reinforced with nonwoven fiberglass.
- D. Surface Conditioner: Manufacturer's standard waterborne surface treatment to bind residual surface dust and efflorescence to substrate.
- E. Bonding Adhesives: For bonding waterproofing sheets[, **containment strips**,] and PVC-sheet flashings to substrates.
- F. Containment Strip: Manufacturer's standard asphalt-resistant, **60-mil-** (1.5-mm-) thick, PVC strip; reinforced with nonwoven fiberglass; **12 inches** (300 mm) wide.
- G. Geotextile Leveling Layer: Manufacturer's standard **0.22-inch-** (5.59-mm-) thick, nonwoven polypropylene fabric.
- H. Separation Layer: Manufacturer's standard **0.16-inch-** (4.06-mm-) thick, nonwoven polypropylene fabric.
- I. Protection Course: [**39-mil-** (1.0-mm-) **thick, HDPE sheet**] [or] [**51-mil-** (1.3-mm-) **thick, hot-air-weldable, PVC sheet**] protection layer.
- J. Waterproofing and Sheet-Flashing Accessories: Provide sealants, pourable sealers, termination reglets, clamps, compression bars, tapes, preformed cone and stack flashings, and other accessories recommended by waterproofing manufacturer for intended use.
- K. Control Test Drain: Manufacturer's standard assembly to verify the absence or presence of leaks from underside of waterproofed slab.

- L. Metal Termination Bars: Manufacturer's standard stainless steel or aluminum bars, prepunched, with noncorrosive fasteners.
- M. Bellows: Where bellows are indicated on the drawings as in contact with the waterproof membrane, provide either 24 gauge soft copper or 60 mil flexible sheet membrane that is jet fuel resistant and compatible with waterproof membrane. Bellows shall be as indicated and shall lap waterproof membrane a minimum 6" per side.

2.4 MOLDED-SHEET DRAINAGE PANELS

- A. Woven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panels consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a woven-geotextile facing with an apparent opening size not exceeding **No. 40** (0.425-mm) sieve laminated to one side of the core; and with a horizontal flow rate not less than **2.8 gpm per ft.** (35 L/min. per m).
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Sika Sarnafil Inc.; [**Drainage Panel 900**] [**Drainage Panel 980**] [or] [**Drainage Panel 990**].
 - b. <Insert manufacturer's name; product name or designation>.
 - c. or approved equal

2.5 INSULATION

- A. Insulation, General: Comply with Section 072100 "Thermal Insulation."
- B. Board Insulation: Extruded-polystyrene board insulation complying with ASTM C 578.
 - 1. Type IV, **25-psi** (173-kPa) minimum compressive strength.
 - 2. Type VI, **40-psi** (276-kPa) minimum compressive strength.
 - 3. Type VII, **60-psi** (414-kPa) minimum compressive strength.
 - 4. Type V, **100-psi** (690-kPa) minimum compressive strength.

2.6 PLAZA-DECK PAVERS

- A. Plaza-Deck Pavers: [**Brick**] [**Concrete**] [**Asphalt-block**] pavers specified in Section 321400 "Unit Paving."
- B. Stone Plaza-Deck Pavers: [**Granite**] [**Limestone**] [**Marble**] [**Quartz-based stone**] [**Slate**] pavers specified in [**Section 096340 "Stone Flooring."**] [**Section 321400 "Unit Paving."**]
- C. Concrete Plaza-Deck Pavers: Solid, hydraulically pressed, standard-weight concrete units, [**square edged**] [**with top edges beveled 3/16 inch** (5 mm)], manufactured for use as plaza-deck pavers; [**7500-psi** (52-MPa)] [**6500-psi** (45-MPa)] <Insert value> minimum compressive strength, ASTM C 140; absorption not greater than 5 percent,

ASTM C 140; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C 67.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hanover Architectural Products.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.
 2. Regional Materials: Concrete plaza-deck pavers shall be manufactured within **500 miles** (800 km) of Project site from aggregates[**and cement**] that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** (800 km) of Project site.
 3. Thickness: [**2 inches (51 mm)**] [**2-1/2 inches (64 mm)**] **<Insert dimension>**.
 4. Face Size: [**12 inches (305 mm) square**] [**12 by 24 inches (305 by 610 mm)**] [**18 inches (457 mm) square**] [**24 inches (610 mm) square**] [**As indicated**] **<Insert dimension(s) and shape>**.
 5. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] **<Insert color>**.
- D. Paver Pedestals: Paver manufacturer's standard paver support assembly, including [**fixed-height**] [**adjustable or stackable**] pedestals, shims, and spacer tabs for joint spacing of [**1/8 inch (3 mm)**] [**3/16 inch (5 mm)**] [**1/8 to 3/16 inch (3 to 5 mm)**].
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the waterproofing.
 1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
 2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
- F. Prepare, treat, and seal surfaces at terminations and penetrations through waterproofing and at drains and protrusions.

3.3 INSTALLATION, GENERAL:

- A. General: Comply with manufacturer's instructions, except where more stringent requirements are shown or specified, and except where project conditions require extra precautions or provisions to ensure satisfactory performance of work.
- B. Start installation of waterproofing membrane only in presence and with advice of manufacturer's technical representative.

3.4 FULLY ADHERED SHEET INSTALLATION

- A. General: Install self-adhered sheets over entire area to receive waterproofing according to manufacturer's written instructions.
 - 1. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required. Stagger end laps.
 - 2. Install laps shingled with slope of deck where possible.
 - 3. Install flashings concurrently with deck sheet.
 - 4. Perform hot-air welding to ensure a watertight seam installation. Inspect outside edge of seams with pointed metal probe and ensure completed laps lay flat and are free of voids, fishmouths, or wrinkles.
 - 5. Install temporary cut-offs if work is interrupted. Remove the cut-offs completely before proceeding with the installation.
 - 6. Install sheets and auxiliary materials to tie into adjoining waterproofing.
- B. Apply surface conditioner, at required rate, to substrates to receive waterproofing. Apply only at temperatures greater than 25 deg F (minus 4 deg C) and rising.

- C. Apply and firmly adhere sheets to substrate; butt adjoining sheets tightly. Apply only when the membrane, air, and substrate temperatures are greater than 40 deg F (5 deg C) and rising. Apply a minimum 8-inch- (203-mm-) wide cover strip centered over joints and lap edges; hot-air weld cover strip to deck sheet.
- D. Hot-air weld three-way overlaps or T-joints with a 4-inch- (102-mm-) round or -square patch.
- E. Unless terminations and deck-sheet waterproofing perimeter are sealed with flashings, secure them with mechanically anchored metal termination bar. Seal edge of termination with sealant.
- F. Install flashing at deck drains. Spread sealant bed over deck drain flange, lap flashing membrane into drain flange and over deck sheet according to membrane manufacturer's written instructions, and hot-air-weld flashing to deck sheet; securely seal flashing sheet in place with clamping ring.
- G. Perform field quality-control flood testing before subsequent work.
- H. Repair tears, voids, and lapped seams in waterproofing that do not comply with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending beyond repaired areas in all directions.
- I. Bellows: Lap waterproof membrane above and below bellows.

3.5 LOOSELY LAID SHEET INSTALLATION

- A. General: Install loosely laid sheets over entire area to receive waterproofing according to manufacturer's written instructions.
 - 1. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required. Stagger end laps.
 - 2. Install laps shingled with slope of deck where possible.
 - 3. Install flashings concurrently with deck sheet.
 - 4. Perform hot-air welding to ensure a watertight seam installation. Inspect outside edge of seams with pointed metal probe and ensure completed laps lay flat and are free of voids, fishmouths, or wrinkles.
 - 5. Install temporary cut-offs if work is interrupted. Remove the cut-offs completely before proceeding with the installation.
 - 6. Install sheets and auxiliary materials to tie into adjoining waterproofing.
- B. Install geotextile leveling layer over entire area to receive deck sheet. Lap edges at least 4 inches (102 mm) and spot adhere fabric to deck as required to keep in position as waterproofing sheet is placed in position. Trim fabric using scissors or utility blades; do not use welding equipment to cut fabric.
- C. Apply deck sheet over area, lapping edges at least 3 inches (76 mm) for machine welding or at least 4 inches (102 mm) for hand welding. Hot-air weld sheets.

- D. Hot-air weld three-way overlaps or T-joints with a 4-inch- (102-mm-) round or -square patch.
- E. Secure perimeter of deck sheet with manufacturer's standard metal termination bars and accessories as recommended by manufacturer for each condition.
- F. At deck drains, spread sealant bed over drain flange and lap membrane into drain flange according to membrane manufacturer's written instructions; securely seal sheets in place with clamping ring.
- G. Perform field quality-control flood testing before subsequent work.
- H. Repair tears, voids, and lapped seams in waterproofing that do not comply with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending beyond repaired areas in all directions.

3.6 COMPARTMENTED, LOOSELY LAID SHEET INSTALLATION

- A. General: Install compartmented, loosely laid sheets over entire area to receive waterproofing according to manufacturer's written instructions.
 - 1. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required. Stagger end laps.
 - 2. Install laps shingled with slope of deck where possible.
 - 3. Install flashings concurrently with deck sheet.
 - 4. Perform hot-air welding to ensure a watertight seam installation. Inspect outside edge of seams with pointed metal probe and ensure completed laps lay flat and are free of voids, fishmouths, or wrinkles.
 - 5. Install temporary cut-offs if work is interrupted. Remove the cut-offs completely before proceeding with the installation.
 - 6. Install sheets and auxiliary materials to tie into adjoining waterproofing.
- B. Construct a test containment grid before beginning installation. Perform manufacturer's recommended peel test on the test containment grid and on each day's completed waterproofing work before resuming the following day's installation.
- C. Install submembrane containment grid to form compartments secured by containment strips. Also, install containment strips at the base of walls, curbs, penetrations, terminations, and transitions and at the perimeter of the installation. Secure containment grid to substrate with bonding adhesive.
- D. Install geotextile leveling layer over entire area between containment strips. Lap edges at least 4 inches (102 mm) and spot adhere fabric to deck as required to keep in position as waterproofing sheet is placed in position. Trim fabric even with edges of containment strips using scissors or utility blades; do not use welding equipment to cut fabric.
- E. Control-Test-Drain Installation: Drill 1-inch- (25-mm-) diameter hole through the substrate at or near the low point of each compartment and install control test drain,

according to manufacturer's written instructions, so as to enable verification of the absence or presence of leaks from underside of waterproofed slab.

- F. Apply deck sheet over area, lapping edges at least **3 inches** (76 mm) for machine welding or at least **4 inches** (102 mm) for hand welding. Hot-air weld the sheet to containment strips.
- G. Hot-air weld three-way overlaps or T-joints with a **4-inch-** (102-mm-) round or -square patch.
- H. Install flashing at deck drains. Spread sealant bed over deck drain flange, lap flashing membrane into drain flange and over containment strips according to membrane manufacturer's written instructions, and hot-air weld flashing to containment strips; securely seal flashing sheet in place with clamping ring.
- I. Perform field quality-control flood testing before subsequent work.
- J. Repair tears, voids, and lapped seams in waterproofing that do not comply with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending beyond repaired areas in all directions.

3.7 SHEET-FLASHING INSTALLATION

- A. Form wall flashings exposed in final construction using exposed sheet flashing; otherwise, use concealed sheet flashing.
- B. Lap sheet flashings over deck sheet or containment strips. Flash penetrations and field-formed inside and outside corners with sheet flashing.
- C. Extend flashings a minimum of **8 inches** (203 mm) above the overburden unless otherwise indicated on Drawings and acceptable to waterproofing manufacturer.
- D. Hot-air weld joints with deck sheet or containment strips and end laps of overlapping sheet flashings and accessories to ensure a watertight seam installation.
- E. Hot-air weld three-way overlaps or T-joints with a **4-inch-** (102-mm-) round or -square patch.
- F. Secure flashings along top edge with mechanically anchored metal termination bar or with mechanically anchored metal reglet for subsequent metal counterflashing. Seal top of termination with sealant.
- G. Terminate deck sheet at expansion joints and discontinuous deck-to-wall or deck-to-deck joints. Bridge and cover joints with sheet flashing and joint accessories according to manufacturer's written instructions for each type of joint.

3.8 PROTECTION COURSE INSTALLATION

- A. Install separation layer over sheet waterproofing before placing protection course.

- B. Install protection course over [**sheet waterproofing**] [**separation layer**] according to manufacturer's written instructions and before beginning subsequent construction operations. Minimize exposure of membrane.

3.9 MOLDED-SHEET DRAINAGE-PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesives or other methods that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed panels during subsequent construction.

3.10 INSULATION INSTALLATION

- A. Install one or more layers of board insulation to achieve required thickness over waterproofed surfaces. Cut and fit to within **3/4 inch** (19 mm) of projections and penetrations.
- B. Lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.11 PLAZA-DECK PAVER INSTALLATION

- A. Install concrete pavers in locations indicated according to manufacturer's written instructions.
- B. Accurately install paver pedestals and accessories in locations and to elevations required. Adjust for final level and slope.
- C. Loosely lay pavers on pedestals, maintaining a uniform open joint width. Tightly seat pavers against spacers to eliminate lateral movement or drift of paving assembly. Align joint patterns parallel in each direction.
 - 1. Lay out pavers to avoid less-than-half-width pavers at perimeter or other terminations.
- D. Install pavers to vary not more than **1/16 inch** (1.6 mm) in elevation between adjacent pavers or more than **1/16 inch** (1.6 mm) from surface plane elevation of individual paver.
- E. Maintain tolerances of paving installation within [**1/4 inch in 10 feet (1:48)**] <Insert **value**> of surface plane in any direction.

3.12 FIELD QUALITY CONTROL

- A. Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions; surface preparation; membrane application, flashings, protection, and drainage components; and to furnish daily reports to DEN Project

Manager.

- B. Flood Testing: Flood test each deck area for leaks, according to recommendations in ASTM D 5957, after completing waterproofing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
 - 1. Flood to an average depth of **2-1/2 inches** (64 mm) with a minimum depth of **1 inch** (25 mm) and not exceeding a depth of **4 inches** (100 mm). Maintain **2 inches** (51 mm) of clearance from top of sheet flashings.
 - 2. Flood each area for **[24] [48] [72]** hours.
 - 3. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.
- C. **[Owner will engage] [Engage]** an independent testing agency to observe flood testing and examine underside of decks and terminations for evidence of leaks during flood testing.
- D. Prepare test and inspection report.

3.13 PROTECTION, REPAIR, AND CLEANING

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Protect installed board insulation from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 071354

SECTION 071413 - HOT FLUID-APPLIED RUBBERIZED ASPHALT WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Rubberized-asphalt waterproofing membrane[, **unreinforced**] [, **reinforced**].
 - 2. Molded-sheet drainage panels.
 - 3. Insulation.
 - 4. Plaza deck pavers.
- B. Related Sections:
 - 1. Section 075556 "Fluid-Applied Protected Membrane Roofing" for hot fluid-applied, rubberized-asphalt roofing.
 - 2. Section 079200 "Joint Sealants" for joint-sealant materials and installation.
 - 3. Section 079500 "Expansion Control" for expansion-joint systems.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.
 - 1. Include data substantiating that all materials comply with requirements.
- B. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins to adjoining waterproofing, and other termination conditions.
 - 1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.
- C. Samples: For the following products in minimum 1' x 1' sizes unless otherwise

indicated:

1. Flashing sheet.
2. Membrane-reinforcing fabric.
3. Insulation.
4. Drainage panel.
5. Plaza deck paver[, **full sized**] in each color and texture required.
6. Paver pedestal assembly.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified [**Installer**] [**testing agency**].
- B. Installer to submit a certificate evidencing not less than three (3) years of successful experienced installing similar types to products specified.
- C. Manufacturer to submit a certificate evidencing not less than five (5) years experienced manufacturing types of products specified.
- D. Manufacturer to submit a field report that all installation work is being done per contract requirements.
- E. Product Test Reports: For waterproofing, based on evaluation of comprehensive tests performed by a qualified testing agency.
- F. Field quality-control reports.
- G. Provide a certificate that bellows are jet fuel resistant.
- H. Provide a certificate stating that waterproofing and protection board to be used at the horizontal and vertical surfaces of basement extensions have been tested for jet fuel resistance and that the required warranty applies to this work. Provide the actual test report.
 1. Minimum Requirements: For waterproofing, expansion joint covers and any associated joints, no loss in waterproofing ability within 48 hours after ponding jet fuel for 72 hours. For protection board, no loss in protection within 48 hours after being immersed in jet fuel for 72 hours.
- I. Warranties: Sample of special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that is **[approved or licensed by]** **[acceptable to]** manufacturer for installation of waterproofing required for this Project and is eligible to receive special warranties specified.
1. Installer will have specialized in installation of types of waterproofing required for project for not less than three (3) years and which is acceptable to manufacturer(s) of primary materials.
 2. Assign work closely associated with waterproofing, including but not limited to waterproofing accessories, and flashings used in conjunction with waterproofing, expansion joints in membrane, insulation and protection course on membrane, to installer of waterproofing, for single, undivided responsibility.
- B. Source Limitations: Obtain primary waterproofing materials of each type required from single manufacturer with not less than three (3) years of successful experience in supplying principal materials for fluid applied waterproofing work. Provide secondary materials only as recommended by manufacturer of primary materials.
- C. Mockups: Install waterproofing to **[100 sq. ft. (9.3 sq. m)]** **<Insert area>** of **[deck]** **[wall]** to demonstrate surface preparation, crack and joint treatment, corner treatment, thickness, texture, and execution quality. **[Install pavers and paver supports to demonstrate aesthetic affects and set quality standards for materials and execution.]**
1. If DEN Project Manager determines mockups do not comply with requirements, reapply waterproofing **[and reinstall overlaying construction]** until mockups are approved.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Approximately two (2) weeks prior to actual commencement of fluid-applied waterproofing installation, meet at project site with Installer, installers of deck or substrate construction to receive work, installers of other work in and around waterproofing work which must precede, follow or penetrate waterproofing work, including mechanical work if any, DEN Project Manager, the Contractor's Quality Control Manager and waterproofing material manufacturer's representative. Record (Contractor) discussions of conference, together with decisions and agreements (or disagreements) reached. Furnish copy of record to each party attending.
1. Review methods and procedures related to work, including but not necessarily limited to the following:
 - a. Tour jobsite areas to be waterproofed. Inspect and discuss condition of substrate, drains, curbs, penetrations, and other preparatory work performed by other trades.

- b. Review waterproofing requirements (drawings, specifications and other contract documents), including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures,.
 - c. Review required submittals. Work cannot begin until all submittals are approved by Owner.
 - d. Review and finalize construction schedule related to waterproofing work and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - e. Review required inspection, testing, and certifying procedures, safety, and hazardous control programs.
 - f. Review protection and repair procedures.
- E. Warranty: Installer to warrant installation for five (5) years including responsibility for removing and replacing work concealing waterproof membrane. Warrant installation to be watertight for application required.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.
- B. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- C. Protect stored materials from direct sunlight.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, or when temperature is below 0 deg F (minus 18 deg C).
 - 1. Do not apply waterproofing in snow, rain, fog, or mist.
- B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace waterproofing and sheet flashings that do not comply with requirements or that fail to remain watertight within specified warranty period.
 - 1. Warranty insulation will retain 80 percent of original published thermal value.
 - 2. Warranty pavers will not dish or warp and will not crack, split, or disintegrate in freeze-thaw conditions.

3. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pedestal-mounted pavers on plaza decks.
4. Warranty Period: **[Five]** **[10]** **<Insert number>** years from date of Substantial Completion.

B. Special Installer's Warranty: Specified form[, **on warranty form at end of this Section,**] signed by Installer, covering Work of this Section, for warranty period of **[two]** **<Insert number>** years.

1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pedestal-mounted pavers on plaza decks.

1.10 CONSTRUCTION WASTE MANAGEMENT

A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GENERAL

A. General Compatibility: Provide products that are recommended by manufacturer to be fully compatible with indicated substrates, including modification by bituminous additives (asphalt or coal tar as needed) and similar proven compounding provisions.

2.2 WATERPROOFING MEMBRANE

A. Hot Fluid-Applied, Rubberized-Asphalt Waterproofing Membrane: Single component; 100 percent solids; hot fluid-applied, rubberized asphalt.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. American Hydrotech, Inc.; Monolithic Membrane 6125.
 - b. American Permaquik Inc.; Permaquik 6100.
 - c. Barrett Company; Ram-Tough 250.
 - d. Carlisle Coatings & Waterproofing Inc.; CCW-500R.
 - e. Henry Company; 790-11.
 - f. Tamko Waterproofing; TW-Hot Melt.
 - g. Tremco Incorporated; Tremproof 150.
 - h. **<Insert manufacturer's name; product name or designation>**.
 - i. or approved equal.

2.3 FLASHING SHEET MATERIALS

- A. Elastomeric Flashing Sheet: **50-mil-** (1.3-mm-) minimum, uncured sheet neoprene as follows:
1. Tensile Strength: **1400 psi** (9.6 MPa) minimum; ASTM D 412, Die C.
 2. Elongation: 300 percent minimum; ASTM D 412.
 3. Tear Resistance: **125 psi** (860 kPa) minimum; ASTM D 624, Die C.
 4. Brittleness: Does not break at minus **30 deg F** (34 deg C); ASTM D 2137.

2.4 AUXILIARY MATERIALS

- A. Primer: ASTM D 41, asphaltic primer.
- B. Elastomeric Sheet: **50-mil-** (1.3-mm-) minimum, uncured sheet neoprene as follows:
1. Tensile Strength: **1400 psi** (9.6 MPa) minimum; ASTM D 412, Die C.
 2. Elongation: 300 percent minimum; ASTM D 412.
 3. Tear Resistance: **125 psi** (860 kPa) minimum; ASTM D 624, Die C.
 4. Brittleness: Does not break at minus **30 deg F** (34 deg C); ASTM D 2137.
- C. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum termination bars; approximately **1 by 1/8 inch** (25 by 3 mm) thick; with anchors.
- D. Sealants and Accessories: Manufacturer's recommended sealants and accessories.
- E. Reinforcing Fabric: Manufacturer's recommended, spun-bonded polyester fabric.
- F. Protection Course: ASTM D 6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:
1. Thickness: [**1/8 inch (3 mm)**] [**1/4 inch (6 mm)**], nominal.
 2. Thickness: **1/8 inch** (3 mm), nominal, for vertical applications; **1/4 inch** (6 mm), nominal, elsewhere.
- G. Protection Course: Manufacturer's standard, **80- to 90-mil-** (2.0- to 2.3-mm-) thick, fiberglass-reinforced rubberized asphalt or modified bituminous sheet.]
- H. Bellows: Where bellows are indicated on the drawings as in contact with the waterproof membrane, provide either 24 gauge soft copper or 60 mil flexible sheet membrane that is jet fuel resistant and compatible with waterproof membrane. Bellows shall be as indicated and shall lap waterproof membrane a minimum 6" per side.

2.5 MOLDED-SHEET DRAINAGE PANELS

- A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite

subsurface drainage panels consisting of a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding **No. 70** (0.21-mm) sieve, laminated to one side **[with] [or] [without]** a polymeric film bonded to the other side of a studded, nonbiodegradable, molded-plastic-sheet drainage core, with a vertical flow rate of **9 to 15 gpm/ft.** (112 to 188 L/min. per m).

- B. Woven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a woven-geotextile facing with an apparent opening size not exceeding **No. 40** (0.43-mm) sieve, laminated to one side **[with] [or] [without]** a polymeric film bonded to the other side of a studded, nonbiodegradable, molded-plastic-sheet drainage core, with a horizontal flow rate not less than **2.8 gpm/ft.** (35 L/min. per m).

2.6 INSULATION

- A. Board Insulation: Extruded-polystyrene board insulation complying with ASTM C 578, shiplap edged.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. DiversiFoam Products.
- b. Dow Chemical Company (The).
- c. Owens Corning.
- d. Pactiv Corporation.
- e. T. Clear Corporation.
- f. **<Insert manufacturer's name>**.
- g. or approved equal.

2. Type VI, **40-psi** (276-kPa) minimum compressive strength.
3. Type VII, **60-psi** (414-kPa) minimum compressive strength.
4. Type V, **100-psi** (690-kPa) minimum compressive strength.

- B. Unfaced Wall Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, **[Type IV, 25-psi (173-kPa)] [or] [Type VI, 40-psi (276-kPa)]** minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. DiversiFoam Products; **[CertiFoam 25] [CertiFoam 40]** Drainage Board.
- b. Dow Chemical Company (The); Perimate.
- c. **<Insert manufacturer's name; product name or designation>**.
- d. or approved equal.

- C. Geotextile-Faced Wall Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, **[Type IV, 25-psi (173-kPa)] [or] [Type VI, 40-psi (276-kPa)]** minimum compressive strength; fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with a nonwoven,

geotextile filter fabric.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Owens Corning; Insul-Drain.
 - b. T. Clear Corporation; [Thermadry 750] [Thermadry 1250].
 - c. <Insert manufacturer's name; product name or designation>.
 - d. or approved equal.

- D. Unfaced Plaza Deck Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, [Type VI, 40-psi (276-kPa)] [Type VII, 60-psi (414-kPa)] minimum compressive strength; unfaced; fabricated with shiplapped or channel edges and with one side having ribbed drainage channels.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. DiversiFoam Products; CertiFoam Plaza Deck.
 - b. Dow Chemical Company (The); Styrofoam Ribbed Roofmate.
 - c. Owens Corning; [Foamular 404 RB] [Foamular 604 RB].
 - d. <Insert manufacturer's name; product name or designation>.
 - e. or approved equal.

- E. Geotextile-Faced Plaza Deck Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, Type VII, 60-psi (414-kPa) minimum compressive strength; fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with a nonwoven, geotextile filter fabric.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. T. Clear Corporation; Thermadry 1750.
 - b. <Insert manufacturer's name; product name or designation>.
 - c. or approved equal.

2.7 PLAZA DECK PAVERS

- A. Plaza Deck Pavers: [Brick] [Concrete] [Asphalt-block] pavers specified in Section 321400 "Unit Paving."
- B. Plaza Deck Pavers: [Granite] [Limestone] [Marble] [Quartz-based stone] [Slate] pavers specified in Section 096340 "Stone Flooring."
- C. Plaza Deck Pavers: Heavyweight, hydraulically pressed, concrete units, [square edged] [with top edges beveled 3/16 inch (5 mm)], manufactured for use as plaza deck pavers; minimum compressive strength [7500 psi (52 MPa)] [6500 psi (45 MPa)] <Insert value>, ASTM C 140; absorption not greater than 5 percent, ASTM C 140; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C 67.

1. Manufacturers: Subject to compliance with requirements, provide products by

one of the following:

- a. Hanover Architectural Products.
 - b. Hastings Pavement Company, LLC.
 - c. Roofblok Limited.
 - d. Sunny Brook Pressed Concrete.
 - e. Wausau Tile, Inc.; Terra-Paving Division.
 - f. Westile Roofing Products.
 - g. <Insert manufacturer's name>.
 - h. or approved equal.
2. Thickness: [**1-5/8 inches** (41 mm)] [**1-3/4 inches** (45 mm)] [**2 inches** (51 mm)] [**2-3/8 inches** (60 mm)] <Insert dimension>.
 3. Face Size: [**8-7/8 inches** (225 mm) square] [**9 inches** (229 mm) square] [**9 by 18 inches** (229 by 457 mm)] [**12 inches** (305 mm) square] [**12 by 24 inches** (305 by 610 mm)] [**18 inches** (457 mm) square] [**24 inches** (610 mm) square] [**As indicated**] <Insert dimensions and shape>.
 4. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
- D. Setting Bed: Provide [**aggregate**] [**mortar**] [**bituminous**] setting-bed materials specified in Section 321400 "Unit Paving."
- E. Paver Supports: Paver manufacturer's standard SBR rubber, high-density polyethylene, or polyurethane paver support assembly, including [**fixed-height**] [**adjustable or stackable**] pedestals, shims, and spacer tabs for joint spacing of [**1/8 inch** (3 mm)] [**3/16 inch** (5 mm)] [**1/8 to 3/16 inch** (3 to 5 mm)].
1. Concrete Fill: ACI 301, compressive strength of **5000 psi** (34 MPa) at 28 days, and air content of 6 percent.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
 2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and prepare substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.
- D. Remove grease, oil, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
 - 1. Abrasive blast clean concrete surfaces uniformly to expose top surface of fine aggregate according to ASTM D 4259 with a self-contained, recirculating, blast-cleaning apparatus. Remove material to provide a sound surface free of laitance, glaze, efflorescence, curing compounds, concrete hardeners, or form-release agents. Remove remaining loose material and clean surfaces according to ASTM D 4258.
- E. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.
- F. Seal joints, and apply bond breakers as recommended by prime materials manufacturer, with particular attention at construction joints.
- G. Install accessories as recommended by prime materials manufacturer.
- H. Prime substrate as recommended (and only if recommended) by prime materials manufacturer.

3.3 JOINTS, CRACKS, AND TERMINATIONS

- A. Prepare and treat substrates to receive waterproofing membrane, including joints and cracks, deck drains, corners, and penetrations according to manufacturer's written instructions.
 - 1. Rout and fill joints and cracks in substrate. Before filling, remove dust and dirt according to ASTM D 4258.
 - 2. Adhere strip of elastomeric sheet to substrate in a layer of hot rubberized asphalt. Extend elastomeric sheet a minimum of **6 inches** (150 mm) on each side of moving joints and cracks or joints and cracks exceeding **1/8 inch** (3 mm) thick, and beyond deck drains and penetrations. Apply second layer of hot fluid-applied, rubberized asphalt over elastomeric sheet.
 - 3. Embed strip of reinforcing fabric into a layer of hot rubberized asphalt. Extend reinforcing fabric a minimum of **6 inches** (150 mm) on each side of nonmoving joints and cracks not exceeding **1/8 inch** (3 mm) thick, and beyond roof drains and penetrations.

- a. Apply second layer of hot fluid-applied, rubberized asphalt over reinforcing fabric.

- B. At expansion joints and discontinuous deck-to-wall or deck-to-deck joints, bridge joints with elastomeric sheet extended a minimum of **6 inches** (150 mm) on each side of joints and adhere to substrates in a layer of hot rubberized asphalt. Apply second layer of hot fluid-applied, rubberized asphalt over elastomeric sheet.

3.4 FLASHING INSTALLATION

- A. Install elastomeric flashing sheets at terminations of waterproofing membrane according to manufacturer's written instructions.
- B. Prime substrate with asphalt primer per manufacturer's instructions.
- C. Install elastomeric flashing sheet and adhere to deck and wall substrates in a layer of hot rubberized asphalt.
- D. Extend elastomeric flashing sheet up walls or parapets a minimum of **8 inches** (200 mm) above plaza deck pavers and **6 inches** (150 mm) onto deck to be waterproofed.
- E. Install termination bars and mechanically fasten to top of elastomeric flashing sheet at terminations and perimeter of roofing.

3.5 MEMBRANE APPLICATION

- A. Apply primer, at manufacturer's recommended rate, over prepared substrate and allow to dry.
- B. Heat and apply rubberized asphalt according to manufacturer's written instructions.
 1. Heat rubberized asphalt in an oil- or air-jacketed melter with mechanical agitator specifically designed for heating rubberized asphalt.
- C. Start application with manufacturer's authorized representative present.
- D. Except as otherwise indicated, extend flashings onto perpendicular surfaces and other work penetrating substrate to not less than 6" beyond finished surface to be applied over waterproofing.
- E. Unreinforced Membrane: Apply hot rubberized asphalt to substrates and adjoining surfaces indicated. Spread to form a uniform, unreinforced, seamless membrane, [**180-mil** (4.5-mm) **minimum thickness**] [**180-mil** (4.5-mm) **average thickness, but not less than 125 mil** (3.2 mm)**thick**].
- F. Reinforced Membrane: Apply hot rubberized asphalt to substrates and adjoining surfaces indicated. Spread to a thickness of **90 mils** (2.3 mm); embed reinforcing fabric,

overlapping sheets **2 inches** (50 mm); spread another **125-mil-** (3.2-mm-) thick layer to provide a uniform, reinforced, seamless membrane **215 mils** (5.5 mm) thick.

- G. Apply waterproofing over prepared joints and up wall terminations and vertical surfaces to heights indicated or required by manufacturer.
- H. Cover waterproofing with protection course with overlapped joints before membrane is subject to **[backfilling] [construction or vehicular traffic]**.
- I. Bellows: Lap waterproof membrane above and below bellows.

3.6 PROTECTION COURSE:

- A. Install protection course on cured membrane (after testing, if required) without delay, so that period of membrane exposure will be minimized.
- B. On all vertical surfaces to be waterproofed install protection course. Comply with waterproofing manufacturer's recommendations for adhesion of protection course to membrane.
- C. On all horizontal surfaces to receive waterproofing including between slabs and at basement extension install protection course. Comply with waterproofing manufacturer's recommendations for adhesion of protection course to membranes.

3.7 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate according to manufacturer's written instructions. Use methods that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.
 - 1. For vertical applications, install **[board insulation] [protection course]** before installing drainage panels.

3.8 INSULATION INSTALLATION

- A. Install **[one or more layers of board insulation to achieve required thickness] [and] [insulation drainage panels]** over waterproofed surfaces. Cut and fit to within **3/4 inch** (19 mm) of projections and penetrations.
- B. On vertical surfaces, set insulation units into rubberized asphalt according to manufacturer's written instructions.
- C. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.9 PLAZA DECK PAVER INSTALLATION

- A. Setting Bed: Install setting bed in locations and of thickness indicated to comply with requirements in [**Section 321400 "Unit Paving."**] [**Section 096340 "Stone Flooring."**]
- B. Install concrete pavers in locations indicated according to manufacturer's written instructions.
- C. Accurately install [**fixed**] [**adjustable**]-height paver pedestals and accessories in locations and to elevations required. Adjust for final level and slope with shims.
 - 1. Fill paver pedestal with concrete mix, strike smooth with top of pedestal, and cure according to ACI 301.
- D. Loosely lay pavers on pedestals, maintaining a uniform open joint width. Tightly seat pavers against spacers to eliminate lateral movement or drift of paving assembly. Align joint patterns parallel in each direction.
 - 1. Lay out pavers to avoid less-than-half-width pavers at perimeter or other terminations.
- E. Install pavers to not vary more than **1/16 inch** (1.6 mm) in elevation between adjacent pavers or more than **1/16 inch** (1.6 mm) from surface plane elevation of individual paver.
- F. Maintain tolerances of paving installation within [**1/4 inch in 10 feet (1:48)**] **<Insert surface tolerance>** of surface plane in any direction.

3.10 FIELD QUALITY CONTROL

- A. Engage a full-time site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions; surface preparation; and application of the membrane, flashings, protection, and drainage components; furnish daily reports to DEN Project Manager.
- B. Flood Testing: Flood test each deck area for leaks, according to recommendations in ASTM D 5957, after completing and protecting waterproofing but before overlaying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
 - 1. Flood to an average depth of **2-1/2 inches** (65 mm) with a minimum depth of **1 inch** (25 mm) and not exceeding a depth of **4 inches** (100 mm). Maintain **2 inches** (50 mm) of clearance from top of sheet flashings.
 - 2. Flood each area for [**24**] [**48**] [**72**] hours.
 - 3. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.
- C. [**Owner will engage**] [**Engage**] an independent testing agency to observe flood testing

and examine underside of decks and terminations for evidence of leaks during flood testing.

1. Independent testing laboratory to certify that waterproofing was installed per contract requirements and to thicknesses required. Submit certificate to DEN Project Manager.

3.11 CLEANING AND PROTECTION

- A. Protect waterproofing from damage and wear during remainder of construction period.
- B. Protect installed [**board insulation**] [**insulation drainage panels**] from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 071413

SECTION 071416 - COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Single-component polyurethane waterproofing.
 - 2. Two-component polyurethane waterproofing.
 - 3. Polyester waterproofing.
 - 4. Latex-rubber waterproofing.
 - 5. Molded-sheet drainage panels.
 - 6. Insulation.
 - 7. Plaza deck pavers.
- B. Related Section:
 - 1. Section 079200 "Joint Sealants" for joint-sealant materials and installation.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.
 - 1. Include data substantiating that all materials comply with requirements.
- B. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
 - 1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.
- C. Samples: For the following products in minimum 1' x 1' sizes unless otherwise indicated:

1. Flashing sheet.
2. Membrane-reinforcing fabric.
3. Insulation.
4. Drainage panel.
5. Plaza deck paver **[full sized]** in each color and texture required.
6. Paver pedestal assembly.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer**[and testing agency]**.
- B. Installer to submit a certificate evidencing not less than five (5) years of successful experienced installing similar types to products specified.
- C. Manufacturer to submit a certificate evidencing not less than five (5) years experienced manufacturing types of products specified.
- D. Manufacturer to submit a field report that all installation work is being done per contract requirements.
- E. Product Test Reports: For waterproofing, based on evaluation of comprehensive tests performed by a qualified testing agency.
- F. Field quality-control reports.
- G. Provide a certificate that bellows are jet fuel resistant.
- H. Provide a certificate stating that waterproofing and protection board to be used at the horizontal and vertical surfaces of the basement extension has been tested for jet fuel resistance and that the required warranty applies to this work. Provide the actual test report.
 1. Minimum Requirements: For waterproofing, expansion joint covers and any associated joints, no loss in waterproofing ability within 48 hours after ponding jet fuel for 72 hours. For protection board, no loss in protection within 48 hours after being immersed in jet fuel for 72 hours.
- I. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that is **[approved or licensed by]** **[acceptable to]**

waterproofing manufacturer for installation of waterproofing required for this Project and is eligible to receive special warranties specified.

1. Installer will have specialized in installation of types of waterproofing required for project for not less than five (5) years and which is acceptable to manufacturer(s) of primary materials.
 2. Assign work closely associated with waterproofing, including (but not limited to) waterproofing accessories, and flashings used in conjunction with waterproofing, expansion joints in membrane, insulation and protection course on membrane, to installer of waterproofing, for single, undivided responsibility.
- B. Source Limitations: Obtain primary waterproofing materials of each type required from single manufacturer with not less than three (3) years of successful experience in supplying principal materials for fluid applied waterproofing work. Provide secondary materials only as recommended by manufacturer of primary materials.
- C. Mockups: Before beginning installation, install waterproofing to **100 sq. ft. (9.3 sq. m)** <Insert area>of **[deck] [wall]** to demonstrate surface preparation, crack and joint treatment, corner treatment, thickness, texture, and execution quality. **[Install pavers and paver supports to demonstrate aesthetic effects and set quality standards for materials and execution.]**
1. If DEN Project Manager determines mockups do not comply with requirements, reapply waterproofing **[and reinstall overlaying construction]** until mockups are approved.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Approximately two (2) weeks prior to actual commencement of fluid-applied waterproofing installation, meet at project site with Installer, installers of deck or substrate construction to receive work, installers of other work in and around waterproofing work which must precede, follow or penetrate waterproofing work (including mechanical work if any), DEN Project Manager, the Contractor's Quality Control Manager and waterproofing material manufacturer's representative. Record (Contractor) discussions of conference, together with decisions and agreements (or disagreements) reached. Furnish copy of record to each party attending.
1. Review methods and procedures related to work, including but not necessarily limited to the following:
 - a. Tour jobsite areas to be waterproofed. Inspect and discuss condition of substrate, drains, curbs, penetrations, and other preparatory work performed by other trades.
 - b. Review waterproofing requirements (drawings, specifications and other contract documents), including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions,

- special details and flashings, and installation procedures.
 - c. Review required submittals. Work cannot begin until all submittals are accepted.
 - d. Review and finalize construction schedule related to waterproofing work and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - e. Review required inspection, testing, and certifying procedures, safety, and hazardous control programs.
 - f. Review protection and repair procedures.
 - E. Contractor to employ an independent testing laboratory to certify that waterproofing was installed per contract requirements and to thicknesses required. Submit certificate to DEN Project Manager.
 - F. Warranty: Installer to warrant installation for five (5) years including responsibility for removing and replacing work concealing waterproof membrane. Warrant installation to be watertight for application required.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Deliver liquid materials to Project site in original containers with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, shelf life, and directions for storing and mixing with other components.
 - B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.
 - C. Remove and replace liquid materials that cannot be applied within their stated shelf life.
 - D. Protect stored materials from direct sunlight.
- 1.8 PROJECT CONDITIONS
- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.
 - 1. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.
 - B. Maintain adequate ventilation during application and curing of waterproofing materials.
- 1.9 WARRANTY
- A. Special Manufacturer's Warranty: Manufacturer's standard form in which waterproofing manufacturer[**and Installer**] agree to repair or replace waterproofing that does not

comply with requirements or that fails to remain watertight within specified warranty period.

1. Warranty does not include failure of waterproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate that exceed **1/16 inch** (1.6 mm) in width.
2. Warranty Period: **[Five]** <Insert number> years from date of Substantial Completion.

B. Special Installer's Warranty: Specified form, **[on warranty form at end of this Section]**, signed by Installer, covering Work of this Section, for warranty period of **[two]** <Insert number> years.

1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pavers on plaza decks.

1.10 CONSTRUCTION WASTE MANAGEMENT

A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GENERAL

A. General Compatibility: Provide products that are recommended by manufacturer to be fully compatible with indicated substrates, including modification by bituminous additives (asphalt or coal tar as needed) and similar proven compounding provisions.

2.2 SINGLE-COMPONENT POLYURETHANE WATERPROOFING

A. Single-Component, Modified Polyurethane Waterproofing: Comply **[with ASTM C 836 and]**with manufacturer's written physical requirements.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. American Permaquik Inc.; PQ 6800.
 - b. Anti-Hydro International, Inc.; A-H Seamless Membrane.
 - c. Carlisle Coatings & Waterproofing Inc.; CCW-525.
 - d. CETCO; LDC 60.
 - e. Degussa Building Systems; HLM 5000.
 - f. Karnak Corporation; One-Kote System.
 - g. Meadows, W.R., Inc.; Sealtight Meadow-Pruf Seamless
 - h. Mer-Kote Products, Inc.; Mer-Thane 320.
 - i. Neogard, Div. of Jones-Blair; Neogard 7401.

- j. Pacific Polymers International, Inc.; [**Elasto-Deck B.T.**] [**Elasto-Deck B.T. 100% Solids**] [**Elasto-Deck B.T. H20**].
 - k. Tremco Incorporated; [**Tremproof 60**] [**Vulkem 250 GC**] [**Vulkem 201**].
 - l. United Coatings; Elastall 1000.
 - m. <**Insert manufacturer's name; product name or designation**>.
 - n. or approved equal.
- B. Single-Component, Reinforced, Modified Polyurethane Waterproofing: Comply [**with ASTM C 836 and**]with manufacturer's written physical requirements.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.; CCW-525-H.
 - b. <**Insert manufacturer's name; product name or designation**>.
 - c. or approved equal.
- C. Single-Component, Unmodified Polyurethane Waterproofing: Comply with ASTM C 836 and with manufacturer's written physical requirements.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. 3M; Scotch Clad 5893/5864.
 - b. Tremco Incorporated; Vulkem 101.
 - c. <**Insert manufacturer's name; product name or designation**>.
 - d. or approved equal.

2.3 TWO-COMPONENT POLYURETHANE WATERPROOFING

- A. Two-Component, Modified Polyurethane Waterproofing: Comply with ASTM C 836 and with manufacturer's written physical requirements.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Gaco Western Inc.; LM-60.
 - b. Tremco Incorporated; Vulkem 222.
 - c. <**Insert manufacturer's name; product name or designation**>.
 - d. or approved equal.
- B. Two-Component, Unmodified Polyurethane Waterproofing: Comply with ASTM C 836 and with manufacturer's written physical requirements.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.; CCW 703 Liqueiseal.
 - b. Pacific Polymers International, Inc.; [**Elasto-Deck B.T. 1000**] [**Elasto-Deck B.T. Two-Component**].
 - c. 3M; FC 100.
 - d. Tremco Incorporated; Vulkem 102.
 - e. <**Insert manufacturer's name; product name or designation**>.
 - f. or approved equal.

- C. Two-Component, Reinforced, Unmodified Polyurethane Waterproofing: Comply [**with ASTM C 836 and**]with manufacturer's written physical requirements.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Kemper System, Inc.; Kemperol 2K-PUR.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.

2.4 POLYESTER WATERPROOFING

- A. Two-Component, Reinforced, Unsaturated Polyester Waterproofing: Comply [**with ASTM C 836 and**]with manufacturer's written physical requirements.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Kemper System, Inc.; Kemperol BR.
 - b. Landmark Products, Inc.; Triflex D.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.

2.5 LATEX-RUBBER WATERPROOFING

- A. Two-Component, Unreinforced, Latex-Rubber Waterproofing: Comply [**with ASTM C 836 and**]with manufacturer's written physical requirements.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Grace, W. R. & Co.; Procor.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.

- B. Two-Component, Reinforced, Latex-Rubber Waterproofing: Comply [**with ASTM C 836 and**]with manufacturer's written physical requirements.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Grace, W. R. & Co.; Procor Deck System 3R.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.

2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials recommended by manufacturer to be compatible with one another and with waterproofing, as demonstrated by waterproofing manufacturer, based on testing and field experience.

- B. Primer: Manufacturer's standard, factory-formulated polyurethane or epoxy primer.

- C. Sheet Flashing: **50-mil-** (1.3-mm-) minimum, nonstaining, uncured sheet neoprene.
 - 1. Adhesive: Manufacturer's recommended contact adhesive.
- D. Membrane-Reinforcing Fabric: Nonwoven, needle-punched white polyester fabric, **[6-oz./sq. yd. (200-g/sq. m)] [5-oz./sq. yd. (169-g/sq. m)] [3.2-oz./sq. yd. (109-g/sq. m)] [manufacturer's standard]** weight.
- E. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.
- F. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing, complying with ASTM C 920 Type M, Class 25; Grade NS for sloping and vertical applications or Grade P for deck applications; Use NT exposure; and as recommended by manufacturer for substrate and joint conditions.
 - 1. Backer Rod: Closed-cell polyethylene foam.
- G. Bellows: Where bellows are indicated on the drawings as in contact with the waterproof membrane, provide either 24 gauge soft copper or 60 mil flexible sheet membrane that is jet fuel resistant and compatible with waterproof membrane. Bellows shall be as indicated and shall lap waterproof membrane a minimum 6" per side.

2.7 PROTECTION COURSE

- A. Protection Course: ASTM D 6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:
 - 1. Thickness: **[1/8 inch (3 mm)] [1/4 inch (6 mm)]**, nominal.
 - 2. Thickness: **1/8 inch (3 mm)**, nominal, for vertical applications; **1/4 inch (6 mm)**, nominal, elsewhere.
 - 3. Adhesive: Rubber-based solvent type recommended by waterproofing manufacturer for type of protection course.
- B. Protection Course: Fan folded, with a core of extruded-polystyrene board insulation faced **[one] [or] [both]** side(s) with plastic film, nominal thickness of **1/4 inch (6 mm)**, with compressive strength not less than **8 psi (55 kPa)** per ASTM D 1621 and maximum water absorption by volume of 0.6 percent per ASTM C 272.
- C. Protection Course: Unfaced, fan-folded, rigid, extruded-polystyrene board insulation; nominal thickness of **1/4 inch (6 mm)** with compressive strength of not less than **8 psi (55 kPa)** per ASTM D 1621.
- D. Protection Course: Fan folded, with a core of molded-polystyrene board insulation faced both sides with plastic film, nominal thickness of **[1/4 inch (6 mm)] [3/8 inch (9.5 mm)] [1/2 inch (13 mm)]**, with compressive strength not less than **12 psi (83 kPa)** per ASTM D 1621 and water absorption by volume of less than 1 percent per ASTM C 272.

- E. Protection Course: Unfaced, extruded-polystyrene board insulation; ASTM C 578, Type X, **1/2 inch** (13 mm) thick.
- F. Protection Course: Molded-polystyrene board insulation, ASTM C 578, Type I, **0.90-lb/cu. ft.** (15-kg/cu. m) minimum density, **1-inch** (25-mm) minimum thickness.

2.8 MOLDED-SHEET DRAINAGE PANELS

- A. Molded-Sheet Drainage Panel: Comply with Section 334600 "Subdrainage."
- B. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding **No. 70** (0.21-mm) sieve laminated to one side[**with**] [**or**] [**without**] a polymeric film bonded to the other side of a studded, nonbiodegradable, molded-plastic-sheet drainage core, with a vertical flow rate of **9 to 15 gpm per ft.** (112 to 188 L/min. per m).
- C. Woven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a woven-geotextile facing with an apparent opening size not exceeding **No. 40** (0.43-mm) sieve, laminated to one side[**with**] [**or**] [**without**] a polymeric film bonded to the other side of a studded, nonbiodegradable, molded-plastic-sheet drainage core, with a horizontal flow rate not less than **2.8 gpm per ft.** (35 L/min. per m).

2.9 INSULATION

- A. Board Insulation: Extruded-polystyrene board insulation complying with ASTM C 578, [**square**] [**or**] [**shiplap**] edged.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning.
 - d. Pactiv Corporation.
 - e. T. Clear Corporation.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
 - 2. Type VI, **40-psi** (276-kPa) minimum compressive strength.
 - 3. Type VII, **60-psi** (414-kPa) minimum compressive strength.
 - 4. Type V, **100-psi** (690-kPa) minimum compressive strength.
- B. Unfaced, Wall Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, [**Type IV, 25-psi** (173-kPa)] [**Type VI, 40-psi** (276-kPa)] minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.
 - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. DiversiFoam Products; CertiFoam **[25] [40]** Drainage Board.
 - b. Dow Chemical Company (The); Perimate.
 - c. Pactiv Corporation; Green-Guard-DC.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
- C. Geotextile-Faced, Wall Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, **[Type IV, 25-psi (173-kPa)] [Type VI, 40-psi (276-kPa)]** minimum compressive strength; fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with a nonwoven-geotextile filter fabric.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Owens Corning; Insul-Drain.
 - b. T. Clear Corporation; Thermadry **[750] [1250]**.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
- D. Unfaced, Plaza Deck, Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, **[Type VI, 40-psi (276-kPa)] [Type VII, 60-psi (414-kPa)]** minimum compressive strength; unfaced; fabricated with shiplapped or channel edges and with one side having ribbed drainage channels.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. DiversiFoam Products; CertiFoam Plaza Deck.
 - b. Dow Chemical Company (The); Styrofoam Ribbed Roofmate.
 - c. Owens Corning; **[Foamular 404 RB] [Foamular 604 RB]**.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
- E. Geotextile-Faced, Plaza Deck, Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, Type VII, **60-psi (414-kPa)** minimum compressive strength; fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with manufacturer's standard, nonwoven-geotextile filter fabric.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. T. Clear Corporation; Thermadry 1750.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
- 2.10 PLAZA DECK PAVERS
- A. Plaza Deck Pavers: **[Brick] [Concrete] [Asphalt-block]** pavers specified in Section 321400 "Unit Paving."

- B. Plaza Deck Pavers: **[Granite] [Limestone] [Marble] [Quartz-based stone] [Slate]** pavers specified in Section 096340 "Stone Flooring."
- C. Plaza Deck Pavers: Heavyweight, hydraulically pressed, concrete units, **[square edged] [with top edges beveled 3/16 inch (5 mm)]**, manufactured for use as plaza deck pavers; minimum compressive strength of **[7500 psi (52 MPa)] [6500 psi (45 MPa)]** <Insert value>, ASTM C 140; absorption not greater than 5 percent, ASTM C 140; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C 67.
- Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - Hanover Architectural Products.
 - Hastings Pavement Company, LLC.
 - Roofblok Ltd.
 - Sunny Brook Pressed Concrete Co.
 - Wausau Tile, Inc.; Terra-Paving Div.
 - Westile Roofing Products.
 - <Insert manufacturer's name>.
 - or approved equal.
 - Thickness: **[1-5/8 inches (41 mm)] [1-3/4 inches (45 mm)] [2 inches (51 mm)] [2-3/8 inches (60 mm)]** <Insert dimension>.
 - Face Size: **[8-7/8 inches (225 mm) square] [9 inches (229 mm) square] [9-by-18 inches (229-by-457 mm)] [12 inches (305 mm) square] [12-by-24 inches (305-by-610 mm)] [18 inches (457 mm) square] [24 inches (610 mm) square] [As indicated]** <Insert dimensions and shape>.
 - Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range]** <Insert color>.
- D. Setting Bed: Provide **[aggregate] [mortar] [bituminous]** setting-bed materials specified in Section 321400 "Unit Paving."
- E. Paver Pedestals: Paver manufacturer's standard SBR rubber, high-density polyethylene, or polyurethane paver support assembly, including **[fixed-height] [adjustable or stackable]** pedestals, shims, and spacer tabs for joint spacing of **[1/8 inch (3 mm)] [3/16 inch (5 mm)] [1/8 to 3/16 inch (3 to 5 mm)]**.
- Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - <Insert manufacturer's name>.
 - or approved equal.
 - Concrete Fill: ACI 301, compressive strength of **5000 psi (34 MPa)** at 28 days and air content of 6 percent.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
 - 1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
 - 2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean and prepare substrate according to manufacturer's written recommendations. Provide clean, dust-free, and dry substrate for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage or overspray affecting other construction.
- C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.
- D. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.
 - 1. Abrasive blast clean concrete surfaces uniformly to expose top surface of fine aggregate according to ASTM D 4259 with a self-contained, recirculating, blast-cleaning apparatus. Remove material to provide a sound surface free of laitance, glaze, efflorescence, curing compounds, concrete hardeners, or form-release agents. Remove remaining loose material and clean surfaces according to ASTM D 4258.
- E. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.
- F. Seal joints, and apply bond breakers as recommended by prime materials manufacturer, with particular attention at construction joints.
- G. Install accessories as recommended by prime materials manufacturer.
- H. Prime substrate as recommended (and only if recommended) by prime materials manufacturer.

3.3 PREPARATION AT TERMINATIONS AND PENETRATIONS

- A. Prepare vertical and horizontal surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, and sleeves according to **[ASTM C 898]** **[ASTM C 1471]** and manufacturer's written instructions.
- B. Prime substrate unless otherwise instructed by waterproofing manufacturer.
- C. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.
 - 1. Provide sealant cants around penetrations and at inside corners of deck-to-wall butt joints when recommended by waterproofing manufacturer.

3.4 JOINT AND CRACK TREATMENT

- A. Prepare, treat, rout, and fill joints and cracks in substrate according to **[ASTM C 898]** **[ASTM C 1471]** and waterproofing manufacturer's written instructions. Remove dust and dirt from joints and cracks, complying with ASTM D 4258, before coating surfaces.
 - 1. Comply with ASTM C 1193 for joint-sealant installation.
 - 2. Apply bond breaker between sealant and preparation strip.
 - 3. Prime substrate and apply a single thickness of preparation strip extending a minimum of **3 inches** (75 mm) along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.
- B. Install sheet flashing and bond to deck and wall substrates where indicated or required according to waterproofing manufacturer's written instructions.
 - 1. Extend sheet flashings onto perpendicular surfaces and other work penetrating substrate according to ASTM C 898.

3.5 WATERPROOFING APPLICATION

- A. Apply waterproofing according to **[ASTM C 898]** **[ASTM C 1471]** and manufacturer's written instructions.
- B. Start installing waterproofing in presence of manufacturer's technical representative.
- C. Apply primer over prepared substrate.
- D. Except as otherwise indicated, extend flashings onto perpendicular surfaces and other work penetrating substrate to not less than 6" beyond finished surface to be applied over waterproofing.
- E. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.

1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases, with an average dry film thickness of **[60 mils (1.5 mm) and a minimum dry film thickness of 50 mils (1.3 mm) at any point] [120 mils (3 mm)] <Insert thickness>**.
 2. Apply waterproofing to prepared wall terminations and vertical surfaces.
 3. Verify wet film thickness of waterproofing every **100 sq. ft. (9.3 sq. m)**.
- F. Reinforced Waterproofing Applications: Mix materials and apply waterproofing by roller, notched squeegee, trowel, or other suitable application method.
1. Apply first coat of waterproofing, embed membrane-reinforcing fabric, and apply second coat of waterproofing to completely saturate reinforcing fabric and to obtain a seamless reinforced membrane free of entrapped gases, with an average dry film total thickness of **[70 mils (1.8 mm)] [80 mils (2 mm)] [120 mils (3 mm)] <Insert thickness>**.
 2. Apply reinforced waterproofing to prepared wall terminations and vertical surfaces.
 3. Verify wet film thickness of waterproofing every **100 sq. ft. (9.3 sq. m)**.
- G. Install protection course with butted joints over nominally cured membrane before starting subsequent construction operations.
1. **[Molded-sheet drainage panels] [Insulation drainage panels] [Board insulation]** may be used in place of a separate protection course to vertical applications when approved by waterproofing manufacturer.
- H. Bellows: Lap waterproof membrane above and below bellows.
- 3.6 PROTECTION COURSE:
- A. Install protection course on cured membrane (after testing, if required) without delay, so that period of membrane exposure will be minimized.
 - B. On all vertical surfaces to be waterproofed install protection course. Comply with waterproofing manufacturer's recommendations for adhesion of protection course to membrane.
 - C. On all horizontal surfaces to receive waterproofing including between slabs and at basement extension install protection course. Comply with waterproofing manufacturer's recommendations for adhesion of protection course to membranes.
 - D. MOLDED-SHEET DRAINAGE PANEL INSTALLATION
 - E. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesives **[or mechanical fasteners]** that do not penetrate waterproofing. Lap edges and ends of geotextile fabric to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

1. For vertical applications, install [**board insulation**] [**protection course**] before installing drainage panels.

3.7 INSULATION INSTALLATION

- A. Install [**one or more layers of board insulation to achieve required thickness**] [**insulation drainage panels**] over waterproofed surfaces. Cut and fit to within **3/4 inch** (19 mm) of projections and penetrations.
- B. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use type of adhesive recommended in writing by insulation manufacturer.
- C. On horizontal surfaces, place insulation units unadhered according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.8 PLAZA DECK PAVER INSTALLATION

- A. Setting Bed: Install setting bed in locations and of thickness indicated to comply with requirements in [**Section 321400 "Unit Paving."**] [**Section 096340 "Stone Flooring."**]
- B. Install concrete pavers, in locations indicated, according to manufacturer's written instructions.
- C. Accurately install [**fixed**] [**adjustable**]-height paver pedestals in locations and to elevations required. Adjust for final level and slope with shims.
 1. Fill paver pedestal with concrete mix, strike smooth with top of pedestal, and cure according to ACI 301.
- D. Loosely lay pavers on pedestals, maintaining a uniform open joint width. Tightly seat pavers against spacers to eliminate lateral movement or drift of paving assembly. Align joint patterns parallel in each direction.
 1. Lay out pavers to avoid less-than-half-width pavers at perimeter or other terminations.
- E. Install pavers to not vary more than **1/16 inch** (1.6 mm) in elevation between adjacent pavers or more than **1/16 inch** (1.6 mm) from surface plane elevation of individual paver.
- F. Maintain tolerances of paving installation within [**1/4 inch in 10 feet (1:48)**] <Insert **surface tolerance**> of surface plane in any direction.

3.9 FIELD QUALITY CONTROL

- A. Engage a full time site representative qualified by the waterproofing membrane

manufacturer to inspect substrate conditions, surface preparation, and application of the membrane, flashings, protection, and drainage components; and to furnish daily reports to DEN Project Manager.

- B. Flood Testing: Flood test each deck area for leaks, according to recommendations in ASTM D 5957, after completing waterproofing but before overlaying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
1. Flood to an average depth of **2-1/2 inches** (64 mm) with a minimum depth of **1 inch** (25 mm) and not exceeding a depth of **4 inches** (100 mm). Maintain **2 inches** (50 mm) of clearance from top of sheet flashings.
 2. Flood each area for **[24] [48] [72]** hours.
 3. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.
- C. **[Owner will engage] [Engage]** an independent testing agency to observe flood testing and examine underside of decks and terminations for evidence of leaks during flood testing.
1. Independent testing laboratory to certify that waterproofing was installed per contract requirements and to thicknesses required. Submit certificate to DEN Project Manager.

3.10 CURING, PROTECTION, AND CLEANING

- A. Cure waterproofing according to manufacturer's written recommendations, taking care to prevent contamination and damage during application stages and curing.
1. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Protect installed **[board insulation] [insulation drainage panels]** from damage due to ultraviolet light, harmful weather exposures, physical abuse, and other causes. Immediately after installation, provide temporary coverings where insulation will be subject to abuse and cannot be concealed and protected by permanent construction.
- D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 071416

SECTION 071613 - POLYMER MODIFIED CEMENT WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes polymer-modified cement waterproofing for **[positive] [negative]-side** application to **[concrete] [concrete unit masonry] [and] [clay masonry]**.
- B. Related Sections:
 - 1. Section 033000 "Cast-in-Place Concrete" for **[waterstops] [, concrete slabs serving as floor toppings to protect waterproofing,]** and finishing concrete walls and slabs to receive waterproofing.
 - 2. Section 042000 "Unit Masonry" for construction cleaning of unit masonry walls to receive waterproofing.
 - 3. Section 079200 "Joint Sealants" for elastomeric and preformed sealants in concrete and masonry walls and floors.
 - 4. Section 092400 "Portland Cement Plastering" for plaster finishes to be applied over waterproofing.
 - 5. Section 099726 "Cementitious Coatings" for polymer-modified cementitious coatings used primarily for decorative purposes.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include **[construction details,]** material descriptions and installation instructions for polymer-modified cement waterproofing.
 - 1. Include data substantiating that all materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.2: For waterproofing for negative-side application, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit IEQ 4: For waterproofing for negative-side application, documentation indicating that products comply with the testing and

product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Samples for Initial Selection: For each type of polymer-modified cement waterproofing indicated.
 - 1. Include Samples of available color selection.
- D. Samples for Verification: For each type of polymer-modified cement waterproofing indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Applicator.
- B. Installer to submit a certificate evidencing not less than five (5) years of successful experienced installing similar types to products specified.
- C. Manufacturer to submit a certificate evidencing not less than five (5) years experienced manufacturing types of products specified.
- D. Manufacturer to submit a field report that all installation work is being done per contract requirements.
- E. Product Certificates: For waterproofing, patching, and plugging materials, from manufacturer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for each type of polymer-modified cement waterproofing.
- G. Field quality-control reports.
- H. Copy of project warranty for waterproofing installation.

1.5 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm experienced in applying polymer-modified cement waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance[, **and that employs workers trained and approved by manufacturer**].

1. Installer will have specialized in installation of types of waterproofing required for project for not less than five (5) years and which is acceptable to manufacturer(s) of primary materials.
 2. Assign work closely associated with waterproofing, including but not limited to waterproofing accessories, and materials used in conjunction with waterproofing, to installer of waterproofing, for single, undivided responsibility.
- B. Source Limitations: Obtain primary waterproofing materials of each type required from single manufacturer with not less than three (3) years of successful experience in supplying principal materials for fluid applied waterproofing work. Provide secondary materials only as recommended by manufacturer of primary materials.
- C. Mockups: Provide mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockup of typical [**vertical**] [**horizontal**] surfaces [**shown on Drawings**] [**10 sq. ft. (0.9 sq. m) in size**] <Insert description>.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Approximately two (2) weeks prior to actual commencement of waterproofing installation, meet at project site with Installer, installers of deck or substrate construction to receive work, installers of other work in and around waterproofing work which must precede, follow or penetrate waterproofing work, including mechanical work if any, DEN Project Manager, the Contractor's Quality Control Manager and waterproofing material manufacturer's representative. Record (Contractor) discussions of conference, together with decisions and agreements (or disagreements) reached. Furnish copy of record to each party attending.
1. Review methods and procedures related to work, including but not necessarily limited to the following:
 - a. Tour jobsite areas to be waterproofed. Inspect and discuss condition of substrate, drains, curbs, penetrations, and other preparatory work performed by other trades.
 - b. Review waterproofing requirements (drawings, specifications and other contract documents), including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures,.
 - c. Review required submittals. Work cannot begin until all submittals are approved by Owner.
 - d. Review and finalize construction schedule related to waterproofing work and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - e. Review required inspection, testing, and certifying procedures, safety, and hazardous control programs.
 - f. Review protection and repair procedures.

- E. Warranty: Installer to warrant installation for five (5) years including responsibility for removing and replacing work concealing waterproof membrane. Warrant installation to be watertight for application required.

1.7 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit polymer-modified cement waterproofing to be performed according to manufacturer's written instructions.
- B. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.
- C. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at **40 deg F** (4.4 deg C) or above during work and cure period, and space is well ventilated and kept free of water.

1.8 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GENERAL

- A. General Compatibility: Provide products that are recommended by manufacturer to be fully compatible with indicated substrates.

2.2 FIELD-MIXED, POLYMER-MODIFIED CEMENT WATERPROOFING

- 1. Admixture for Field Mixing: Manufacturer's standard polymer admixture for mixing with Portland cement and sand to produce a waterproof coating that is suitable for vertical and horizontal applications below or above grade, is breathable, resists **[positive]** **[negative]**-side hydrostatic pressure, has VOC content complying with limits of authorities having jurisdiction, and has properties meeting or exceeding the criteria specified below.
- B. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Anti-Hydro International, Inc.; Anti-Hydro.
 - 2. **<Insert manufacturer's name; product name or designation>**.

3. or approved equal.
4. Water Permeability: Maximum [**zero for water at 30 feet** (9 m)] **<Insert requirement>** when tested according to CE CRD-C 48.
5. Compressive Strength: Minimum [**4000 psi (27.6 MPa)**] **<Insert value>** at 28 days when tested according to ASTM C 109/C 109M.
6. Flexural Strength: Minimum [**710 psi (4.8 MPa)**] **<Insert value>** at 28 days when tested according to ASTM C 348.
7. Bond Strength: Minimum [**220 psi (1.5 MPa)**] **<Insert value>** at 14 days when tested according to ASTM C 321.
8. VOC Content of Negative-Side Waterproofing: Products shall comply with VOC limits of authorities having jurisdiction, but not exceed 400 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. Emissions from Negative-Side Waterproofing: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 PREPACKAGED, POLYMER-MODIFIED CEMENT WATERPROOFING

- A. Negative-Side, Polymer-Modified Cement Waterproofing: Manufacturer's proprietary blend of dry cementitious and other ingredients for mixing with [**potable water**] [**or**] [**polymer admixture**] to produce a waterproof coating that is suitable for vertical and horizontal applications below or above grade, is breathable, resists negative-side hydrostatic pressure, has VOC content complying with limits of authorities having jurisdiction, and has properties meeting or exceeding the criteria specified below.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. American PERMAQUIK Inc.; [**ECTOFLEX 646**] [**ECTOFLEX 4020**].
 - b. Anti-Hydro International, Inc.; A-H Hydroseal.
 - c. AQUAFIN, Inc.; [**AQUAFIN-1K**] [**MORTAR-LN**].
 - d. BASF Building Systems; [**Brushbond**] [**Masterseal 550i**] [**Sonnoblock**] [**Thoroseal Foundation Coating**] [**Thoroseal**].
 - e. Conproco Corporation; Conpro Seal[**with Color K-88 Admix**].
 - f. Euclid Tamms; [**TAMOSEAL**] [**TAMOSEAL FOUNDATION COATING**].
 - g. Five Star Products, Inc.; [**Five Star Cement Coat**] [**Five Star Waterproofing**].
 - h. Gemite Products Inc.; [**Cem-Kote Plus**] [**Cem-Kote ST**] [**Cem-Kote Flex ST**].
 - i. International Chem-Crete, Inc.; CCC 150.
 - j. Metalcrete Industries; [**Blokcoat**] [**Blokcoat FR**].
 - k. Sika Corporation, Inc.; Sika Top Seal 107.
 - l. Specco Industries, Inc.; Speccrete P-10.
 - m. Vandex USA LLC; [**VANDEX BB 75**] [**VANDEX BB 75 E**].
 - n. **<Insert manufacturer's name; product name or designation>**.
 - o. or approved equal.
 2. Water Permeability: Maximum [**zero for water at 30 feet** (9 m)] **<Insert requirement>** when tested according to CE CRD-C 48.

3. Compressive Strength: Minimum [**4000 psi (27.6 MPa)**] <Insert value> at 28 days when tested according to ASTM C 109/C 109M.
 4. Flexural Strength: Minimum [**710 psi (4.8 MPa)**] <Insert value> at 28 days when tested according to ASTM C 348.
 5. Bond Strength: Minimum [**220 psi (1.5 MPa)**] <Insert value> at 14 days when tested according to ASTM C 321.
 6. Color: [**White**] [**Gray**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from full range**] [**As indicated in a color schedule**] <Insert color>.
 7. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction, but not exceed 400 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 8. Low-Emitting Materials: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Positive-Side, Polymer-Modified Cement Waterproofing: Manufacturer's proprietary blend of dry cementitious and other ingredients for mixing with [**potable water**] [**or**] [**polymer admixture**] to produce a waterproof coating that is suitable for vertical and horizontal applications below or above grade, is breathable, resists positive-side hydrostatic pressure, has VOC content complying with limits of authorities having jurisdiction, and has properties meeting or exceeding the criteria specified below.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. American PERMAQUIK Inc.; [**ECTOFLEX 646**] [**ECTOFLEX 4020**].
 - b. Anti-Hydro International, Inc.; A-H Hydroseal.
 - c. AQUAFIN, Inc.; [**AQUAFIN-1K**] [**MORTAR-LN**] [**AQUAFIN-2K/M**].
 - d. BASF Building Systems; [**Brushbond**] [**Flextight**] [**Masterseal 550i**] [**Sonnoblock**] [**Thoroseal Foundation Coating**] [**Thoroseal**].
 - e. Conproco Corporation; [**Foundation Coat**] [**F/C Membrane**] [**Foundation Coat with K-88 Admix**] [**F/C Membrane with K-88 Admix**].
 - f. Damtite Waterproofing, Inc.; Powder Foundation Waterproofer[**with Acrylic Bonding Liquid**].
 - g. Euclid Tamms; [**TAMOSEAL**] [**TAMOSEAL FOUNDATION COATING**].
 - h. Five Star Products, Inc.; [**Five Star Cement Coat**] [**Five Star Waterproofing**].
 - i. Gemite Products Inc.; [**Cem-Kote ST**] [**Cem-Kote Flex ST**].
 - j. International Chem-Crete, Inc.; CCC 150.
 - k. Metalcrete Industries; [**Blokcoat**] [**Blokcoat FR**].
 - l. Sika Corporation, Inc.; Sika Top Seal 107.
 - m. Specco Industries, Inc.; Speccrete P-10.
 - n. Vandex USA LLC; [**VANDEX BB 75**] [**VANDEX BB 75 E**].
 - o. Wall Firma, Inc.; Wall Dri Foundation Coating.
 - p. <Insert manufacturer's name; product name or designation>.
 - q. or approved equal.
 2. Water Permeability: Maximum [**zero for water at 30 feet (9 m)**] <Insert requirement> when tested according to CE CRD-C 48.

3. Compressive Strength: Minimum [**4000 psi (27.6 MPa)**] <Insert value> at 28 days when tested according to ASTM C 109/C 109M.
4. Flexural Strength: Minimum [**710 psi (4.8 MPa)**] <Insert value> at 28 days when tested according to ASTM C 348.
5. Bond Strength: Minimum [**220 psi (1.5 MPa)**] <Insert value> at 14 days when tested according to ASTM C 321.
6. Color: [**White**] [**Gray**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from full range**] [**As indicated in a color schedule**] <Insert color>.

2.4 ACCESSORY MATERIALS

- A. Patching Compound: Factory-premixed cementitious repair mortar, crack filler, or sealant recommended by waterproofing manufacturer for filling and patching tie holes, honeycombs, reveals, and other imperfections; compatible with substrate and other materials indicated; and VOC content complying with limits of authorities having jurisdiction.
- B. Plugging Compound: Factory-premixed cementitious compound with hydrophobic properties and recommended by waterproofing manufacturer; resistant to water and moisture but vapor permeable for all standard applications (vertical, overhead, and horizontal surfaces not exposed to vehicular traffic); compatible with substrate and other materials indicated; and VOC content complying with limits of authorities having jurisdiction.
- C. Portland Cement: ASTM C 150, Type I.
- D. Slurry-Coat[**and Protective-Topping**] Sand: ASTM C 144.
- E. Trowel-Coat Sand: ASTM C 33, fine aggregate.
- F. Polymer Admixture for Protective Topping: Polymer bonding agent and admixture designed to improve adhesion to prepared substrates and to not create a vapor barrier.
- G. Water: Potable.

2.5 MIXES

- A. Field-Mixed, Polymer-Modified Cement Waterproofing: Add polymer admixture to Portland cement and sand according to manufacturer's written instructions. Blend together with mechanical mixer or by hand to required consistency.
- B. Prepackaged, Polymer-Modified Cement Waterproofing: Add prepackaged dry ingredients to mixing liquid according to manufacturer's written instructions. Mix together with mechanical mixer or by hand to required consistency.

- C. Protective Topping: Measure, batch, and mix Portland cement and sand in the proportion of [1:3] <Insert proportion> and water[**gaged with a polymer admixture**]. Blend together with mechanical mixer to required consistency.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for suitable conditions where waterproofing is to be applied.
- B. Proceed with application only after unsatisfactory conditions have been corrected.
- C. Notify DEN Project Manager in writing of active leaks or defects that would affect system performance.

3.2 PREPARATION

- A. Protect other work from damage caused by cleaning, preparation, and application of waterproofing. Provide temporary enclosure[**to confine spraying operation and**] to ensure adequate ambient temperatures and ventilation conditions for application.
- B. Do not allow waterproofing, patching, and plugging materials to enter reveals or annular spaces intended for resilient sealants or gaskets, such as joint spaces between pipes and pipe sleeves.
- C. Stop active water leaks with plugging compound according to waterproofing manufacturer's written instructions.
- D. Repair damaged or unsatisfactory substrate with patching compound according to manufacturer's written instructions.
1. At holes and cracks in substrate, remove loosened chips and cut reveal with sides perpendicular to surface, not tapered, and approximately **1 inch** (25.4 mm) deep. Fill reveal with patching compound flush with surface.
- E. Surface Preparation: Comply with waterproofing manufacturer's written instructions to remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, paint, curing compounds, and form-release agents to ensure that waterproofing bonds to surfaces.
1. Clean concrete surfaces according to ASTM D 4258.
- a. Scratch- and Float-Finished Concrete: Etch with 10 percent muriatic (hydrochloric) acid solution according to ASTM D 4260.
- b. Prepare smooth-formed and trowel-finished concrete by mechanical abrading or abrasive-blast cleaning according to ASTM D 4259.
2. Clean concrete unit masonry surfaces according to ASTM D 4261.

- a. Lightweight Concrete Unit Masonry: Etch with 10 percent muriatic (hydrochloric) acid solution or abrade surface by wire brushing. Remove acid residue until pH readings of water after rinse are not more than 1.0 pH lower or 2.0 pH higher than pH of water before rinse.
 - b. Medium- and Normal-Weight Concrete Unit Masonry: Sandblast or bushhammer to a depth of **1/16 inch** (1.6 mm).
3. Clean clay masonry surfaces according to ASTM D 5703.
 4. Concrete Joints: Clean reveals according to waterproofing manufacturer's written instructions.
- F. Seal joints, and apply bond breakers as recommended by prime materials manufacturer, with particular attention at construction joints.
- G. Install accessories as recommended by prime materials manufacturer.
- H. Prime substrate as recommended (and only if recommended) by prime materials manufacturer.
- ### 3.3 APPLICATION
- A. General: Comply with waterproofing manufacturer's written instructions for application and curing.
1. Saturate surface with water[**for several hours prior to application**] with water and maintain damp condition until applying waterproofing. Remove standing water.
 2. Apply waterproofing to surfaces indicated on Drawings.
 3. Number of Coats: **[Number required for specified water permeability]** **[Two]** **[Three]** <Insert number>.
 - a. Coating Thickness: Maximum application thickness of **[47 mils (1.2 mm)]** <Insert value> per coat for total thickness **[as required for specified water permeability]** **[of 100 mils (2.5 mm)]** <Insert requirement>.
 - b. Apply first coat as a slurry with brush or roller, and apply subsequent coats with brush, roller, spray, or trowel.
 - c. Vigorously work first coat onto the substrate, forcing the material into surface voids. Apply each subsequent coat into full contact with previous coat.
 - d. Allow manufacturer's recommended time between coats. Dampen surface between coats.
- B. Final Coat Finish: **[Smooth troweled]** **[Brushed]** **[Textured]** <Insert requirement>.
- C. Curing: Air-cure waterproofing for not less than **[five]** <Insert number> days immediately after application and prior to being placed in service.

- D. Curing: Moist-cure waterproofing for not less than **[three]** <Insert number> days immediately after application has set, followed by air drying prior to being placed in service unless otherwise recommended in writing by manufacturer.
- E. Waterproofing Treatment Extensions: Extend waterproofing treatment as follows:
1. Onto columns integral with treated walls.
 2. Onto interior nontreated walls intersecting exterior treated walls, for a distance of **[24 inches (600 mm) for cast-in-place concrete]** [and] **[48 inches (1200 mm) for masonry]**.
 3. Onto exterior walls and onto both exterior and interior columns, for a height of **12 inches (300 mm)**, where floors, but not walls, are treated.
 4. Onto every substrate in areas indicated for treatment, including **[pipe trenches]** **[pipe chases]** **[pits]** **[sumps]** <Insert area> [and] **[similar offsets and features]**.
- F. Protective Floor Topping: Apply **[1-inch- (25.4-mm-)]** <Insert dimension> thick, protective topping over floor surfaces.

3.4 FIELD QUALITY CONTROL

- A. Inspection: Engage manufacturer's representative to inspect completed application and provide a written report that application complies with manufacturer's written instructions.
- B. **[Owner will engage]** **[Engage]** an Independent testing laboratory to certify that waterproofing was installed per contract requirements and to thicknesses required. Submit certificate to DEN Project Manager.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 071613

SECTION 071616 - CRYSTALLINE WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes crystalline waterproofing for [**positive**] [**negative**]-side application to [**concrete**] [**and**] [**concrete unit masonry**].
- B. Related Sections:
 - 1. Section 033000 "Cast-in-Place Concrete" for [**waterstops,**] [**concrete slabs serving as floor toppings to protect waterproofing,**] and finishing concrete walls and slabs to receive waterproofing.
 - 2. Section 042000 "Unit Masonry" for construction cleaning of concrete unit masonry walls to receive waterproofing.
 - 3. Section 079200 "Joint Sealants" for elastomeric and preformed sealants in concrete and concrete unit masonry walls and floors.
 - 4. Section 092400 "Portland Cement Plastering" for plaster finishes to be applied over waterproofing.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include[**construction details,**] material descriptions and installation instructions for crystalline waterproofing.
 - 1. Include data substantiating that all materials comply with requirements.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Applicator.
- B. Installer to submit a certificate evidencing not less than five (5) years of successful experienced installing similar types to products specified.

- C. Manufacturer to submit a certificate evidencing not less than five (5) years experienced manufacturing types of products specified.
- D. Manufacturer to submit a field report that all installation work is being done per contract requirements.
- E. Product Certificates: For waterproofing, patching, and plugging materials, from manufacturer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for crystalline waterproofing.
- G. Field quality-control reports.
- H. Copy of project warranty for waterproofing installation.

1.5 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm experienced in applying crystalline waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance[, **and that employs workers trained and approved by manufacturer**].
 - 1. Installer will have specialized in installation of types of waterproofing required for project for not less than five (5) years and which is acceptable to manufacturer(s) of primary materials.
 - 2. Assign work closely associated with waterproofing, including but not limited to waterproofing accessories, and materials used in conjunction with waterproofing, to installer of waterproofing, for single, undivided responsibility.
- B. Source Limitations: Obtain primary waterproofing materials of each type required from single manufacturer with not less than three (3) years of successful experience in supplying principal materials for fluid applied waterproofing work. Provide secondary materials only as recommended by manufacturer of primary materials.
- C. Mockups: Provide mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup of typical [**vertical**] [**horizontal**] surfaces [**shown on Drawings**] [**10 sq. ft. (0.9 sq. m) in size**] <Insert description>.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Approximately two (2) weeks prior to actual commencement of waterproofing installation, meet at project site with Installer, installers of deck or substrate construction to receive work, installers of other work in and around waterproofing work which must precede, follow or penetrate waterproofing work, including mechanical work if any, DEN Project Manager, DEN Resident Engineer, Owner, the Contractor's Quality Control Manager and waterproofing material manufacturer's representative. Record (Contractor) discussions of conference, together with decisions and agreements (or disagreements) reached. Furnish copy of record to each party attending.
1. Review methods and procedures related to work, including but not necessarily limited to the following:
 - a. Tour jobsite areas to be waterproofed. Inspect and discuss condition of substrate, drains, curbs, penetrations, and other preparatory work performed by other trades.
 - b. Review waterproofing requirements (drawings, specifications and other contract documents), including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures,.
 - c. Review required submittals. Work cannot begin until all submittals are approved by Owner.
 - d. Review and finalize construction schedule related to waterproofing work and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - e. Review required inspection, testing, and certifying procedures, safety, and hazardous control programs.
 - f. Review protection and repair procedures.
- E. Warranty: Installer to warrant installation for five (5) years including responsibility for removing and replacing work concealing waterproof membrane. Warrant installation to be watertight for application required.

1.7 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit crystalline waterproofing to be performed according to manufacturer's written instructions.
- B. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after substrate defects, including honeycombs, voids, and cracks, have

been repaired to provide a sound substrate free of forming materials, including reveal inserts.

- C. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at **40 deg F** (4.4 deg C) or above during work and cure period, and space is well ventilated and kept free of water.

1.8 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GENERAL

- A. General Compatibility: Provide products that are recommended by manufacturer to be fully compatible with indicated substrates.

2.2 WATERPROOFING MATERIALS

- A. Crystalline Waterproofing: Prepackaged, **[gray]** **[white]**-colored proprietary blend of Portland cement, specially treated sand, and active chemicals that, when mixed with water and applied, penetrates into concrete and concrete unit masonry and reacts chemically with the byproducts of cement hydration in the presence of water to develop crystalline growth within substrate capillaries to produce an impervious, dense, waterproof substrate; that has VOC content complying with limits of authorities having jurisdiction; with properties meeting or exceeding the criteria specified below.

1. Products: Subject to compliance with requirements. Provide one of the following:

- a. American PERMAQUIK Inc.; Super 200.
- b. Anti-Hydro International, Inc.; A-H Hydrocap.
- c. AQUAFIN, Inc.; AQUAFIN-1C.
- d. BASF Building Systems; Tegraproof.
- e. Conproco Corporation; Conpro Super Seal.
- f. Euclid Tamms; **[HEY'DI K-11]** **[HEY'DI POWER X SYSTEM]**.
- g. Gemite Products Inc.; Cem-Kote CW Plus.
- h. ICS Penetron International Ltd.; Penetron.
- i. International Chem-Crete, Inc.; Chem-Cretex Cem 600.
- j. IPA Systems, Inc.; Drycon.
- k. Kryton Group of Companies (The); Krystol T1 & T2 Waterproofing System.
- l. Vandex USA LLC; Vandex Super/Super White.
- m. Xypex Chemical Corporation; Xypex.
- n. **<Insert manufacturer's name; product name or designation>**.
- o. or approved equal.

2. Water Permeability: Maximum [**zero for water at 30 feet** (9 m)] **<Insert requirement>** when tested according to CE CRD-C 48.
3. Compressive Strength: Minimum [**4000 psi (27.6 MPa)**] **<Insert value>** at 28 days when tested according to ASTM C 109/C 109M.

2.3 ACCESSORY MATERIALS

- A. Patching Compound: Factory-premixed cementitious repair mortar, crack filler, or sealant recommended by waterproofing manufacturer for filling and patching tie holes, honeycombs, reveals, and other imperfections; compatible with substrate and other materials indicated; and VOC content complying with limits of authorities having jurisdiction.
- B. Plugging Compound: Factory-premixed cementitious compound with hydrophobic properties and recommended by waterproofing manufacturer; resistant to water and moisture but vapor permeable for all standard applications (vertical, overhead, and horizontal surfaces not exposed to vehicular traffic); compatible with substrate and other materials indicated; and VOC content complying with limits of authorities having jurisdiction.
- C. Portland Cement: ASTM C 150, Type I.
- D. Sand: ASTM C 144.
- E. Polymer Admixture for Protective Topping: Polymer bonding agent and admixture designed to improve adhesion to prepared substrates and not to create a vapor barrier.
- F. Water: Potable.

2.4 MIXES

- A. Crystalline Waterproofing: Add prepackaged dry ingredients to water according to manufacturer's written instructions. Mix together with mechanical mixer or by hand to required consistency.
- B. Protective Topping: Measure, batch, and mix Portland cement and sand in the proportion of [**1:3**] **<Insert proportion>** and water[**gaged with a polymer admixture**]. Blend together with mechanical mixer to required consistency.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for suitable conditions where waterproofing is to be applied.

- B. Proceed with application only after unsatisfactory conditions have been corrected.
- C. Notify DEN Project Manager in writing of active leaks or defects that would affect system performance.

3.2 PREPARATION

- A. Protect other work from damage caused by cleaning, preparation, and application of waterproofing. Provide temporary enclosure[**to confine spraying operation and**] to ensure adequate ambient temperatures and ventilation conditions for application.
- B. Do not allow waterproofing, patching, and plugging materials to enter reveals or annular spaces intended for resilient sealants or gaskets, such as joint spaces between pipes and pipe sleeves.
- C. Stop active water leaks with plugging compound according to waterproofing manufacturer's written instructions.
- D. Repair damaged or unsatisfactory substrate with patching compound according to manufacturer's written instructions.
 - 1. At holes and cracks in substrate, remove loosened chips and cut reveal with sides perpendicular to surface, not tapered, and approximately **1 inch** (25.4 mm) deep. Fill reveal with patching compound flush with surface.
- E. Surface Preparation: Comply with waterproofing manufacturer's written instructions to remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, paint, curing compounds, and form-release agents to ensure that waterproofing bonds to surfaces.
 - 1. Clean concrete surfaces according to ASTM D 4258.
 - a. Scratch- and Float-Finished Concrete: Etch with 10 percent muriatic (hydrochloric) acid solution according to ASTM D 4260.
 - b. Prepare smooth-formed and trowel-finished concrete by mechanical abrading or abrasive-blast cleaning according to ASTM D 4259.
 - 2. Clean concrete unit masonry surfaces according to ASTM D 4261.
 - a. Lightweight Concrete Unit Masonry: Etch with 10 percent muriatic (hydrochloric) acid solution or abrade surface by wire brushing. Remove acid residue until pH readings of water after rinse are not more than 1.0 pH lower or 2.0 pH higher than pH of water before rinse.
 - b. Medium- and Normal-Weight Concrete Unit Masonry: Sandblast or bushhammer to a depth of **1/16 inch** (1.6 mm).
 - 3. Concrete Joints: Clean reveals according to waterproofing manufacturer's written instructions.
- F. Seal joints, and apply bond breakers as recommended by prime materials manufacturer, with particular attention at construction joints.

- G. Install accessories as recommended by prime materials manufacturer.
- H. Prime substrate as recommended (and only if recommended) by prime materials manufacturer.

3.3 APPLICATION

- A. General: Comply with waterproofing manufacturer's written instructions for application and curing.
 - 1. Saturate surface with water for several hours prior to application and maintain damp condition until applying waterproofing. Remove standing water.
 - 2. Apply waterproofing to surfaces indicated on Drawings.
 - 3. Number of Coats: **[Number required for specified water permeability] [Two] [Three] <Insert number>**.
 - 4. Application Method: **[Brush] [Spray]**. Apply to ensure that each coat fills voids and is in full contact with substrate or previous coat.
 - 5. Dampen surface between coats.
- B. Final Coat Finish: **[Smooth] [Brushed] [Spray Textured]**.
- C. Curing: Moist-cure waterproofing for **[three] <Insert number>** days immediately after final coat has set, followed by air drying, unless otherwise recommended in writing by manufacturer.
- D. Waterproofing Treatment Extensions: Extend waterproofing treatment as follows:
 - 1. Onto columns integral with treated walls.
 - 2. Onto interior nontreated walls intersecting exterior treated walls, for a distance of **[24 inches (600 mm) for cast-in-place concrete] [and] [48 inches (1200 mm) for masonry]**.
 - 3. Onto exterior walls and onto both exterior and interior columns, for a height of **12 inches (300 mm)**, where floors, but not walls, are treated.
 - 4. Onto every substrate in areas indicated for treatment, including **[pipe trenches] [pipe chases] [pits] [sumps] <Insert area> [and] [similar offsets and features]**.
- E. Protective Topping: Apply **[1-inch- (25.4-mm-)] <Insert dimension>** thick, protective topping over floor surfaces.

3.4 FIELD QUALITY CONTROL

- A. Inspection: Engage manufacturer's representative to inspect completed application and provide a written report that application complies with manufacturer's written instructions.
- B. **[Owner will engage] [Engage]** an Independent testing laboratory to certify that waterproofing was installed per contract requirements and to thicknesses required. Submit certificate to DEN Project Manager.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 071616

SECTION 071619 - METAL OXIDE WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes metal-oxide waterproofing for [**positive**] [**negative**]-side application to [**concrete**] [**concrete unit masonry**] [**and**] [**clay masonry**].
- B. Related Sections:
 - 1. Section 033000 "Cast-in-Place Concrete" for [**waterstops,**] [**concrete slabs serving as floor toppings to protect waterproofing,**] and finishing concrete walls and slabs to receive waterproofing.
 - 2. Section 042000 "Unit Masonry" for construction cleaning of unit masonry walls to receive waterproofing.
 - 3. Section 079200 "Joint Sealants" for elastomeric and preformed sealants in concrete and masonry walls and floors.
 - 4. Section 092400 "Portland Cement Plastering" for plaster finishes to be applied over waterproofing.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include[**construction details,**] material descriptions and installation instructions for metal-oxide waterproofing.
 - 1. Include data substantiating that materials comply with requirements.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Applicator [**and testing agency**].
- B. Installer to submit a certificate evidencing not less than five (5) years of successful experienced installing similar types to products specified.
- C. Manufacturer to submit a certificate evidencing not less than ten (10) years

experienced manufacturing types of products specified.

- D. Manufacturer to submit a field report that all installation work is being done per contract requirements.
- E. Product Certificates: For waterproofing, patching, and plugging materials, from manufacturer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for metal-oxide waterproofing.
- G. Field quality-control reports.
- H. Copy of project warranty for waterproofing installation.

1.5 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm experienced in applying metal-oxide waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance[, **and that employs workers trained and approved by manufacturer**].
 - 1. Installer will have specialized in installation of types of waterproofing required for project for not less than five (5) years and which is acceptable to manufacturer(s) of primary materials.
 - 2. Assign work closely associated with waterproofing, including but not limited to waterproofing accessories, and materials used in conjunction with waterproofing, to installer of waterproofing, for single, undivided responsibility.
- B. Source Limitations: Obtain primary waterproofing materials of each type required from single manufacturer with not less than three (3) years of successful experience in supplying principal materials for fluid applied waterproofing work. Provide secondary materials only as recommended by manufacturer of primary materials.
- C. Mockups: Provide mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup of typical [vertical] [horizontal] surfaces [shown on Drawings] **[10 sq. ft. (0.9 sq. m) in size] <Insert description>**.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Approximately two (2) weeks prior to actual commencement of fluid applied waterproofing installation, meet at project site with Installer, installers of deck or substrate construction to receive work, installers of other work in and around waterproofing work which must precede, follow or penetrate waterproofing work, including mechanical work if any, DEN Project Manager, DEN Resident Engineer, Owner, the Contractor's Quality Control Manager and waterproofing material manufacturer's representative. Record (Contractor) discussions of conference, together with decisions and agreements (or disagreements) reached. Furnish copy of record to each party attending.
1. Review methods and procedures related to work, including but not necessarily limited to the following:
 - a. Tour jobsite areas to be waterproofed. Inspect and discuss condition of substrate, drains, curbs, penetrations, and other preparatory work performed by other trades.
 - b. Review waterproofing requirements (drawings, specifications and other contract documents), including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures,.
 - c. Review required submittals. Work cannot begin until all submittals are approved by Owner.
 - d. Review and finalize construction schedule related to waterproofing work and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - e. Review required inspection, testing, and certifying procedures, safety, and hazardous control programs.
 - f. Review protection and repair procedures.
- E. Warranty: Installer to warrant installation for five (5) years including responsibility for removing and replacing work concealing waterproof membrane. Warrant installation to be watertight for application required.
- 1.7 PROJECT CONDITIONS
- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit metal-oxide waterproofing to be performed according to manufacturer's written instructions.
 - B. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.

- C. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at **40 deg F** (4.4 deg C) or above during work and cure period, and space is well ventilated and kept free of water.

1.8 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GENERAL

- A. General Compatibility: Provide products that are recommended by manufacturer to be fully compatible with indicated substrates.

2.2 WATERPROOFING MATERIALS

- A. Metal-Oxide Waterproofing Compound: A product specifically formulated for waterproofing concrete and masonry substrates; containing pulverized iron and a chemical oxidizing agent to cause the iron particles to rust and grow in size in the presence of water; with VOC content complying with limits of authorities having jurisdiction.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Anti-Hydro International, Inc.; A-H Metallic Waterproofing.
 - b. Euclid Chemical Company (The); Iron Waterpeller.
 - c. Metalcrete Industries; Metalcrete Waterproofing.
 - d. Specco Industries, Inc.; Speccrete Metallic Waterproofer.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.

2.3 ACCESSORY MATERIALS

- A. Patching Compound: Factory-premixed cementitious repair mortar, crack filler, or sealant recommended by waterproofing manufacturer for filling and patching tie holes, honeycombs, reveals, and other imperfections; compatible with substrate and other materials indicated; and VOC content complying with limits of authorities having jurisdiction.
- B. Plugging Compound: Factory-premixed cementitious compound with hydrophobic properties and recommended by waterproofing manufacturer; resistant to water and moisture but vapor permeable for all standard applications (vertical, overhead, and horizontal surfaces not exposed to vehicular traffic); compatible with substrate and

other materials indicated; and VOC content complying with limits of authorities having jurisdiction.

- C. Portland Cement: ASTM C 150, Type I.
- D. Sand: ASTM C 144.
- E. Water: Potable.

2.4 MIXES

- A. Metal-Oxide Coats: Add metal-oxide waterproofing compound to[**Portland cement, sand, and**] water according to manufacturer's written instructions. Blend together with mechanical mixer or by hand to required consistency for each coat.
- B. Protection Coat: Field mix protection coat consisting of Portland cement and sand as recommended by same manufacturer as metal-oxide waterproofing according to manufacturer's written instructions for application over waterproofing. Measure, batch, and mix materials with potable water. Blend together with mechanical mixer to required consistency.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for suitable conditions where waterproofing is to be applied.
- B. Proceed with application only after unsatisfactory conditions have been corrected.
- C. Notify DEN Project Manager in writing of active leaks or defects that would affect system performance.

3.2 PREPARATION

- A. Protect other work from damage caused by cleaning, preparation, and application of waterproofing. Provide temporary enclosure[**to confine spraying operation and**] to ensure adequate ambient temperatures and ventilation conditions for application.
- B. Do not allow waterproofing, patching, and plugging materials to enter reveals or annular spaces intended for resilient sealants or gaskets, such as joint spaces between pipes and pipe sleeves.
- C. Stop active water leaks with plugging compound according to waterproofing manufacturer's written instructions.

- D. Repair damaged or unsatisfactory substrate with patching compound according to manufacturer's written instructions.
1. At holes and cracks in substrate, remove loosened chips and cut reveal with sides perpendicular to surface, not tapered, and approximately **1 inch** (25.4 mm) deep. Fill reveal with patching compound flush with surface.
- E. Surface Preparation: Comply with waterproofing manufacturer's written instructions to remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, paint, curing compounds, and form-release agents to ensure that waterproofing bonds to surfaces.
1. Clean concrete surfaces according to ASTM D 4258.
 - a. Scratch- and Float-Finished Concrete: Etch with 10 percent muriatic (hydrochloric) acid solution according to ASTM D 4260.
 - b. Prepare smooth-formed and trowel-finished concrete by mechanical abrading or abrasive-blast cleaning according to ASTM D 4259.
 2. Clean concrete unit masonry surfaces according to ASTM D 4261.
 - a. Lightweight Concrete Unit Masonry: Etch with 10 percent muriatic (hydrochloric) acid solution or abrade surface by wire brushing. Remove acid residue until pH readings of water after rinse are not more than 1.0 pH lower or 2.0 pH higher than pH of water before rinse.
 - b. Medium- and Normal-Weight Concrete Unit Masonry: Sandblast or bushhammer to a depth of **1/16 inch** (1.6 mm).
 3. Clean clay masonry surfaces according to ASTM D 5703.
 4. Concrete Joints: Clean reveals according to waterproofing manufacturer's written instructions.
- F. Seal joints, and apply bond breakers as recommended by prime materials manufacturer, with particular attention at construction joints.
- G. Install accessories as recommended by prime materials manufacturer.
- H. Prime substrate as recommended (and only if recommended) by prime materials manufacturer.

3.3 APPLICATION

- A. General: Comply with waterproofing manufacturer's written instructions for application and curing.
1. Saturate surface[**for several hours prior to application**] with water and maintain damp condition until applying waterproofing. Remove standing water.
 2. Apply waterproofing to surfaces indicated on Drawings.
 3. Number of Metal-Oxide Coats: [**Number required for specified water permeability**] [**Two**] [**Three**] **<Insert number>**.

4. Application Method: Brush apply the waterproofing, vigorously working first coat onto the substrate and forcing the material into surface voids. Brush each subsequent coat into full contact with previous coat.
 5. Dampen surface between coats.
 6. Allow each coat to set for [24] <Insert number> hours between coats.
 7. Protection Coat: Apply to a thickness of [1/8 inch (3 mm)] [1/4 inch (6 mm)] <Insert dimension> for walls and [1 inch (25 mm)] <Insert dimension> for floors.
- B. Final Coat Finish: [Smooth] [Brushed] [Textured] <Insert requirement>.
- C. Curing: Moist-cure waterproofing for [three] <Insert number> days immediately after final coat has set, followed by air drying prior to being placed in service, unless otherwise recommended in writing by manufacturer.
- D. Waterproofing Treatment Extensions: Extend waterproofing treatment as follows:
1. Onto columns integral with treated walls.
 2. Onto interior nontreated walls intersecting exterior treated walls, for a distance of [24 inches (600 mm) for cast-in-place concrete] [and] [48 inches (1200 mm) for masonry].
 3. Onto exterior walls and onto both exterior and interior columns, for a height of 12 inches (300 mm), where floors, but not walls, are treated.
 4. Onto every substrate in areas indicated for treatment, including [pipe trenches] [pipe chases] [pits] [sumps] <Insert area> [and] [similar offsets and features].

3.4 FIELD QUALITY CONTROL

- A. Inspection: Engage manufacturer's representative to inspect completed application and provide a written report that application complies with manufacturer's written instructions.
- B. [Owner will engage] [Engage] an Independent testing laboratory to certify that waterproofing was installed per contract requirements and to thicknesses required. Submit certificate to DEN Project Manager.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 071619

SECTION 071700 - BENTONITE WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Bentonite waterproofing.
- 2. Molded-sheet drainage panels.
- 3. Insulation.

- B. Related Sections:

- 1. Section 033000 "Cast-in-Place Concrete" for forms, waterstops, and concrete placement.
- 2. Section 312000 "Earth Moving" for excavating and backfilling.
- 3. Section 315000 "Excavation Support and Protection" for permanent below-grade support systems that require blind-side waterproofing.
- 4. Section 334713 "Pond and Reservoir Liners" for flexible, impervious membrane pond and reservoir liners.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include product specifications and manufacturer's written installation instructions.

- 1. Include data substantiating that all materials comply with requirements.

- B. Shop Drawings: Show installation details for interface with other work.

- C. Samples: For each of the following products, in minimum 1' x 1' sizes unless otherwise indicated:

- 1. Waterproofing.
- 2. Drainage Panels.
- 3. Insulation.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type of bentonite waterproofing, from manufacturer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by **[manufacturer and witnessed by a qualified testing agency] [a qualified testing agency]**, for bentonite waterproofing.
- C. Installer to submit a certificate evidencing not less than five (5) years of successful experienced installing similar types to products specified.
- D. Manufacturer to submit a certificate evidencing not less than five (5) years experienced manufacturing types of products specified.
- E. Manufacturer to submit a field report that all installation work is being done per contract requirements.
- F. Field quality-control reports.
- G. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm experienced in applying polymer-modified cement waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance[, **and that employs workers trained and approved by manufacturer**].
 - 1. Installer will have specialized in installation of types of waterproofing required for project for not less than five (5) years and which is acceptable to manufacturer(s) of primary materials.
 - 2. Assign work closely associated with waterproofing, including but not limited to waterproofing accessories, and materials used in conjunction with waterproofing, to installer of waterproofing, for single, undivided responsibility.
- B. Source Limitations: Obtain bentonite waterproofing system from single source from single manufacturer with not less than three (3) years of successful experience in supplying principal materials for fluid applied waterproofing work. Obtain accessory products used with bentonite waterproofing from sources acceptable to bentonite waterproofing manufacturer.
- C. Mockups: Build mockups to verify selections made under sample submittals and to set quality standards for fabrication and installation.

1. Approval of mockups is also for other material and construction qualities specifically approved by DEN Project Manager in writing.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
- D. Preinstallation Conference: Preinstallation Conference: Approximately two (2) weeks prior to actual commencement of waterproofing installation, meet at project site with Installer, installers of deck or substrate construction to receive work, installers of other work in and around waterproofing work which must precede, follow or penetrate waterproofing work, including mechanical work if any, DEN Project Manager, DEN Resident Engineer, Owner, the Contractor's Quality Control Manager and waterproofing material manufacturer's representative. Record (Contractor) discussions of conference, together with decisions and agreements (or disagreements) reached. Furnish copy of record to each party attending.
1. Review methods and procedures related to work, including but not necessarily limited to the following:
 - a. Tour jobsite areas to be waterproofed. Inspect and discuss condition of substrate, drains, curbs, penetrations, and other preparatory work performed by other trades.
 - b. Review waterproofing requirements (drawings, specifications and other contract documents), including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures,.
 - c. Review required submittals. Work cannot begin until all submittals are approved by Owner.
 - d. Review and finalize construction schedule related to waterproofing work and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - e. Review required inspection, testing, and certifying procedures, safety, and hazardous control programs.
 - f. Review protection and repair procedures.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original unopened and undamaged containers.
- B. Store materials in a dry, well-ventilated space.
- C. Remove and replace bentonite materials that have been prematurely exposed to moisture.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted

weather conditions permit bentonite waterproofing to be installed according to manufacturers' written instructions and warranty requirements.

1. Do not apply waterproofing materials to surfaces where ice or frost is visible. Do not apply bentonite waterproofing materials in areas with standing water.
2. Placing bentonite clay products in panel or composite form on damp surfaces is allowed if approved in writing by manufacturer.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agree(s) to repair or replace components of bentonite waterproofing system that fail in materials or workmanship within specified warranty period, including responsibility for removing and replacing work concealing waterproof membrane.

1. Warranty Period: **[Five]** <Insert number> years from date of Substantial Completion.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GENERAL

- A. General Compatibility: Provide products that are recommended by manufacturer to be fully compatible with indicated substrates and site conditions.

2.2 GEOTEXTILE/BENTONITE SHEETS

- A. Geotextile/Bentonite Waterproofing: Minimum of **1.0 lb/sq. ft.** (5 kg/sq. m) of bentonite clay granules between two layers of geotextile polypropylene fabric, one woven and one nonwoven, needle punched and heat fused together.

1. Products: Subject to compliance with requirements, provide one of the following]:
 - a. Carlisle Coatings & Waterproofing; CCW MiraCLAY.
 - b. CETCO; Voltex.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
2. Grab Tensile Strength: **[95 lbf (422 N)]** <Insert value> according to ASTM D 4632.

- B. Contaminant-Resistant Geotextile/Bentonite Waterproofing: Minimum of **1.0 lb/sq. ft.** (5 kg/sq. m) of bentonite clay granules specially formulated for use in saltwater or contaminated ground water, between two layers of geotextile polypropylene fabric, one woven and one nonwoven, needle punched and heat fused together.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing; CCW MiraCLAY EF.
 - b. CETCO; Voltex CR.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
 2. Grab Tensile Strength: **[95 lbf (422 N)]** **<Insert value>** according to ASTM D 4632.
- C. Geotextile-Geomembrane/Bentonite Waterproofing: Minimum of **1.0 lb/sq. ft.** (5 kg/sq. m) of bentonite clay granules between two layers of geotextile polypropylene fabric, one woven and one nonwoven, needle punched and heat fused together; and the woven fabric coated with a low-permeable polypropylene geomembrane.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing; CCW MiraCLAY GM.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
 2. Grab Tensile Strength: **95 lbf** (422 N) according to ASTM D 4632.
- D. Composite Geotextile-HDPE/Bentonite Membrane: Minimum of **1.1 lb/sq. ft.** (5.4 kg/sq. m) of bentonite clay granules bonded to nonwoven geotextile polypropylene fabric, with HDPE bonded to surface of nonwoven fabric.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CETCO; Voltex DS.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
 2. Grab Tensile Strength: **120 lbf** (534 N) according to ASTM D 4632.
 3. Puncture Resistance: **140 lbf** (620 N) according to ASTM D 4833.
 4. Vapor Permeance: 0.03 perms according to ASTM E 96.
- E. Contaminant-Resistant Composite Geotextile-HDPE/Bentonite Membrane: Minimum of **1.1 lb/sq. ft.** (5.4 kg/sq. m) of bentonite clay granules specially formulated for use in saltwater or contaminated ground water, bonded to nonwoven geotextile polypropylene fabric, with HDPE bonded to surface of nonwoven fabric.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CETCO; Voltex DSCR.
 - b. **<Insert manufacturer's name; product name or designation>**.

- c. or approved equal.
2. Grab Tensile Strength: **120 lbf** (534 N) according to ASTM D 4632.
3. Puncture Resistance: **140 lbf** (620 N) according to ASTM D 4833.
4. Vapor Permeance: 0.03 perms according to ASTM E 96.

2.3 COMPOSITE HDPE/BENTONITE MEMBRANE

- A. Composite HDPE/Bentonite Membrane: Minimum **90-mil-** (2.3-mm-) thick membrane consisting of a **12-mil-** (0.5-mm-) thick, HDPE geomembrane liner bonded to a layer of bentonite clay granules **78 mils** (1.9 mm) thick.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CETCO; Swelltite.
 - b. Tremco Commercial Sealants & Waterproofing, an RPM company; Paraseal.
 - c. Tremco Commercial Sealants & Waterproofing, an RPM company; Deckseal.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
 2. Puncture Resistance: **169 lbf** (752 N) according to ASTM E 154.
 3. Vapor Permeance: 0.03 perms according to ASTM E 96.
- B. Composite HDPE/Bentonite Membrane with Protective Facing: Minimum **170-mil-** (4.3-mm-) thick membrane consisting of HDPE geomembrane liner bonded to a layer of bentonite clay granules and with a spun polypropylene facing.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Tremco Commercial Sealants & Waterproofing, an RPM company; Paraseal LG.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
 2. Puncture Resistance: **169 lbf** (752 N) according to ASTM E 154.
 3. Vapor Permeance: 0.03 perms according to ASTM E 96.
- C. Composite HDPE/Bentonite-Polymer Membrane: Minimum **200-mil-** (5-mm-) thick membrane consisting of HDPE geomembrane liner bonded to a layer of bentonite-polymer clay granules.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CETCO; Volclay Ultraseal SP.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
 2. Puncture Resistance: **75 lbf** (334 N) according to ASTM D 4833.

3. Vapor Permeance: 0.005 perms according to ASTM E 96.
- D. Composite Gastight HDPE/Bentonite Membrane: Minimum **150-mil-** (3.8-mm-) thick membrane consisting of a **60-mil-** (1.5-mm-) thick, HDPE geomembrane liner bonded to a layer of bentonite clay.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Tremco Commercial Sealants & Waterproofing, an RPM company; Paraseal GM.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
 2. Puncture Resistance: **169 lbf** (752 N) according to ASTM E 154.
 3. Vapor Permeance: 0.03 perms according to ASTM E 96.
- E. Composite Saline/Alkaline HDPE/Bentonite Membrane: Minimum **150-mil-** (3.8-mm-) thick membrane consisting of a **60-mil-** (1.5-mm-) thick, HDPE geomembrane liner bonded to a layer of bentonite clay granules.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Tremco Commercial Sealants & Waterproofing, an RPM company; Saltwater Paraseal.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
 2. Puncture Resistance: **169 lbf** (752 N) according to ASTM E 154.
 3. Vapor Permeance: 0.03 perms according to ASTM E 96.

2.4 COMPOSITE GEOTEXTILE-HDPE/BENTONITE MEMBRANE

- A. Geotextile/Bentonite-Polymer Waterproofing: Minimum **250-mil-** (6.4-mm-) thick membrane of bentonite-polymer clay granules between two layers of geotextile polypropylene fabric, one woven and one nonwoven, needle punched and heat fused together.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CETCO; Volclay Ultraseal BT.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
 2. Puncture Resistance: **75 lbf** (334 N) according to ASTM D 4833.
 3. Vapor Permeance: 0.005 perms according to ASTM E 96.

2.5 BENTONITE PANELS

- A. Standard Panels: **3/16-inch-** (5-mm-) thick, corrugated kraft-paper panels with a

minimum of **1.0 lb/sq. ft.** (5 kg/sq. m) of bentonite confined in corrugations of boards.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CETCO; Volclay Type 1.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.

B. Coated Panels: **3/16-inch-** (5-mm-) thick, corrugated kraft-paper panels specially coated to resist premature hydration due to incidental moisture; filled with a minimum of **1.0 lb/sq. ft.** (5 kg/sq. m) of bentonite.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CETCO; Volclay Type 1-C.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.

C. Contaminant-Resistant Panels: **3/16-inch-** (5-mm-) thick, corrugated kraft-paper panels with a minimum of **1.0 lb/sq. ft.** (5 kg/sq. m) of contaminant-resistant granular bentonite specially formulated for use in contaminated ground-water conditions; confined in corrugations of boards.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CETCO; Volclay Type 1 CR.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.

2.6 INSTALLATION ACCESSORIES

- A. Granular Bentonite: Sodium bentonite clay containing a minimum of 90 percent montmorillonite (hydrated aluminum silicate), with a minimum of 90 percent passing a **No. 20** (0.85-mm) sieve.
- B. Bentonite Mastic: Trowelable consistency, bentonite compound, specifically formulated for application at joints and penetrations.
- C. Granular Bentonite Tubes: Manufacturer's standard **2-inch-** (50-mm-) diameter, water-soluble tube containing approximately **1.5 lb/ft.** (2.2 kg/m) of bentonite; hermetically sealed; designed specifically for placing on wall footings at line of joint with exterior base of wall.
- D. Termination Bar: Extruded-aluminum or formed-stainless-steel bars with upper flange to receive sealant.
- E. Plastic Protection Sheet: Polyethylene sheeting complying with ASTM D 4397; thickness recommended by waterproofing manufacturer to suit application but at least **6 mils** (0.15 mm) thick.

- F. Cement Grout Patching Material: Manufacturer's recommended grout mix compatible with substrate being patched.
- G. Masonry Fasteners: Casehardened nails or hardened-steel, powder-actuated fasteners. Depending on manufacturer's written requirements, provide 1/2- or 1-inch- (13- or 25-mm-) diameter washers under fastener heads.
- H. Sealants: As recommended in writing by waterproofing manufacturer. Comply with requirements specified in Section 079200 "Joint Sealants."
- I. Tapes: Waterproofing manufacturer's recommended tape for joints between sheets, membranes, or panels.
- J. Adhesive: Water-based adhesive used to secure waterproofing to both vertical and horizontal surfaces.
- K. Protection Course: ASTM D 6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners, and as follows:
1. Thickness: [1/8 inch (3 mm)] [1/4 inch (6 mm)], nominal.
 2. Thickness: 1/8 inch (3 mm), nominal, for vertical applications; 1/4 inch (6 mm), nominal, elsewhere.
- L. Geotextile Protection Course: As recommended by waterproofing manufacturer.
- M. Molded-Sheet Drainage Panel: Comply with Section 334600 "Subdrainage."
- N. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm) sieve laminated to one side [with] [or] [without] a polymeric film bonded to the other side of a studded, nonbiodegradable, molded-plastic-sheet drainage core, with a vertical flow rate of 9 to 15 gpm per foot (112 to 188 L/min. per m).
- O. Woven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a woven-geotextile facing with an apparent opening size not exceeding No. 40 (0.425-mm) sieve laminated to one side [with] [or] [without] a polymeric film bonded to the other side of a studded, nonbiodegradable, molded-plastic-sheet drainage core, with a horizontal flow rate not less than 2.8 gpm per foot (35 L/min. per m).
- P. Board Insulation: Extruded-polystyrene board insulation complying with ASTM C 578, [square] [or] [shiplap] edged.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning.

- d. Pactiv Corporation.
 - e. T. Clear Corporation.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
2. Type VI, **40-psi** (276-kPa) minimum compressive strength.
 3. Type VII, **60-psi** (414-kPa) minimum compressive strength.
 4. Type V, **100-psi** (690-kPa) minimum compressive strength.
- Q. Unfaced Wall Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, Type VI, **40-psi** (276-kPa) minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. DiversiFoam Products; CertiFoam 40 Drainage Board.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
- R. Geotextile-Faced Wall Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, Type VI, **40-psi** (276-kPa) minimum compressive strength; fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with nonwoven geotextile filter fabric.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. T. Clear Corporation; Thermadry 1250.
 2. **<Insert manufacturer's name; product name or designation>**.
 - a. or approved equal.
- S. Unfaced Plaza Deck Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, [**Type VI, 40-psi** (276-kPa)] [**Type VII, 60-psi** (414-kPa)] minimum compressive strength; unfaced; fabricated with shiplapped or channel edges and with one side having ribbed drainage channels.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. DiversiFoam Products; CertiFoam Plaza Deck.
 - b. Dow Chemical Company (The); Styrofoam Ribbed Roofmate.
 - c. Owens Corning; [**Foamular 404 RB**] [**Foamular 604 RB**].
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with

requirements for substrate preparations affecting performance of bentonite waterproofing.

- B. Verify that substrate is complete and that work that will penetrate waterproofing is complete and rigidly installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate work in the vicinity of waterproofing to ensure proper conditions for installing the waterproofing system and to prevent damage to waterproofing after installation.
- B. Formed Concrete Surfaces: Remove fins and projections. Fill voids, rock pockets, form-tie holes, and other defects with bentonite mastic or cement grout patching material according to manufacturer's written instructions.
- C. Horizontal Concrete Surfaces: Remove debris, standing water, oily substances, mud, and similar substances that could impair the bonding ability of concrete or the effectiveness of waterproofing. Fill voids, cracks greater than **1/8 inch (3 mm)**, honeycomb areas, and other defects with bentonite mastic or cement grout patching material according to manufacturer's written instructions.
- D. Excavation Support and Protection System: If water is seeping, use plastic protection sheets or other suitable means to prevent wetting the bentonite waterproofing. Fill minor gaps and spaces **1/8 inch (3 mm)** wide or wider with wood, metal, concrete, or other appropriate filling material. Cover or fill large voids and crevices with cement mortar according to manufacturer's written instructions.

3.3 INSTALLATION, GENERAL

- A. Install waterproofing and accessories according to manufacturer's written instructions.
 - 1. Apply granular bentonite around penetrations in horizontal surfaces and changes in plane according to manufacturer's details in preparation for granular bentonite tubes and mastic.
 - 2. Apply granular bentonite tubes, bentonite mastic, or both at changes of plane, construction joints in substrate, projections, and penetrations.
- B. Apply granular bentonite tubes continuously on footing against base of wall to be waterproofed according to manufacturer's written instructions.
- C. Protect waterproofing from damage and wetting before and during subsequent construction operations. Repair punctures, tears, and cuts according to manufacturer's written instructions.
- D. Install protection course before backfilling or placing overburden when recommended by waterproofing manufacturer.

3.4 GEOTEXTILE/BENTONITE SHEET INSTALLATION

- A. General: Install a continuous layer of waterproofing sheets directly against concrete to be waterproofed. Lap ends and edges a minimum of **4 inches** (100 mm) on horizontal and vertical substrates. Stagger end joints between sheets a minimum of **24 inches** (600 mm). Fasten seams by stapling to adjacent sheet or nailing to substrate.
- B. Below Structural Slabs-on-Grade: Place waterproofing sheets on compacted substrate with ends and edges lapped and stapled.
1. Install a layer of waterproofing sheets under footings, grade beams, and pile caps; or continue waterproofing through key joints between footings and foundation walls, and extend a minimum of **8 inches** (200 mm) up or beyond perimeter slab forms.
- C. Concrete Walls: Starting at bottom of wall, apply waterproofing sheets horizontally with primary backing side against wall. Secure with masonry fasteners spaced according to manufacturer's written instructions. Extend to bottom of footing, grade beam, or wall, and secure.
1. Termination at Grade: Extend waterproofing sheets to within **2 inches** (50 mm) of finish grade unless otherwise indicated. Secure top edge with termination bar. Apply sealant to top edge of termination bar.
 2. Termination at Grade: Fasten top edge of waterproofing sheets to wall and protect top edge with sheet metal counterflashing. Cover waterproofing with a lapped course of plastic protection sheets if backfilling does not proceed immediately.
- D. Excavation Support and Protection (Permanent Shoring): Encase tieback rods, nuts, and plates, using bentonite mastic and waterproofing sheets, according to waterproofing manufacturer's written instructions for each configuration.
1. Install a layer of waterproofing sheets, with ends and edges lapped and nailed to shoring. Cover waterproofing with plastic protection sheets if needed for protection from precipitation; remove plastic sheets before placing concrete.
 2. Inspect and repair waterproofing after reinforcing steel has been placed. Coordinate and control concrete placement to avoid damage to waterproofing.

3.5 COMPOSITE HDPE/BENTONITE MEMBRANE INSTALLATION

- A. General: Install a continuous layer of waterproofing membrane with ends and edges lapped a minimum of **3 inches** (75 mm). Stagger end joints between membranes. Seal joints with permanent seam tape.
- B. Below Structural Slabs-on-Grade: Apply waterproofing membrane with HDPE side down and staple ends and edges.
1. Install under footings, grade beams, and pile caps; or continue waterproofing through key joints between footings and foundation walls, and extend a minimum

- of **8 inches** (200 mm) up or beyond perimeter slab forms.
2. Protect waterproofing from damage caused by reinforcing bar supports with sharp edges.
- C. Slabs: Starting at lowest point, install a continuous layer of waterproofing membrane, with ends and edges lapped a minimum of **2 inches** (50 mm).
- D. Vertical Concrete[**or Masonry**] Walls: Apply mastic around penetrations and form continuous **2-inch** (50-mm) cant at intersection of footings and walls with mastic.
1. Starting at lowest point, install a layer of waterproofing membrane horizontally, extending a minimum of **6 inches** (150 mm) onto the footing. Lap membrane ends and edges a minimum of **2 inches** (50 mm).
 2. Secure membrane to wall with adhesive or washer-headed fasteners, and tape terminations of membrane at grade.
- E. Excavation Support and Protection: Cut, clean, and treat tiebacks and similar projections. Encase tieback rods, nuts, and plates. If water is present, cover shoring and lagging with plastic protection sheets.
1. Starting at lowest point, install a layer of waterproofing membrane, with ends and edges lapped and nailed to shoring.
- F. Horizontal Roofs, Plazas, and between Slabs: Starting at lowest point, install a layer of waterproofing membrane, with ends and edges lapped and taped a minimum of **3 inches** (75 mm).
1. Prime concrete substrates. Primer may be omitted on concrete surfaces that comply with requirements for dryness, surface texture, and freedom from imperfections.
 2. Install bentonite side of membrane against the material to be waterproofed.
 3. Terminations at Vertical Surfaces: Provide a fillet or cant at intersection of horizontal and vertical substrates. Extend waterproofing membrane to top of curb or to a minimum of **6 inches** (150 mm) above plane of waterproofing; secure with manufacturer's recommended tape.
 4. Cover waterproofing with a plastic slip-sheet.
- 3.6 COMPOSITE GEOTEXTILE-HDPE/BENTONITE MEMBRANE INSTALLATION
- A. General: Install a continuous layer of waterproofing membrane with ends and edges lapped a minimum of **3 inches** (75 mm). Stagger end joints between membranes. Seal joints with permanent seam tape.
- B. Below Structural Slabs-on-Grade: Apply waterproofing membrane with HDPE side down and staple ends and edges.
1. Install under footings, grade beams, and pile caps; or continue waterproofing through key joints between footings and foundation walls, and extend a minimum of **8 inches** (200 mm) up or beyond perimeter slab forms.

2. Protect waterproofing from damage caused by reinforcing bar supports with sharp edges.
- C. Concrete Walls: Starting at bottom of wall, apply waterproofing membrane with HDPE side facing Installer; overlap sheets **3 inches** (75 mm). Secure with powder-actuated fasteners or casehardened nails. Extend to bottom of footing, grade beam, or wall, and secure.
1. Termination at Grade: Extend waterproofing membrane to within **2 inches** (50 mm) of finish grade unless otherwise indicated. Secure top edge with termination bar. Apply sealant to top edge of termination bar.
- D. Excavation Support and Protection (Permanent Shoring): Cut, clean, and treat tiebacks and similar projections. Encase tieback rods, nuts, and plates. If water is present, cover shoring and lagging with plastic protection sheets; remove plastic sheets before placing concrete.
1. Starting at lowest point, install a layer of waterproofing membrane, with ends and edges lapped and mechanically secured to shoring.
 2. Inspect and repair waterproofing membrane after reinforcing steel has been placed. Coordinate and control concrete placement to avoid damage to waterproofing.
- E. Horizontal Slabs, Roofs, and Plazas: Starting at lowest point, install a layer of waterproofing membrane, with ends and edges lapped and taped a minimum of **3 inches** (75 mm).
1. Clean overlap area and apply waterproof tape, rolling the exposed edge to seal to sheet below.
 2. Turn edges up and seal to vertical surfaces.
 3. Cover waterproofing with a plastic slip-sheet.

3.7 BENTONITE PANEL INSTALLATION

- A. General: Install a continuous layer of bentonite waterproofing panels with ends and edges lapped a minimum of **1-1/2 inches** (38 mm) unless otherwise indicated. Stagger joints in adjoining panel rows.
1. Install a double layer of waterproofing panels, with ends and edges butted instead of lapped and with second layer of joints staggered over first. Staple panels together to hold them in place.
- B. Concrete Walls: Starting at bottom of wall, apply waterproofing panels with ends and edges lapped and with vertical joints staggered. Secure with fasteners or adhesive recommended in writing by manufacturer. Extend to bottom of footing, grade beam, or wall.
1. Horizontal-to-Vertical Transitions: Install granular bentonite tubes immediately before backfilling and compact backfill over the joint.

2. Termination at Grade: Extend waterproofing panels to within **2 inches** (50 mm) of finish grade unless otherwise indicated. Secure top edge with termination bar. Apply sealant to top edge of termination bar.
3. Termination at Grade: Fasten top edge of waterproofing panels to wall and protect top edge with sheet metal counterflashing.
4. Cover waterproofing panels with a lapped course of plastic protection sheets; remove plastic sheets before backfilling.

3.8 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate. Use adhesives[**or mechanical fasteners**] that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.
 1. For vertical applications, install [**board insulation**] [**protection course**] before installing drainage panels.

3.9 INSULATION INSTALLATION

- A. Install [**one or more layers of board insulation to achieve required thickness**] [**and**] [**insulation drainage panels**] over waterproofed surfaces. Cut and fit to within **3/4 inch** (19 mm) of projections and penetrations.
- B. On vertical surfaces, set insulation units in adhesive or tape applied according to manufacturer's written instructions.
- C. On horizontal surfaces, loosely lay insulation units. Stagger end joints and tightly abut insulation units.

3.10 FIELD QUALITY CONTROL

- A. Inspection: Arrange for manufacturer's representative to inspect completed waterproofing installation before covering with other construction and provide written report that installation complies with manufacturer's written instructions.
 1. Remove and replace applications of bentonite waterproofing where inspection indicates that it does not comply with specified requirements.
- B. Flood Testing: Flood test each deck area for leaks, according to recommendations in ASTM D 5957, after completing waterproofing but before overlaying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
 1. Flood to an average depth of **2-1/2 inches** (64 mm) with a minimum depth of **1 inch** (25 mm) but not exceeding a depth of **4 inches** (100 mm). Maintain **2 inches** (50 mm) of clearance from top of membrane flashings.
 2. Flood each area for [**24**] [**48**] **<Insert number>** hours.

3. After flood testing, repair leaks, repeat flood test, and make further repairs until waterproofing installation is watertight.
- C. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 071700

SECTION 071800 - TRAFFIC COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes traffic coatings[**and pavement markings**] for the following applications:
 - 1. Pedestrian traffic.
 - 2. Vehicular traffic.
 - 3. Equipment-room floor.
- B. Related Requirements:
 - 1. Section 071900 "Water Repellents" for penetrating and film-forming water repellents applied on traffic-bearing surfaces.
 - 2. Section 096723 "Resinous Flooring" for fluid-applied, [**decorative**] [**general-use commercial**] [**general-use industrial**] [**high-performance**] resinous flooring that does not serve as a waterproofing membrane with integral wearing surface.
 - 3. Section 096766 "Fluid-Applied Athletic Flooring" for fluid-applied, resinous flooring for athletic activity areas.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at [**Project site**] [**location and time as determined by DEN Project Manager**]
- B. <Insert location>.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including installation instructions, maintenance instructions, and general recommendations by manufacturer covering each material required for work.

1. Include data substantiating that materials comply with requirements..
- B. LEED Submittals:
1. Product Test Reports for Credit SS 7.2: For traffic coatings that are roof coverings, documentation indicating compliance with Solar Reflectance Index requirement.
 2. Product Data for Credit IEQ 4.2: For interior field-applied traffic coatings[**and pavement-marking paints**], documentation including printed statement of VOC content.
 3. Laboratory Test Reports for Credit IEQ 4: For interior traffic coatings[**and pavement-marking paints**], documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For traffic coatings.
1. Include details for treating substrate joints and cracks, flashings, deck penetrations, and other termination conditions.
 2. Include plans showing layout of pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.
- D. Samples for Initial Selection: For each type of exposed finish.
- E. Samples for Verification: For each type of exposed finish, prepared on rigid backing.
1. Provide stepped Samples on backing to illustrate buildup of traffic coatings, minimum 12 inch square, of fully cured, exposed finish materials, in colors required for the Project.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For Installer.
 - B. Product Certificates: For each type of traffic coating.
 - C. Field quality-control reports.
 - D. Sample Warranty: For special warranty.
- 1.6 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For traffic coatings to include in maintenance manuals.

1.7 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 MAINTENANCE MATERIALS

- A. Extra stock: Provide minimum four (4) gallons extra traffic topping. Store as directed by DEN Project Manager.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
 - 1. Firm certified in writing by manufacturer as licensed or approved applicator and with a minimum three (3) years experience installing materials of this type.
- B. Manufacturer Qualifications: A firm with not less than five (5) years successful experience in producing traffic topping materials of types equivalent to those required for this project.
- C. UL Listed Products: Provide materials that have been tested and listed by UL for applications indicated, with following rating for deck and ramp slopes shown:
 - 1. "Class A" rated materials/system.
- D. Mockups: Build mockups to set quality standards for materials and execution.
 - 1. Build mockup for each traffic coating and substrate to receive traffic coatings.
 - 2. Size: [200 sq. ft. (18.5 sq. m)] <Insert dimension> of each substrate to demonstrate surface preparation, joint and crack treatment, thickness, texture, color, and standard of workmanship.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Apply traffic coatings within the range of ambient and substrate temperatures recommended in writing by manufacturer. Do not apply traffic coatings to damp or wet substrates, when temperatures are below 40 deg F (5 deg C), when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.

1. Do not apply traffic coatings in snow, rain, fog, or mist, or when such weather conditions are imminent during the application and curing period. Apply only when frost-free conditions occur throughout the depth of substrate.
- B. Do not install traffic coating until substrate construction and items that penetrate membrane have been installed.
- C. Provide ventilation and heat in compliance with manufacturers recommended limitations during installation.
- D. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of **[40 deg F (4.4 deg C) for oil-based materials]** **[50 deg F (10 deg C) for water-based materials]**, and not exceeding **95 deg F (35 deg C)**.

1.11 WARRANTY

- A. Special Project Warranty: Manufacturer and installer agree to repair or replace traffic coating that fails in materials or workmanship within specified warranty period.
 1. Submit manufacturer's standard warranty with available options and flashing endorsement, signed by Applicator and authorized representative of manufacturer, warranting traffic topping materials against failures resulting from normal exposure, but excluding failures due to unusual weather phenomena, failure of substrate, fire, abuse by unusual traffic, or other abnormal activities. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the Contract Documents.
 2. Failures include, but are not limited to, the following:
 - a. Adhesive or cohesive failures.
 - b. Abrasion or tearing failures.
 - c. Surface crazing or spalling.
 - d. Intrusion of water, oils, gasoline, grease, salt, deicer chemicals, or acids into deck substrate.
 3. Warranty Period: Minimum **[five]** **<Insert number>** years from date of Substantial Completion.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Material Compatibility: Provide primers; base-, intermediate-, and topcoat; and accessory materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Source Limitations:
1. Obtain traffic coatings from single source from single manufacturer.
 2. Obtain primary traffic-coating materials, including primers, from traffic-coating manufacturer. Obtain accessory materials including aggregates, sheet flashings, joint sealants, and substrate repair materials of types and from sources recommended in writing by primary material manufacturer.
 3. Obtain pavement-marking paint from single source from single manufacturer.

2.2 TRAFFIC COATING <Insert drawing designation>

- A. Traffic Coating: Manufacturer's standard, traffic-bearing, seamless, high-solids-content, cold liquid-applied, elastomeric, waterproofing membrane system with integral wearing surface for [**pedestrian traffic**] [**vehicular traffic**] [**and**] [**equipment-room floor**] <Insert requirement>; according to ASTM C 957.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advanced Polymer Technology Corporation.
 - b. AVM Industries, Inc.
 - c. BASF Construction Chemicals, LLC - Building Systems.
 - d. Carlisle Coatings & Waterproofing Inc.
 - e. Crossfield Products Corp.
 - f. Euclid Chemical Company (The); an RPM company.
 - g. Gaco Western LLC.
 - h. Key Resin Company.
 - i. LymTal International Inc.
 - j. Neogard; Division of Jones-Blair.
 - k. Pacific Polymers International, Inc.
 - l. ParexLahabra, Inc.
 - m. Pecora Corporation.
 - n. POLY-CARB, Inc.
 - o. Sherwin-Williams Company (The).
 - p. Tremco Incorporated; an RPM company.
 - q. Urethane Polymers International, Inc.
 - r. <Insert manufacturer's name>.
 - s. or approved equal.

- B. Primer: Liquid [**waterborne**] [**solvent-borne**] primer recommended for substrate and conditions by traffic-coating manufacturer.
1. Material: [**Epoxy**] [**Urethane**].
- C. Preparatory and Base Coats: [**Polyurethane**] [**Aromatic urethane**] [**Aliphatic urethane**] [**or**] [**epoxy**].
1. Thicknesses: Minimum [**dry**] [**or**] [**wet**] film thickness [**as recommended in writing by manufacturer for substrate and service conditions indicated**] <Insert thickness>.
- D. Intermediate Coat: [**Polyurethane**] [**Aromatic urethane**] [**Aliphatic urethane**] [**or**] [**epoxy**].
1. Thicknesses: Minimum [**dry**] [**or**] [**wet**] film thickness [**as recommended in writing by manufacturer for substrate and service conditions indicated**] <Insert thickness>, measured excluding aggregate.
 2. Aggregate Content: [**As recommended in writing by traffic-coating manufacturer for substrate and service conditions indicated**] [**Not less than 8 to 10 lb/100 sq. ft. (3.6 to 4.5 kg/10 sq. m)**] [**To refusal**] <Insert requirement>.
- E. Topcoat: [**Polyurethane**] [**Aromatic urethane**] [**Aliphatic urethane**] [**Aromatic urethane with UV inhibitors**] [**or**] [**epoxy**].
1. Thicknesses: Minimum [**dry**] [**or**] [**wet**] film thickness [**as recommended in writing by manufacturer for substrate and service conditions indicated**] <Insert thickness>, measured excluding aggregate.
 2. Aggregate Content: [**As recommended in writing by traffic-coating manufacturer for substrate and service conditions indicated**] [**As required to achieve slip-resistant finish**] [**8 to 10 lb/100 sq. ft. (3.6 to 4.5 kg/10 sq. m)**] [**To refusal**] <Insert requirement>.
 3. Color: [**As selected by DEN Project Manager from manufacturer's full range**] [**Match DEN Project Manager's sample**] <Insert color>.
- F. Aggregate: [**Manufacturer's standard aggregate for each use indicated**] [**Uniformly graded, washed silicon carbide sand**] [**Uniformly graded, washed silica sand**] [**Uniformly graded, washed flint shot silica**] [**Walnut shell granules**] [**Aluminum-oxide grit**] <Insert aggregate> of particle sizes, shape, and minimum hardness recommended in writing by traffic-coating manufacturer.
- G. Fire-Test-Response Characteristics: Provide traffic-coating materials with the fire-test-response characteristics as determined by testing identical products per test method below for deck type and slopes indicated by an independent testing and inspecting agency that is acceptable to authorities having jurisdiction.
1. [**Class A**] roof covering per ASTM E 108[**or UL 790**].
 2. <Insert test requirement>.
- H. Energy Performance: Provide traffic coating with an initial Solar Reflectance Index of

not less than 78 when calculated according to ASTM E 1980 based on the testing of identical products by a qualified testing agency.

- I. Energy Performance: Provide traffic coating that is listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.
- J. Energy Performance: Provide traffic coating with an initial Solar Reflectance Index of **[not less than 0.70] <Insert value>** and emissivity of **[not less than 0.75] <Insert value>** when tested according to CRRC-1.
- K. VOC Content: Traffic coating shall have a VOC content of 150 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- L. Low-Emitting Materials: Traffic coating shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 ACCESSORY MATERIALS

- A. Joint Sealants: **[As specified in Section 079200 "Joint Sealants."]** **[ASTM C 920.] <Insert requirement.>**
- B. Sheet Flashing: Nonstaining **[sheet material recommended in writing by traffic-coating manufacturer]** **[, uncured neoprene sheet]** **[, cured neoprene sheet]** **<Insert material>**.
 - 1. Thickness: Minimum **[60 mils (1.5 mm)]** **[50 mils (1.3 mm)]** **<Insert value>**.
- C. Adhesive: Contact adhesive recommended in writing by traffic-coating manufacturer.
- D. Reinforcing Strip: Fiberglass mesh recommended in writing by traffic-coating manufacturer.

2.4 PAVEMENT MARKINGS

- A. Pavement-Marking Paint: Comply with **[Section 321216 "Asphalt Paving."]** **[Section 321313 "Concrete Paving."]**
- B. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, **[Type N]** ; colors complying with FS TT-P-1952.
 - 1. Color: **[White]** **[Yellow]** **[Blue]** **[As indicated]** **<Insert color>**.
- C. Pavement-Marking Paint: MPI #32 Alkyd Traffic Marking Paint.
 - 1. Color: **[White]** **[Yellow]** **[Blue]** **[As indicated]** **<Insert color>**.
- D. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready

mixed, complying with FS TT-P-1952, Type II, with drying time of less than **[three] [45]** minutes.

1. Color: **[White] [Yellow] [Blue] [As indicated] <Insert color>**.

E. Pavement-Marking Paint: MPI #97 Latex Traffic Marking Paint.

1. Color: **[White] [Yellow] [Blue] [As indicated] <Insert color>**.

F. Glass Beads: **[AASHTO M 247, Type 1] [FS TT-B-1325, Type 1A]**.

G. VOC Content: Pavement-marking paints shall have a VOC content of 150 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

H. Low-Emitting Materials: Pavement-marking paints shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 GENERAL

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with DEN Project Manager.
- B. Allow concrete pavement to cure for 28 days and be thoroughly dry before starting pavement marking.

3.2 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for surface smoothness, surface moisture, and other conditions affecting performance of traffic-coating work.
- B. Verify that substrates are visibly dry and free of moisture.
 - 1. Test for moisture according to ASTM D 4263.
 - 2. Test for moisture content by **[measuring with an electronic moisture meter] [method recommended in writing by traffic-coating manufacturer] <Insert test method>**.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of traffic-coating work.
- D. Proceed with installation only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

1. Begin coating application only after minimum concrete-curing and -drying period recommended in writing by traffic-coating manufacturer has passed and after substrates are dry.
2. Application of coating indicates acceptance of surfaces and conditions.

3.3 PREPARATION

- A. General: Before applying traffic coatings, clean and prepare substrates according to ASTM C 1127 and manufacturer's written instructions to produce clean, dust-free, dry substrate for traffic-coating application. Remove projections, fill voids, and seal joints if any, as recommended in writing by traffic-coating manufacturer. Form coves at corners and penetrations of substrate.
- B. Test substrate for excessive moisture content, in manner recommended by manufacturer.
- C. Prime and seal substrate as recommended by traffic topping manufacturer, applying thinned coating of membrane liquid or other primer material at recommended spreading rate.
- D. Schedule preparation work so dust and other contaminants from process do not fall on wet, newly coated surfaces.
- E. Mask adjoining surfaces not receiving traffic coatings to prevent overspray, spillage, leaking, and migration of coatings. Prevent traffic-coating materials from entering deck substrate penetrations and clogging weep holes and drains.
- F. Concrete Substrates: [**Mechanically abrade surface to a uniform profile acceptable to manufacturer, according to ASTM D 4259.**] Do not acid etch.
 1. Remove grease, oil, paints, and other penetrating contaminants from concrete.
 2. Remove concrete fins, ridges, and other projections.
 3. Remove laitance, glaze, efflorescence, curing compounds, concrete hardeners, form-release agents, and other incompatible materials that might affect coating adhesion.
 4. Remove remaining loose material to provide a sound surface, and clean surfaces according to ASTM D 4258.

3.4 TERMINATIONS AND PENETRATIONS

- A. Prepare vertical and horizontal surfaces at terminations and penetrations through traffic coatings and at expansion joints, drains, and sleeves according to ASTM C 1127 and manufacturer's written instructions.
- B. Provide sealant cants at penetrations and at reinforced and nonreinforced, deck-to-wall butt joints.
- C. Terminate edges of deck-to-deck expansion joints with preparatory base-coat strip.

- D. Install sheet flashings at deck-to-wall expansion and dynamic joints, and bond to deck and wall substrates according to manufacturer's written recommendations.

3.5 JOINT AND CRACK TREATMENT

- A. Prepare, treat, rout, and fill joints and cracks in substrates according to ASTM C 1127 and manufacturer's written recommendations. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.

- 1. Comply with recommendations in ASTM C 1193 for joint-sealant installation.

- B. Apply reinforcing strip in traffic-coating system where recommended in writing by traffic-coating manufacturer.

3.6 TRAFFIC-COATING APPLICATION

- A. Apply traffic coating according to ASTM C 1127 and manufacturer's written instructions.
- B. Apply number of coats of specified compositions for each type of traffic coating at locations as indicated on Drawings.
- C. Start traffic-coating application in presence of manufacturer's technical representative.
- D. Verify that wet film thickness of each coat complies with requirements every [100 sq. ft. (9 sq. m)] <Insert dimension>.
- E. Uniformly broadcast aggregate on coats specified to receive aggregate. Embed aggregate according to manufacturer's written instructions. After coat dries, sweep away excess aggregate.
- F. Apply traffic coatings to prepared wall terminations and vertical surfaces to height indicated; omit aggregate on vertical surfaces.
- G. Cure traffic coatings. Prevent contamination and damage during application and curing stages.

3.7 PAVEMENT MARKINGS

- A. Do not apply pavement-marking paint for striping and other markings until layout, colors, and placement have been verified with DEN Project Manager and traffic coating has cured.
- B. Sweep and clean surface to eliminate loose material and dust.
- C. Apply pavement-marking paint with mechanical equipment to produce markings of dimensions indicated with uniform straight edges. Apply at manufacturer's recommended rates for a 15-mil- (0.4-mm-) minimum, wet film thickness.

1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.
2. Broadcast glass beads uniformly into wet pavement-marking paint at a rate of **6 lb/gal.** (0.72 kg/L).

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform the following field tests and inspections:
1. Materials Testing:
 - a. Samples of material delivered to Project site shall be taken, identified, sealed, and certified in presence of [**Owner and**] Contractor.
 - b. Testing agency shall perform tests for characteristics specified, using applicable referenced testing procedures.
 - c. Testing agency shall verify thickness of coatings during traffic-coating application for each [**600 sq. ft. (56 sq. m)**] <Insert dimension> of installed traffic coating or part thereof.
 2. Electronic Leak-Detection Testing:
 - a. Testing agency shall test [**each deck area**] [**each deck area indicated for testing on Drawings**] <Insert area to be tested> for leaks using an electronic leak-detection method that locates discontinuities in the traffic-coating membrane.
 - b. Testing agency shall perform tests on abutting or overlapping smaller areas as necessary to cover entire test area.
 - c. Testing agency shall create a conductive electronic field over the area of traffic coating to be tested and electronically determine locations of discontinuities or leaks, if any, in the traffic coating.
 - d. Testing agency shall provide survey report indicating locations of discontinuities, if any.
 3. If test results show traffic coating does not comply with requirements, remove and replace or repair the membrane as recommended in writing by traffic-coating manufacturer and make further repairs after retesting until traffic-coating installation passes.
- B. Final Traffic-Coating Inspection: Arrange for traffic-coating manufacturer's technical personnel to inspect membrane installation on completion.
1. Notify DEN Project Manager 48 hours in advance of date and time of inspection.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

- D. Prepare test and inspection reports.

3.9 PROTECTING AND CLEANING

- A. Protect traffic coatings from damage and wear during remainder of construction period.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section.

END OF SECTION 071800

SECTION 071900 - WATER REPELLENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes **[penetrating] [film-forming] [MPI-approved]** water-repellent treatments for the following vertical and horizontal surfaces:
 - 1. Cast-in-place concrete.
 - 2. Precast concrete.
 - 3. Cast stone.
 - 4. Concrete unit masonry.
 - 5. Clay brick masonry.
 - 6. Natural stone.
 - 7. Portland cement plaster (stucco).
- B. Related Sections:
 - 1. Section 030130 "Maintenance of Cast-in-Place Concrete" for penetrating polymer sealers for exterior traffic surfaces.
 - 2. Section 040140 "Maintenance of Stone Assemblies" for combined stone consolidation and water-repellent treatment.
 - 3. Section 042000 "Unit Masonry" for integral water-repellent admixture for unit masonry assemblies.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Water repellents shall meet performance requirements indicated without failure due to defective manufacture, fabrication, or installation.
 - 1. Water Repellents: Comply with performance requirements specified, as determined by **[preconstruction]testing[on manufacturer's standard]** substrate assemblies representing those indicated for this Project.
- B. Water Absorption: Minimum **[80] [90] <Insert number>** percent reduction of water absorption after 24 hours in comparison of treated and untreated specimens.

1. Cast-in Place Concrete: ASTM C 642.
2. Precast Concrete: ASTM C 642.
3. Cast Stone: ASTM C 1195.
4. Concrete Masonry Units: ASTM C 140.
5. Clay Brick: ASTM C 67.
6. Natural Stone: ASTM C 97.
7. Portland Cement Plaster (Stucco): ASTM D 6532.

C. Water-Vapor Transmission: Comply with one or both of the following:

1. Maximum [10] <Insert number> percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, according to ASTM E 96/E 96M.
2. Minimum [80] <Insert number> percent water-vapor transmission in comparison of treated and untreated specimens, according to ASTM D 1653.

D. Water Penetration and Leakage through Masonry: Minimum [90] <Insert number> percent reduction in leakage rate in comparison of treated and untreated specimens, according to ASTM E 514.

E. Durability: Maximum [5] <Insert number> percent loss of water-repellent properties after 2500 hours of weathering according to ASTM G 154 in comparison to water-repellent-treated specimens before weathering.

F. Chloride-Ion Intrusion in Concrete: NCHRP Report 244, Series II tests.

1. Reduction of Water Absorption: [80] <Insert number> percent.
2. Reduction in Chloride Content: [80] <Insert number> percent.

1.4 PRECONSTRUCTION TESTING

A. Preconstruction Testing: Installed water repellents shall comply with performance requirements indicated, as evidenced by reports **[of tests performed on manufacturer's standard substrate assemblies] [based on Project-specific preconstruction testing of existing substrate assemblies]** by a qualified testing agency.

1. Select sizes and configurations of assemblies to adequately demonstrate capability of water repellents to comply with performance requirements.
2. In addition to verifying performance requirements, use test applications to verify manufacturer's written instructions for application procedure and optimum rates of product application to substrate assemblies.
3. Notify DEN Project Manager [seven] <Insert number> days in advance of the dates and times when assemblies will be tested.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include manufacturer's printed statement of VOC content.
2. Include manufacturer's standard colors.
3. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.
4. Printout of current "MPI Approved Products List" for each product category specified in Part 2 that specifies water repellents approved by MPI, with the proposed product highlighted.

- B. Samples: For each type[**and color**] of water repellent and substrate indicated, **12 by 12 inches** (300 by 300 mm) in size, with specified water-repellent treatment applied to half of each Sample.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified [**Applicator**] [**testing agency**].
- B. Product Certificates: For each type of water repellent, from manufacturer.
 1. Include data substantiating that materials comply with requirements.
- C. Preconstruction Testing Reports: For water-repellent-treated substrates.
- D. Field quality-control reports.
- E. Warranty: Special warranty specified in this Section.

1.7 QUALITY ASSURANCE

- A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.
- B. MPI Standards: Comply with MPI standards indicated and provide water repellents listed in its "MPI Approved Products List."
- C. Mockups: Apply water repellent to each type of substrate required.
 1. Locate each test application as [**shown on Drawings**] [**directed by DEN Project Manager**].
 2. Size: [**10 sq. ft. (9.3 sq. m)**] [**25 sq. ft. (2.3 sq. m)**] <Insert size>.
 3. Final approval by DEN Project Manager of[**color and**] water-repellent application will be from test applications.
- D. Preinstallation Conference: Conduct conference at [**Project site**] [**location and time as determined by DEN Project Manager**].
- E. <Insert location>.

1.8 PROJECT CONDITIONS

- A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:
1. Concrete surfaces and mortar have cured for not less than 28 days.
 2. Building has been closed in for not less than 30 days before treating wall assemblies.
 3. Ambient temperature is above **40 deg F** (4.4 deg C) and below **100 deg F** (37.8 deg C) and will remain so for 24 hours.
 4. Substrate is not frozen and substrate-surface temperature is above **40 deg F** (4.4 deg C) and below **100 deg F** (37.8 deg C).
 5. Rain or snow is not predicted within 24 hours.
 6. Not less than **[24 hours]** **[seven days]** have passed since surfaces were last wet.
 7. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.
 8. **<Insert restriction>**.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which **[manufacturer]** **[and]** **[Applicator]** agree(s) to repair or replace materials that fail to maintain water repellency specified in "Performance Requirements" Article within specified warranty period.
1. Warranty Period: Minimum **[five]** **<Insert number>** years from date of Substantial Completion.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PENETRATING WATER REPELLENTS

- A. Silane, Penetrating Water Repellent: Clear, containing **[20]** **<Insert number>** percent or more solids of alkyltrialkoxysilanes; with alcohol, mineral spirits, water, or other proprietary solvent carrier; and with 400 g/L or less of VOCs.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Advanced Chemical Technologies, Inc.; **[Sil-Act ATS-100]** **[Sil-Act**

- Multiguard].**
- b. BASF Construction Chemicals, LLC; [**Enviroseal 20**] [**Enviroseal 40**] [**Hydrozo 100**] [**Hydrozo 100 Plus**].
 - c. Chemical Products Industries, Inc.; SW-244-100 VOC.
 - d. Dayton Superior Corporation; Weather Worker J-29-WB.
 - e. Degussa Corp; [**Protectosil Aqua-Trete 20**] [**Protectosil Aqua-Trete 40**] [**Protectosil Aqua-Trete Concentrate**] [**Protectosil Aqua-Trete BH-N**] [**Protectosil BH-O**] [**Protectosil Chem-Trete BSM 400**] [**Protectosil Chem-Trete PB 100**].
 - f. Fox Industries, Inc.; [**FX-424**] [**FX-425**].
 - g. Kelly-Moore Paint Company Inc.; Kel-Seal 77.
 - h. LymTal International, Inc.; [**Iso-Flex 618-50 VOC**] [**Iso-Flex 618-100 CRS**].
 - i. Nox-Crete Products Group; [**Stifel GC**] [**Stifel HC**] [**Stifel SC**] [**Stifel VC**].
 - j. Pecora Corporation; [**KlereSeal 940-S VOC**] [**KlereSeal 9100-S**].
 - k. Price Research, Ltd.; [**Price Aqua Seal-40**] [**Price Aqua Silane-20**] [**Price Aqua Silane-40**].
 - l. PROSOCO, Inc.; [**SL100**] [**SLX100**].
 - m. Specco Industries, Inc.; Waterstopper S-40 Silane.
 - n. Tamms Industries, Inc., Euclid Chemical Company (The); Baracade Silane 100.
 - o. Textured Coatings of America, Inc.; [**Rainstopper 110**] [**Rainstopper 120**] [**Rainstopper 140**] [**Rainstopper 1750 Clear**].
 - p. Tnemec Inc.; [**Dur A Pell 40**] [**Dur A Pell 100**].
 - q. Vexcon Chemicals Inc.; [**Certi-Vex Envio Water Proof 100**] [**Certi-Vex Envio Water Proof 500**] [**Certi-Vex Penseal 244 VOC AIM**] [**Certi-Vex Stain Repellent AIM**] [**Certi-Vex Stain Repellent WB**] [**Powerseal 20**] [**Powerseal 40**].
 - r. Wacker Chemical Corporation; [**Silres BS 1316**] [**Silres BS Creme C**].
 - s. <Insert manufacturer's name; product name or designation>.
 - t. or approved equal.
- B. Silane, Penetrating Water Repellent: Clear, containing [20] <Insert number> percent or more solids of alkyltrialkoxysilanes; with alcohol, mineral spirits, water, or other proprietary solvent carrier; and with 600 g/L or less of VOCs.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Advanced Chemical Technologies, Inc.; [**Sil-Act ATS-22 VOC**] [**Sil-Act ATS-42**] [**Sil-Act ATS-42L**] [**Sil-Act ATS-55**] [**Sil-Act ATS-100**] [**Sil-Act Multiguard**].
 - b. BASF Construction Chemicals, LLC; [**Enviroseal 20**] [**Enviroseal 40**] [**Hydrozo 100**] [**Hydrozo 100 Plus**] [**Hydrozo Clear 40 VOC**] [**Hydrozo Silane 40 VOC**] [**Masterseal SL 40 VOC**] [**Penetrating Sealer 40 VOC**].
 - c. Chemical Products Industries, Inc.; [**SW-244-100 VOC**] [**SW-244-40 VOC**].
 - d. ChemMasters; Aquanil Plus 40.
 - e. Conspec by Dayton Superior; [**Conspec Silane 20 WB**] [**Conspec Silane 40**] [**Conspec Silane 40 WB**].
 - f. Dayton Superior Corporation; Weather Worker J-29-WB.
 - g. Degussa Corporation; [**Protectosil Aqua-Trete 20**] [**Protectosil Aqua-Trete 40**] [**Protectosil Aqua-Trete Concentrate**] [**Protectosil**

- Aqua-Trete BH-N** [**Protectosil BH-O**] [**Protectosil Chem-Trete 40 VOC**] [**Protectosil Chem-Trete BSM 400**] [**Protectosil Chem-Trete PB 100**] [**Protectosil Chem-Trete 4PB VOC**].
- h. Fox Industries, Inc.; [**FX-424**] [**FX-425**].
 - i. H&C Concrete Care Products, Sherwin-Williams Company (The); H&C SL-40.
 - j. Kelly-Moore Paint Company Inc.; Kel-Seal 77.
 - k. LymTal International, Inc.; [**Iso-Flex 618-40 VOC**] [**Iso-Flex 618-50 VOC**] [**Iso-Flex 618-100 CRS**].
 - l. Nox-Crete Products Group; [**Stifel GC**] [**Stifel HC**] [**Stifel SC**] [**Stifel VC**].
 - m. Pecora Corporation; [**KlereSeal 940-S VOC**] [**KlereSeal 9100-S**].
 - n. Price Research, Ltd.; [**Price Aqua Seal-40**] [**Price Aqua Silane-20**] [**Price Aqua Silane-40**].
 - o. PROSOCO, Inc.; [**SL40 (greater than) 600**] [**SL100**] [**SLX100**].
 - p. Specco Industries, Inc.; Waterstopper S-40 Silane.
 - q. Symons by Dayton Superior; [**Silane 40%**] [**Silane 100%**].
 - r. Tamms Industries, Inc., Euclid Chemical Company (The); [**Barcade Silane 40**] [**Barcade Silane 40 IPA**].
 - s. Textured Coatings of America, Inc.; [**Rainstopper 110**] [**Rainstopper 120**] [**Rainstopper 140**] [**Rainstopper 1750 Clear**].
 - t. TK Products, Division of Sierra Corporation; [**TK-590 Tri-Silane**] [**TK-1311 WB**].
 - u. Tnemec Inc.; [**Deck A Pell 40**] [**Dur A Pell 40**] [**Dur A Pell 100**].
 - v. Vexcon Chemicals Inc.; [**Certi-Vex Envio Water Proof 100**] [**Certi-Vex Envio Water Proof 500**] [**Certi-Vex Penseal 244 40%**] [**Certi-Vex Penseal 244 VOC AIM**] [**Certi-Vex Stain Repellent**] [**Certi-Vex Stain Repellent AIM**] [**Certi-Vex Stain Repellent WB**] [**Powerseal 20**] [**Powerseal 40**].
 - w. Wacker Chemical Corporation; [**Silres BS 1316**] [**Silres BS Creme C**].
 - x. <Insert manufacturer's name; product name or designation>.
 - y. or approved equal.
- C. Siloxane, Penetrating Water Repellent: Clear, containing [10] <Insert number> percent or more solids of oligomeric alkylalkoxysiloxanes; with alcohol, ethanol, mineral spirits, water, or other proprietary solvent carrier; and with 400 g/L or less of VOCs.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Chemical Products Industries, Inc.; [**CP-250W**] [**CP-500W**].
 - b. ChemMasters; Aquanil Plus WB.
 - c. Conproco Corporation; Conpro Shield MX.
 - d. Dayton Superior Corporation; [**Weather Worker WB (J-26-WB)**] [**Weather Worker WB Heavy Duty (J-27-WB)**].
 - e. Diedrich Technologies, Inc.; 303-C.
 - f. Euclid Chemical Company (The), an RPM company; Euco-Guard VOX.
 - g. H&C Concrete Care Products, Sherwin-Williams Company (The); [**H&C Super V**] [**H&C SX-7**].
 - h. Price Research, Ltd.; [**Price Aqua Seal-20**] [**Price Aqua Siloxane-#7**].
 - i. Rainguard Products Company; MicroSeal.
 - j. SaverSystems; DEFY Water Repellent for Brick.

- k. Specco Industries, Inc.; Waterstopper S-10 WB Siloxane.
 - l. Tamms Industries, Inc., Euclid Chemical Company (The); Baracade M.E.
 - m. Textured Coatings of America, Inc.; **[Rainstopper 600] [Rainstopper 1500]**.
 - n. **<Insert manufacturer's name; product name or designation>**.
 - o. or approved equal.
- D. Siloxane, Penetrating Water Repellent: Clear, containing [10] **<Insert number>** percent or more solids of oligomeric alkylalkoxysiloxanes; with alcohol, ethanol, mineral spirits, water, or other proprietary solvent carrier; and with 600 g/L or less of VOCs.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Chemical Products Industries, Inc.; **[CP-250W] [CP-500W]**.
 - b. ChemMasters; Aquanil Plus WB.
 - c. Conproco Corporation; Conpro Shield MX.
 - d. Conspec by Dayton Superior; Weather Seal WB.
 - e. Dayton Superior Corporation; **[Weather Worker WB (J-26-WB)] [Weather Worker WB Heavy Duty (J-27-WB)]**.
 - f. Diedrich Technologies, Inc.; 303-C.
 - g. Euclid Chemical Company (The), an RPM company; Euco-Guard VOX.
 - h. Fabrikem Manufacturing Ltd.; **[Fabrishield 650] [Fabrishield 652] [Fabrishield 653]**.
 - i. H&C Concrete Care Products, Sherwin-Williams Company (The); **[H&C Super V] [H&C SX-7]**.
 - j. Price Research, Ltd.; **[Price Aqua Seal] [Price Aqua Seal-20] [Price Aqua Siloxane-#7]**.
 - k. PROSOCO, Inc.; **[Limestone & Marble Protector] [Natural Stone Treatment]**.
 - l. Rainguard Products Company; MicroSeal.
 - m. SaverSystems; DEFY Water Repellent for Brick.
 - n. Specco Industries, Inc.; **[Waterstopper S-10 WB Siloxane] [Waterstopper S-20 Siloxane]**.
 - o. Tamms Industries, Inc., Euclid Chemical Company (The); Baracade M.E.
 - p. Textured Coatings of America, Inc.; **[Rainstopper 600] [Rainstopper 1500]**.
 - q. **<Insert manufacturer's name; product name or designation>**.
 - r. or approved equal.
- E. Silane/Siloxane-Blend, Penetrating Water Repellent: Clear, silane and siloxane blend with 400 g/L or less of VOCs.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Advanced Chemical Technologies, Inc.; Sil-Act Dri-Treat.
 - b. BASF Construction Chemicals, LLC; **[Enviroseal 7] [Enviroseal Double 7 for Brick] [Enviroseal Double 7 HD] [Enviroseal PBT] [White Roc 10 WB]**.
 - c. Conproco Corporation; **[Conpro Shield W] [Conpro Shield W20]**.

- d. Degussa Corporation; Protectosil Aqua-Trete EM.
 - e. Fabrikem Manufacturing Ltd.; Fabrishield 900 Series.
 - f. Karnak Corporation; **[LL10] [LL20]**.
 - g. Kryton International Inc., Kryton Group of Companies (The); Hydrostop WB.
 - h. L&M Construction Chemicals, Inc.; **[Aquapel] [Aquapel Plus] [Hydroblock] [Hydropel WB]**.
 - i. LymTal International, Inc.; Iso-Flex 628.
 - j. OKON Co., Inc., Division of ZINSSER Co., Inc., an RPM company; **[S-20] [S-40]**.
 - k. Pecora Corporation; **[KlereSeal 910-W] [KlereSeal 920-W]**.
 - l. Price Research, Ltd.; **[Price Aqua Seal-77] [Price Salt-Sentry WB]**.
 - m. PROSOCO, Inc.; **[Saltguard WB] [Siloxane PD] [Siloxane WB Concentrate] [Weather Seal GP]**.
 - n. Rainguard Products Company; **[Blok-Lok] [Regular] [Super]**.
 - o. SaverSystems; DEFY All-Purpose Heavy-Duty Water Repellent.
 - p. Sika Corporation, Inc.; Sikagard 701W.
 - q. Symons by Dayton Superior; Siloxane/Silane 10%.
 - r. Tamms Industries, Inc., Euclid Chemical Company (The); **[Barcade WB 244] [Chemstop WB Regular] [Chemstop WB Heavy Duty]**.
 - s. Tnemec Inc.; **[Dur A Pell 10] [Dur A Pell 20] [Prime-A-Pell H2O] [Prime-A-Pell Plus, Series V662]**.
 - t. Wacker Chemical Corporation; **[Silres BS 1001A] [Silres BS 2001] [Silres BS SMK 1311]**.
 - u. **<Insert manufacturer's name; product name or designation>**.
 - v. or approved equal.
- F. Silane/Siloxane-Blend, Penetrating Water Repellent: Clear, silane and siloxane blend with 600 g/L or less of VOCs.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Advanced Chemical Technologies, Inc.; Sil-Act Dri-Treat.
 - b. BASF Construction Chemicals, LLC; **[Enviroseal 7] [Enviroseal Double 7 for Brick] [Enviroseal Double 7 HD] [Enviroseal PBT] [White Roc 10 WB]**.
 - c. Conproco Corporation; **[Conpro Shield W] [Conpro Shield W20]**.
 - d. Degussa Corporation; Protectosil Aqua-Trete EM.
 - e. Fabrikem Manufacturing Ltd.; **[Fabrishield 760] [Fabrishield 761] [Fabrishield 762] [Fabrishield 763] [Fabrishield 900 Series]**.
 - f. Karnak Corporation; **[LL10] [LL20]**.
 - g. Kryton International Inc., Kryton Group of Companies (The); Hydrostop WB.
 - h. Lambert Corporation; Waterban 90.
 - i. L&M Construction Chemicals, Inc.; **[Aquapel] [Aquapel Plus] [Hydroblock] [Hydropel WB]**.
 - j. LymTal International, Inc.; Iso-Flex 628.
 - k. OKON Co., Inc., Division of ZINSSER Co., Inc., an RPM company; **[S-20] [S-40]**.
 - l. Pecora Corporation; **[KlereSeal 910-W] [KlereSeal 920-W]**.
 - m. Price Research, Ltd.; **[Price Aqua Seal-77] [Price Salt-Sentry WB]**.

- n. PROSOCO, Inc.; [**Saltguard**] [**Saltguard WB**] [**Siloxane PD**] [**Siloxane WB Concentrate**] [**Weather Seal GP**].
 - o. Rainguard Products Company; [**Blok-Lok**] [**Regular**] [**Super**].
 - p. SaverSystems; DEFY All-Purpose Heavy-Duty Water Repellent.
 - q. Sika Corporation, Inc.; Sikagard 701W.
 - r. Symons by Dayton Superior; Siloxane/Silane 10%.
 - s. Tamms Industries, Inc., Euclid Chemical Company (The); [**Barcade WB 244**] [**Chemstop WB Regular**] [**Chemstop WB Heavy Duty**].
 - t. TK Products, Division of Sierra Corporation; TK-290 WB Tri-Siloxane.
 - u. Tnemec Inc.; [**Dur A Pell 10**] [**Dur A Pell 20**] [**Prime-A-Pell H2O**] [**Prime-A-Pell Plus, Series 662**] [**Prime-A-Pell Plus, Series V662**].
 - v. Wacker Chemical Corporation; [**Silres BS 1001A**] [**Silres BS 2001**] [**Silres BS SMK 1311**].
 - w. <Insert manufacturer's name; product name or designation>.
 - x. or approved equal.
- G. Siliconate, Penetrating Water Repellent: Clear, methyl siliconate water repellent with 400 g/L or less of VOCs.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals, LLC; Thoroclear Special.
 - b. PROSOCO, Inc.; Natural Stone Treatment WB.
 - c. <Insert manufacturer's name; product name or designation>.
 - d. or approved equal.
- H. Proprietary-Blend, Penetrating Water Repellent: Clear, consisting of one or several different resins (silanes or siloxanes), polymers, stearates, or oils plus other compounds or products of components; and with 400 g/L or less of VOCs.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals, LLC; Enviroseal Surface Guard.
 - b. PROSOCO, Inc.; [**Stain Barrier**] [**STMP**].
 - c. <Insert manufacturer's name; product name or designation>.
 - d. or approved equal.
- I. Proprietary-Blend, Penetrating Water Repellent: Clear, consisting of one or several different resins (silanes or siloxanes), polymers, stearates, or oils plus other compounds or products of components; and with 600 g/L or less of VOCs.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals, LLC; [**Enviroseal Surface Guard**] [**Hydrozo Clear Double 7 VOC**] [**White Roc 10 VOC**].
 - b. PROSOCO, Inc.; [**Impregnator**] [**Stain Barrier**] [**STMP**].
 - c. <Insert manufacturer's name; product name or designation>.
 - d. or approved equal.

2.2 FILM-FORMING WATER REPELLENTS

- A. Silicone-Resin Sealer, Film-Forming Water Repellent: Clear, polymerized, silicone-resin water repellent for dense substrates; with a solvent- or waterborne solution containing not less than 3 and up to 5 percent solids by weight; and with 400 g/L or less of VOCs.
- Products: Subject to compliance with requirements, provide one of the following:
 - H&C Concrete Care Products, Sherwin-Williams Company (The); H&C WB-50.
 - Professional Products of Kansas, Inc.; Professional Water Sealant (Regular).
 - <Insert manufacturer's name; product name or designation>.**
 - or approved equal.
- B. Silicone-Resin Sealer, Film-Forming Water Repellent: Clear, polymerized, silicone-resin water repellent for dense substrates; with a solvent- or waterborne solution containing not less than 3 and up to 5 percent solids by weight; and with 600 g/L or less of VOCs.
- Products: Subject to compliance with requirements, provide one of the following:
 - ChemMasters; Aquanil.
 - H&C Concrete Care Products, Sherwin-Williams Company (The); H&C WB-50.
 - Professional Products of Kansas, Inc.; Professional Water Sealant (Regular).
 - <Insert manufacturer's name; product name or designation>.**
 - or approved equal.
- C. Proprietary-Blend, Film-Forming Water Repellent: **[Clear] [Pigmented]**, consisting of one or several different resins, acrylics, polymers, stearates, or oils plus other compounds or products of components; and with 400 g/L or less of VOCs.
- Products: Subject to compliance with requirements, provide one of the following:
 - OKON Co., Inc., Division of ZINSSER Co., Inc., an RPM company; **[Multi-Surface] [Okon W-1] [Okon W-2]**.
 - SaverSystems; DEFY Water Repellent for Split-Face Block.
 - Wacker Chemical Corporation; Silres BS 29 A.
 - ChemMasters; Colorsil.
 - Nox-Crete Products Group; Nox Carb X.
 - Textured Coatings of America, Inc.; **[Rainstopper 400 (Semi-Transparent)] [Rainstopper 500 (Opaque)]**.
 - <Insert manufacturer's name; product name or designation>.**
 - or approved equal.
 - Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from**

manufacturer's full range] <Insert color>.

- D. Proprietary-Blend, Film-Forming Water Repellent: **[Clear] [Pigmented]**, consisting of one or several different resins, acrylics, polymers, stearates, or oils plus other compounds or products of components; and with 600 g/L or less of VOCs.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. OKON Co., Inc., Division of ZINSSER Co., Inc., an RPM company; **[Multi-Surface] [Okon W-1] [Okon W-2]**.
 - b. SaverSystems; DEFY Water Repellent for Split-Face Block.
 - c. Wacker Chemical Corporation; Silres BS 29 A.
 - d. ChemMasters; Colorsil.
 - e. Nox-Crete Products Group; Nox Carb.
 - f. PROSOCO, Inc.; Breathable Masonry Coating II.
 - g. Textured Coatings of America, Inc.; **[Rainstopper 400 (Semi-Transparent)] [Rainstopper 500 (Opaque)]**.
 - h. **<Insert manufacturer's name; product name or designation>**.
 - i. or approved equal.
 2. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
- E. Acrylic, Film-Forming Water Repellent: **[Clear] [Pigmented]**, breathing coating of acrylic resins; with a waterborne, solvent-borne, or acrylic emulsion solution containing less than 15 percent solids by volume; and with 400 g/L or less of VOCs.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals, LLC; White Roc W.
 - b. Convenience Products, Division of Clayton Corporation; **[Seal-Krete Multi-Surface] [Seal-Krete Original]**.
 - c. Nox-Crete Products Group; Sparkl-Seal E.
 - d. OKON Co., Inc., Division of ZINSSER Co., Inc., an RPM company; Plugger.
 - e. Nox-Crete Products Group; Acryl Pen X.
 - f. **<Insert manufacturer's name; product name or designation>**.
 - g. or approved equal.
 2. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
- F. Acrylic, Film-Forming Water Repellent: **[Clear] [Pigmented]**, breathing coating of acrylic resins; with a waterborne, solvent-borne, or acrylic emulsion solution containing less than 15 percent solids by volume; with 600 g/L or less of VOCs.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Convenience Products, Division of Clayton Corporation; **[Seal-Krete**

Multi-Surface] [Seal-Krete Original].

- b. OKON Co., Inc., Division of ZINSSER Co., Inc., an RPM company; Plugger.
- c. BASF Construction Chemicals, LLC; White Roc Toner VOC.
- d. Nox-Crete Products Group; Acryl Pen.
- e. **<Insert manufacturer's name; product name or designation>.**
- f. or approved equal.

2. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.**

2.3 MPI-APPROVED WATER REPELLENTS

- A. Water Repellent, Clear (Paintable); MPI #34: Penetrating, solvent-borne, clear water-repellent coating, for use on interior or exterior masonry, brick, and concrete surfaces, and that can be recoated with conventional paints; often applied by flooding the surface under low-pressure spray.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert manufacturer's name; product name or designation>.**
 - b. or approved equal.
2. VOC Content: **[600 g/L or less] [Less than 151 g/L] <Insert limit>.**
3. MPI Green Performance Standard: **[GPS-1] [GPS-2].**

- B. Water Repellent, Clear (Not Paintable); MPI #117: Penetrating, solvent-borne, silicone-oil type, clear water-repellent for interior or exterior masonry block or brick that will not be recoated with a coating other than the repellent; applied by brush, flooding, spray, or roller.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert manufacturer's name; product name or designation>.**
 - b. or approved equal.
2. VOC Content: **[600 g/L or less] [400 g/L or less] [Less than 201 g/L] <Insert limit>.**
3. MPI Green Performance Standard: **[GPS-1] [GPS-2].**

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.

1. Verify that surfaces are clean and dry according to water-repellent

- manufacturer's requirements. Check moisture content in **[three]** **<Insert number>** representative locations by method recommended by manufacturer.
2. Inspect for previously applied treatments that may inhibit penetration or performance of water repellents.
 3. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
 4. Verify that required repairs are complete, cured, and dry before applying water repellent.
- B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions[**and as follows:**][.]
1. **[Cast-in-Place Concrete] [Precast Concrete] [Cast Stone] [and] [Concrete Unit Masonry]**: Remove oil, curing compounds, laitance, and other substances that inhibit penetration or performance of water repellents **[according to ASTM E 1857] <Insert requirement>**.
 2. Clay Brick Masonry: **[ASTM D 5703.] [Section 040120 "Maintenance of Unit Masonry."]**
 3. Natural Stone: **[ASTM C 1515.] [ASTM D 5107.] [Section 040140 "Maintenance of Stone Assemblies."]**
 4. Portland Cement Plaster (Stucco): **[ASTM E 1857] <Insert requirement>**.
- B. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.
- C. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.
- D. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.3 APPLICATION

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.
- B. Apply a heavy-saturation coating of water repellent, on surfaces indicated for treatment, using [**15 psi- (103 kPa)- pressure spray with a fan-type spray nozzle**] [**roller**] [**or**] [**brush**] <Insert requirement> to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.
1. [**Precast Concrete**] [**and**] [**Cast Stone**]: At Contractor's option, first application of water repellent on units may be completed before installing them. Mask mortar and sealant bond surfaces to prevent water repellent from migrating onto joint surfaces.
- C. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.4 FIELD QUALITY CONTROL

- A. Testing of Water-Repellent Material: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when water repellent is being applied:
1. Owner will engage the services of a qualified testing agency to sample water-repellent material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 2. Testing agency will perform tests for compliance of water-repellent material with product requirements.
 3. Owner may direct Contractor to stop applying water repellents if test results show material being used does not comply with product requirements. Contractor shall remove noncomplying material from Project site, pay for testing, and correct deficiency of surfaces treated with rejected materials, as approved by DEN Project Manager. <Insert additional requirements to suit Project>.
- B. Coverage Test: In the presence of DEN Project Manager, hose down a dry, repellent-treated surface to verify complete and uniform product application. A change in surface color will indicate incomplete application.
1. Notify DEN Project Manager [**seven**] <Insert number> days in advance of the dates and times when surfaces will be tested.
 2. Reapply water repellent until coverage test indicates complete coverage.

3.5 CLEANING

- A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by DEN Project Manager.
- B. Comply with manufacturer's written cleaning instructions.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 071900

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Foam-plastic board insulation.
2. Cellular-glass insulation.
3. Glass-fiber board insulation.
4. Mineral-wool board insulation.
5. Glass-fiber blanket insulation.
6. Mineral-wool blanket insulation.
7. Loose-fill insulation.
8. Spray-applied cellulosic insulation.
9. Spray polyurethane foam insulation.
10. Radiant barriers.
11. Vapor retarders.

B. Related Sections:

1. Section 042000 "Unit Masonry" for insulation installed in[**cavity walls and**] masonry cells.
2. Section 061600 "Sheathing" for foam-plastic board sheathing over wood or steel framing.
3. [Section 071326 "Self-Adhering Sheet Waterproofing"] [Section 071353 "Elastomeric Sheet Waterproofing"] [Section 071354 "Thermoplastic Sheet Waterproofing"] [Section 071413 "Hot Fluid-Applied Rubberized Asphalt Waterproofing"] [Section 071416 "Cold Fluid-Applied Waterproofing"] for insulated drainage panels installed with waterproofing.
4. [Section 072413 "Polymer-Based Exterior Insulation and Finish System (EIFS)"] [Section 072419 "Water-Drainage Exterior Insulation and Finish System (EIFS)"] for insulation specified as part of these systems.
5. [Section 075113 "Built-up Asphalt Roofing"] [Section 075116 "Built-up Coal Tar Roofing"] [Section 075216 "Atactic-Polypropylene (APP) Modified Bituminous Membrane Roofing"] [Section 075216 "Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing"] [Section 075316 "Chlorosulfonate-Polyethylene (CSPE) Roofing"] [Section 075323 "Ethylene-Propylene-Diene-Monomer (EPDM) Roofing"]

- [Section 075416 "Ethylene Interpolymer (KEE) Roofing"] [Section 075419 Polyvinyl-Chloride (PVC) Roofing] [Section 075423 "Thermoplastic Polyolefin (TPO) Roofing"] [Section 075552 "Modified Bituminous Protected Membrane Roofing"] [Section 075556 "Fluid-Applied Protected Membrane Roofing"] [and] "[Section 075700 "Coated Foamed Roofing"]" for insulation specified as part of roofing construction.
6. Section 078446 "Fire-Resistive Joint Systems" for insulation installed as part of a perimeter fire-resistive joint system.
 7. [Section 092116.23 "Gypsum Board Shaft Wall Assemblies"] [Section 092300 "Gypsum Plastering"] [Section 092400 "Portland Cement Plastering"] [Section 092613 "Gypsum Veneer Plastering"] for installation in wood- and metal-framed assemblies of insulation specified by referencing this Section.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.
- B. Research/Evaluation Reports: For foam-plastic insulation, from **[ICC-ES] <Insert applicable model code organization>**.

1.5 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according

to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
 - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
 - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.
- C. CONSTRUCTION WASTE MANAGEMENT
 - 1. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 FOAM-PLASTIC BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning.
 - d. Pactiv Building Products.
 - e. **<Insert manufacturer>**
 - f. or approved equal.
 - 2. Type X, **15 psi** (104 kPa).
 - 3. Type IV, **25 psi** (173 kPa).
 - 4. Type VI, **40 psi** (276 kPa).
 - 5. Type VII, **60 psi** (414 kPa).
 - 6. Type V, **100 psi** (690 kPa).

- B. Unfaced Wall Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, [Type IV, 25-psi (173-kPa)] [or] [Type VI, 40-psi (276-kPa)] minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Pactiv Building Products.
 - d. <Insert manufacturer>
 - e. or approved equal.
- C. Geotextile-Faced Wall Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, [Type IV, 25-psi (173-kPa)] [or] [Type VI, 40-psi (276-kPa)] minimum compressive strength; fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with nonwoven geotextile filter fabric.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Owens Corning.
 - b. <Insert manufacturer>
 - c. or approved equal.
- D. Molded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Plymouth Foam, Inc.
 - c. <Insert manufacturer>
 - d. or approved equal.
 2. Type I, 10 psi (69 kPa).
 3. Type II, 15 psi (104 kPa).
 4. Type VIII, 20 psi (138 kPa).
- E. Foil-Faced, Polyisocyanurate Board Insulation: ASTM C 1289, Type I, [Class 1] [or] [Class 2], with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Atlas Roofing Corporation.
 - b. Dow Chemical Company (The).
 - c. Rmax, Inc.
 - d. **<Insert manufacturer>**
 - e. or approved equal.
- F. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

2.2 CELLULAR-GLASS INSULATION

- A. Cellular-Glass Insulation: ASTM C 552, **[Type I (flat block)] [Type IV (board) faced on both sides with manufacturer's special kraft-paper sheets laminated to glass block with asphalt]**.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pittsburgh Corning Corporation.
 - b. **<Insert manufacturer>**
 - c. or approved equal.
- B. Asphalt Coating for Cellular-Glass Block Insulation: Cutback asphalt or asphalt emulsion of type recommended by manufacturer of cellular-glass block insulation.

2.3 GLASS-FIBER BOARD INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CertainTeed Corporation.
 2. Johns Manville.
 3. Knauf Insulation.
 4. Owens Corning.
 5. **<Insert manufacturer>**
 6. or approved equal.
- B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
- C. Unfaced, Flexible Glass-Fiber Board Insulation: ASTM C 612, Type IA; ASTM C 553, Types I, II, and III; or ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84, passing ASTM E 136 for combustion characteristics.
1. Nominal density of **1.0 lb/cu. ft.** (16 kg/cu. m), thermal resistivity of **3.7 deg F x h x sq. ft./Btu x in. at 75 deg F** (25.7 K x m/W at 24 deg C).

2. Nominal density of not less than 1.5 lb/cu. ft. (24 kg/cu. m) or more than 1.7 lb/cu. ft. (27 kg/cu. m), thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F (27.7 K x m/W at 24 deg C).
- D. Foil-Faced, Flexible Glass-Fiber Board Insulation: ASTM C 612, Type IA or ASTM C 553, Types I, II, and III; faced on one side with foil-scrim-kraft vapor retarder; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84.
1. Nominal density of 1.0 lb/cu. ft. (16 kg/cu. m), thermal resistivity of 3.7 deg F x h x sq. ft./Btu x in. at 75 deg F (25.7 K x m/W at 24 deg C).
 2. Nominal density of not less than 1.5 lb/cu. ft. (24 kg/cu. m) or more than 1.7 lb/cu. ft. (27 kg/cu. m), thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F (27.7 K x m/W at 24 deg C).
- E. Unfaced, Glass-Fiber Board Insulation: ASTM C 612, Type IA; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84[, **passing ASTM E 136 for combustion characteristics**].
1. Nominal density of 2.25 lb/cu. ft. (36 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).
 2. Nominal density of 3 lb/cu. ft. (48 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).
 3. Nominal density of 4.25 lb/cu. ft. (68 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).
 4. Nominal density of 6 lb/cu. ft. (96 kg/cu. m), thermal resistivity of 4.4 deg F x h x sq. ft./Btu x in. at 75 deg F (30.5 K x m/W at 24 deg C).
- F. Foil-Faced, Glass-Fiber Board Insulation: ASTM C 612, Type IA; faced on one side with foil-scrim-kraft or foil-scrim-polyethylene vapor retarder, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84.
1. Nominal density of 2.25 lb/cu. ft. (36 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).
 2. Nominal density of 3 lb/cu. ft. (48 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).
 3. Nominal density of 4.25 lb/cu. ft. (68 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).
 4. Nominal density of 6 lb/cu. ft. (96 kg/cu. m), thermal resistivity of not less than 4.34 deg F x h x sq. ft./Btu x in. at 75 deg F (30.1 K x m/W at 24 deg C).
- G. Dark-Surfaced, Glass-Fiber Board Insulation: ASTM C 612, Type IA; faced on one side with black glass-fiber mat or black polymer finish; maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84.
1. Nominal density of 1.5 lb/cu. ft. (24 kg/cu. m), thermal resistivity of 4.2 deg F x h x sq. ft./Btu x in. at 75 deg F (29.1 K x m/W at 24 deg C).
 2. Nominal density of 2.25 lb/cu. ft. (36 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).

3. Nominal density of 3 lb/cu. ft. (48 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).
4. Nominal density of 6 lb/cu. ft. (96 kg/cu. m), thermal resistivity of 4.5 deg F x h x sq. ft./Btu x in. at 75 deg F (31.2 K x m/W at 24 deg C).

H. Sustainability Requirements: Provide glass-fiber board insulation as follows:

1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

2.4 MINERAL-WOOL BOARD INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fibrex Insulations Inc.
2. Isolatek International.
3. Owens Corning.
4. Roxul Inc.
5. Thermafiber.
6. <Insert manufacturer>
7. or approved equal.

B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent.

C. Unfaced, Mineral-Wool Board Insulation: ASTM C 612; with maximum flame-spread and smoke-developed indexes of 15 and 0, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

1. Nominal density of 4 lb/cu. ft. (64 kg/cu. m), Types IA and IB, thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F (27.7 K x m/W at 24 deg C).
2. Nominal density of 6 lb/cu. ft. (96 kg/cu. m), Type II, thermal resistivity of 4.16 deg F x h x sq. ft./Btu x in. at 75 deg F (28.8 K x m/W at 24 deg C).
3. Nominal density of 8 lb/cu. ft. (128 kg/cu. m), Type III, thermal resistivity of 4.35 deg F x h x sq. ft./Btu x in. at 75 deg F (30.2 K x m/W at 24 deg C).
4. Fiber Color: Darkened, where indicated.

D. Foil-Faced, Mineral-Wool Board Insulation: ASTM C 612; faced on one side with foil-scrim or foil-scrim-polyethylene vapor retarder; with maximum flame-spread and smoke-developed indexes of 25 and 5, respectively, per ASTM E 84.

1. Nominal density of 4 lb/cu. ft. (64 kg/cu. m), Types IA and IB, thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F (27.7 K x m/W at 24 deg C).
2. Nominal density of 6 lb/cu. ft. (96 kg/cu. m), Type II, thermal resistivity of 4.16 deg F x h x sq. ft./Btu x in. at 75 deg F (28.8 K x m/W at 24 deg C).

3. Nominal density of **8 lb/cu. ft.** (128 kg/cu. m), Type III, thermal resistivity of **4.35 deg F x h x sq. ft./Btu x in. at 75 deg F** (30.2 K x m/W at 24 deg C).

2.5 GLASS-FIBER BLANKET INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. CertainTeed Corporation.
 2. Guardian Building Products, Inc.
 3. Johns Manville.
 4. Knauf Insulation.
 5. Owens Corning.
 6. **<Insert manufacturer>**
 7. or approved equal.
- B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
- C. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
- D. Polypropylene-Scrim-Kraft-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type II (non-reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier).
- E. Kraft-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type II (non-reflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier).
- F. Reinforced-Foil-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.
- G. Foil-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (reflective faced), Class B (faced surface with a flame-propagation resistance of 0.12 W/sq. cm); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.
- H. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide cross ventilation between insulated attic spaces and vented eaves.
- I. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
 1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.

2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

2.6 MINERAL-WOOL BLANKET INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Fibrex Insulations Inc.
 2. Owens Corning.
 3. Roxul Inc.
 4. Thermafiber.
 5. **<Insert manufacturer>**
 6. or approved equal.
- B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
- C. Unfaced, Mineral-Wool Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
- D. Reinforced-Foil-Faced, Mineral-Wool Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less per ASTM E 84); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

2.7 LOOSE-FILL INSULATION

- A. Cellulosic-Fiber Loose-Fill Insulation: ASTM C 739, chemically treated for flame-resistance, processing, and handling characteristics.
 1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
- B. Glass-Fiber Loose-Fill Insulation: ASTM C 764, [**Type I for pneumatic application**] [**or**] [**Type II for poured application**]; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
 1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.

2.8 SPRAY-APPLIED CELLULOSIC INSULATION

- A. Self-Supported, Spray-Applied Cellulosic Insulation: ASTM C 1149, [**Type I (materials applied with liquid adhesive; suitable for either exposed or enclosed applications),**] [**Type II (materials containing a dry adhesive activated by water**

during installation; intended only for enclosed or covered applications),] [Type III (materials containing an adhesive mixed with water during application; intended for application on attic floors),] chemically treated for flame-resistance, processing, and handling characteristics.

1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.

2.9 SPRAY POLYURETHANE FOAM INSULATION

A. Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. BaySystems NorthAmerica, LLC.
 - c. Dow Chemical Company (The).
 - d. ERSystems, Inc.
 - e. Gaco Western Inc.
 - f. Henry Company.
 - g. NCFI; Division of Barnhardt Mfg. Co.
 - h. SWD Urethane Company.
 - i. Volatile Free, Inc.
 - j. **<Insert manufacturer>**
 - k. or approved equal.
2. Minimum density of **1.5 lb/cu. ft.** (24 kg/cu. m), thermal resistivity of **6.2 deg F x h x sq. ft./Btu x in. at 75 deg F** (43 K x m/W at 24 deg C).

B. Open-Cell Polyurethane Foam Insulation: Spray-applied polyurethane foam using water as a blowing agent, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BaySystems NorthAmerica, LLC.
 - b. Demilec (USA) LLC.
 - c. Gaco Western Inc.
 - d. Icynene Inc.
 - e. SWD Urethane Company.
 - f. **<Insert manufacturer>**
 - g. or approved equal.
2. Minimum density of **0.4 lb/cu. ft.** (6.4 kg/cu. m), thermal resistivity of **3.4 deg F x h x sq. ft./Btu x in. at 75 deg F** (24 K x m/W at 24 deg C).

2.10 RADIANT BARRIERS

A. Sheet Radiant Barriers: ASTM C 1313 and as follows:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fi-Foil Company; Radiant Shield.
 - b. Innovative Energy, Inc.; R+Heatshield [**Commercial Solid**] [**Perforated**].
 - c. Innovative Insulation, Inc.; Super R [**Premium**] [**Plus**].
 - d. TVM Building Products; Reflective [**House Wrap**] [**Vapor Barrier**].
 - e. **<Insert manufacturer>**
 - f. or approved equal.
2. Sheet Construction: [**Foil on one side of substrate**] [**Foil on both sides of substrate**] [**Vacuum metallizing on substrate**].
3. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes of [**5 and 10**] **<Insert numbers>**, respectively.
4. Tear Resistance: **<Insert value>**.
5. Water-Vapor Transmission: [**1 perm, maximum**] [**5 perms or greater**].
6. Sheet Width: **<Insert width>**.

B. Interior Radiation Control Coating System: Silver-colored, not thickness-dependent, low-emissivity, [**solvent**] [**water**]-based coating; formulated for adherence to substrates indicated and with a surface emittance value of 0.25 or less as measured per ASTM C 1371.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. SOLEC Corporation; LO/MIT-I.
 - b. SOLEC Corporation; LO/MIT-II.
 - c. **<Insert manufacturer>**
 - d. or approved equal.

2.11 VAPOR RETARDERS

A. Polyethylene Vapor Retarders: ASTM D 4397, [**6 mils (0.15 mm)**] [**10 mils (0.25 mm)**] thick, with maximum permeance rating of **0.13 perm** (7.5 ng/Pa x s x sq. m).

B. Reinforced-Polyethylene Vapor Retarders: Two outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nylon cord or polyester scrim and weighing not less than **25 lb/1000 sq. ft.** (12 kg/100 sq. m), with maximum permeance rating of **0.0507 perm** (2.9 ng/Pa x s x sq. m).

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Raven Industries Inc.; DURA-SKRIM 6WW.
 - b. Reef Industries, Inc.; Griffolyn T-65.
 - c. **<Insert manufacturer>**
 - d. or approved equal.

C. Fire-Retardant, Reinforced-Polyethylene Vapor Retarders: Two outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nonwoven grid of nylon cord or polyester scrim and weighing not less than **22 lb/1000 sq. ft.** (10 kg/100 sq. m), with maximum permeance rating of **0.1317 perm** (7.56 ng/Pa x s x sq. m) and with flame-spread and smoke-developed indexes of not more than 5 and 60, respectively, per ASTM E 84.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Raven Industries Inc.; DURA-SKRIM 2FR.
 - b. Reef Industries, Inc.; Griffolyn T-55 FR.
 - c. **<Insert manufacturer>**
 - d. or approved equal.

D. Foil-Polyester-Film Vapor Retarders: Two layers of **0.5-mil-** (0.013-mm-) thick polyester film laminated to an inner layer of **1-mil-** (0.025-mm-) thick aluminum foil, with maximum water-vapor transmission rate in flat condition of 0.0 g/h x sq. m and with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Alumiseal Corporation; Zero Perm Vapor Barrier.
 - b. **<Insert manufacturer>**
 - c. or approved equal.

E. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

F. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

G. Single-Component Nonsag Urethane Sealant: ASTM C 920, Type I, Grade NS, Class 25, Use NT related to exposure, and Use O related to vapor-barrier-related substrates.

H. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.

2.12 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
 - b. Gemco; Spindle Type.
 - c. **<Insert manufacturer>**
 - d. or approved equal.

2. Plate: Perforated, galvanized carbon-steel sheet, **0.030 inch** (0.762 mm) thick by **2 inches** (50 mm) square.
 3. Spindle: Copper-coated, low-carbon steel; fully annealed; **0.105 inch** (2.67 mm) in diameter; length to suit depth of insulation indicated.
- B. Adhesively Attached, Angle-Shaped, Spindle-Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Gemco; 90-Degree Insulation Hangers.
 - b. **<Insert manufacturer>**
 - c. or approved equal.
 2. Angle: Formed from **0.030-inch-** (0.762-mm-) thick, perforated, galvanized carbon-steel sheet with each leg **2 inches** (50 mm) square.
 3. Spindle: Copper-coated, low-carbon steel; fully annealed; **0.105 inch** (2.67 mm) in diameter; length to suit depth of insulation indicated.
- C. Insulation-Retaining Washers: Self-locking washers formed from **0.016-inch-** (0.41-mm-) thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than **1-1/2 inches** (38 mm) square or in diameter.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AGM Industries, Inc.; **[RC150] [SC150]**.
 - b. Gemco; **[Dome-Cap] [R-150] [S-150]**.
 - c. **<Insert manufacturer's name>**
 - d. or approved equal.
 2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
 - a. Crawl spaces.
 - b. Ceiling plenums.
 - c. Attic spaces.
 - d. Where indicated.
 - e. **<Insert location>**.
- D. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of **[1 inch (25 mm)] [2 inches (50 mm)] [3 inches (76 mm)]** between face of insulation and substrate to which anchor is attached.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Gemco; Clutch Clip.
 - b. **<Insert manufacturer>**

- c. or approved equal.
- E. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AGM Industries, Inc.; TACTOO Adhesive.
 - b. Gemco; Tuff Bond Hanger Adhesive.
 - c. **<Insert manufacturer>**
 - d. or approved equal.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation[**or vapor retarders, including removing projections capable of puncturing vapor retarders,**] or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF BELOW-GRADE INSULATION

- A. On vertical surfaces, set insulation units [**using manufacturer's recommended adhesive**] [**loosely laid**] according to manufacturer's written instructions.
 - 1. If not otherwise indicated, extend insulation a minimum of [**24 inches (610 mm)**] [**36 inches (915 mm)**] **<Insert dimension>** below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written

instructions. Stagger end joints and tightly abut insulation units.

1. If not otherwise indicated, extend insulation a minimum of **[24 inches (610 mm)] [36 inches (915 mm)]** <Insert dimension> in from exterior walls.

3.4 INSTALLATION OF CAVITY-WALL INSULATION

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately **24 inches (610 mm)** o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
 1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."
- B. Cellular-Glass Board Insulation: Install with closely fitting joints using **[adhesive pad] [serrated trowel]** attachment method according to manufacturer's written instructions.

3.5 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Foam-Plastic Board Insulation: Seal joints between units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
- C. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 3. Maintain **3-inch (76-mm)** clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 4. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
 5. For metal-framed wall cavities where cavity heights exceed **96 inches (2438 mm)**, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
 6. For wood-framed construction, install blankets according to ASTM C 1320 and as follows:

- a. With faced blankets having stapling flanges, secure insulation by inset, stapling flanges to sides of framing members.
 - b. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.
7. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.
- a. Exterior Walls: Set units with facing placed toward **[interior of construction] [as indicated on Drawings]**.
 - b. Interior Walls: Set units with facing placed **[toward areas of high humidity] [as indicated on Drawings] <Insert location>**.
- D. Loose-Fill Insulation: Apply according to ASTM C 1015 and manufacturer's written instructions. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.
1. For cellulosic-fiber loose-fill insulation, comply with CIMA's Bulletin #2, "Standard Practice for Installing Cellulose Insulation."
- E. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.
- F. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately **2.5 lb/cu. ft.** (40 kg/cu. m).
 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.
- 3.6 INSTALLATION OF INSULATION IN CEILINGS FOR SOUND ATTENUATION
- A. Where glass-fiber blankets are indicated for sound attenuation above ceilings, install blanket insulation over entire ceiling area in thicknesses indicated. Extend insulation **48 inches** (1219 mm) up either side of partitions.
- 3.7 INSTALLATION OF RADIANT BARRIERS
- A. Install interior radiation control coating system according to ASTM C 1321.
 - B. Install sheet radiant barriers according to ASTM C 1158.

3.8 INSTALLATION OF INSULATION FOR CONCRETE SUBSTRATES

- A. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
 2. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.
 3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.
 4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

3.9 INSTALLATION OF CURTAIN-WALL INSULATION

- A. Install board insulation in curtain-wall construction where indicated on Drawings according to curtain-wall manufacturer's written instructions.
1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated between insulation and glass.
 2. Install insulation where it contacts perimeter fire-containment system to prevent insulation from bowing under pressure from perimeter fire-containment system.

3.10 INSTALLATION OF VAPOR RETARDERS

- A. Place vapor retarders on side of construction indicated on Drawings. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives or other anchorage system as indicated. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- B. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs.
1. Fasten vapor retarders to wood framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners **16 inches** (406 mm) o.c.
 2. Before installing vapor retarders, apply urethane sealant to flanges of metal framing including runner tracks, metal studs, and framing around door and window openings. Seal overlapping joints in vapor retarders with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Seal butt joints with vapor-retarder tape. Locate all joints over framing members or other solid substrates.

3. Firmly attach vapor retarders to metal framing and solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacturer.

- C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
- D. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.11 PROTECTION

- A. Protect installed insulation[**and vapor retarders**] from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

3.12 INSULATION SCHEDULE

- A. Insulation Type <Insert number>: [**Type IV**] <Insert Type> extruded-polystyrene board insulation.
- B. Insulation Type <Insert number>: [**Type VI**] <Insert Type> extruded-polystyrene drainage panels.
- C. Insulation Type <Insert number>: Fabric-faced, extruded-polystyrene drainage panels.
- D. Insulation Type <Insert number>: [**Type I**] <Insert Type> molded-polystyrene board insulation.
- E. Insulation Type <Insert number>: Foil-faced, polyisocyanurate board insulation.
- F. Insulation Type <Insert number>: Cellular-glass insulation.
- G. Insulation Type <Insert number>: Unfaced, flexible glass-fiber board insulation.
- H. Insulation Type <Insert number>: Foil-faced, flexible glass-fiber board insulation.
- I. Insulation Type <Insert number>: Unfaced, glass-fiber board insulation.
- J. Insulation Type <Insert number>: Foil-faced, glass-fiber board insulation.
- K. Insulation Type <Insert number>: Glass-mat-faced, glass-fiber board insulation.
- L. Insulation Type <Insert number>: Unfaced, mineral-wool board insulation.
- M. Insulation Type <Insert number>: Foil-faced, mineral-wool board insulation.

- N. Insulation Type <Insert number>: Unfaced, glass-fiber blanket insulation.
- O. Insulation Type <Insert number>: Faced, glass-fiber blanket insulation.
- P. Insulation Type <Insert number>: Unfaced, mineral-wool blanket insulation.
- Q. Insulation Type <Insert number>: Faced, mineral-wool blanket insulation.
- R. Insulation Type <Insert number>: Cellulosic-fiber loose-fill insulation.
- S. Insulation Type <Insert number>: Glass-fiber loose-fill insulation.
- T. Insulation Type <Insert number>: Spray-applied cellulosic insulation.
- U. Insulation Type <Insert number>: Polyurethane spray foam insulation.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 072100

SECTION 072413 - POLYMER-BASED EXTERIOR INSULATION AND FINISH SYSTEM (EIFS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior insulation and finish system (EIFS) applied over **[concrete] [masonry] [exterior cement board] [gypsum sheathing] [plywood sheathing] <Insert substrate>**.
 - 2. Prefabricated panels consisting of EIFS applied over **[exterior cement board] [gypsum sheathing]** on metal framing.
- B. Related Sections:
 - 1. Section 061600 "Sheathing" for sheathing[**and weather-resistant sheathing paper**].
 - 2. Section 079200 "Joint Sealants" for sealing joints in EIFS with elastomeric joint sealants.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 SYSTEM DESCRIPTION

- A. Class PB EIFS: A non-load-bearing, exterior wall cladding system that consists of an insulation board attached adhesively, mechanically, or both to the substrate; an integrally reinforced base coat; and a textured protective finish coat.

1.4 PERFORMANCE REQUIREMENTS

- A. EIFS Performance: Comply with the following:
 - 1. Bond Integrity: Free from bond failure within EIFS components or between system and supporting wall construction, resulting from exposure to fire, wind loads, weather, or other in-service conditions.

2. Weathertightness: Resistant to water penetration from exterior into EIFS and assemblies behind it or through them into interior of building that results in deterioration of thermal-insulating effectiveness or other degradation of EIFS and assemblies behind it, including substrates, supporting wall construction, and interior finish.
- B. Class PB EIFS: Provide EIFS having physical properties and structural performance that comply with the following:
1. Abrasion Resistance: Sample consisting of **1-inch-** (25.4-mm-) thick EIFS mounted on **1/2-inch-** (12.7-mm-) thick gypsum board; cured for a minimum of 28 days; and showing no cracking, checking, or loss of film integrity after exposure to **528 quarts** (500 L) of sand when tested per ASTM D 968, Method A.
 2. Absorption-Freeze Resistance: No visible deleterious effects and negligible weight loss after 60 cycles per EIMA 101.01.
 3. Accelerated Weathering: Five samples per ICC-ES AC219 showing no cracking, checking, crazing, erosion, rusting, blistering, peeling, delamination, or other characteristics that might affect performance as a wall cladding after testing for 2000 hours when viewed under 5 times magnification per **[ASTM G 153 or ASTM G 154] [ASTM G 153 or ASTM G 155] <Insert test method>**.
 4. Freeze-Thaw: No surface changes, cracking, checking, crazing, erosion, rusting, blistering, peeling, or delamination, or indications of delamination between components when viewed under 5 times magnification after **[60 cycles per EIMA 101.01] [10 cycles per ICC-ES AC219]**.
 5. Mildew Resistance of Finish Coat: Sample applied to **2-by-2-inch** (50.8-by-50.8-mm) clean glass substrate, cured for 28 days, and showing no growth when tested per ASTM D 3273 and evaluated according to ASTM D 3274.
 6. Salt-Spray Resistance: No deleterious effects when tested according to ICC-ES AC219.
 7. Tensile Adhesion: No failure in the EIFS, adhesive, base coat, or finish coat when tested per **[EIMA 101.03] [ICC-ES AC219]**.
 8. Water Penetration: Sample consisting of **1-inch-** (25.4-mm-) thick EIFS mounted on **1/2-inch-** (12.7-mm-) thick gypsum board, cured for 28 days, and showing no water penetration into the plane of the base coat to expanded-polystyrene board interface of the test specimen after 15 minutes at **6.24 lbf/sq. ft.** (299 Pa) of air pressure difference or 20 percent of positive design wind pressure, whichever is greater, across the specimen during a test period when tested per EIMA 101.02.
 9. Water Resistance: Three samples, each consisting of **1-inch-** (25.4-mm-) thick EIFS mounted on **1/2-inch-** (12.7-mm-) thick gypsum board; cured for 28 days; and showing no cracking, checking, crazing, erosion, rusting, blistering, peeling, or delamination after testing for 14 days per ASTM D 2247.
 10. Wind-Driven-Rain Resistance: Resist wind-driven rain according to ICC-ES AC219.
 11. Impact Resistance: Sample consisting of **1-inch-** (25.4-mm-) thick EIFS when constructed, conditioned, and tested per EIMA 101.86; and meeting or exceeding the following:
 - a. Standard Impact Resistance: **25 to 49 inch-lb** (2.8 to 5.6 J).

- b. Medium Impact Resistance: **50 to 89 inch-lb** (5.7 to 10.1 J).
 - c. High Impact Resistance: **90 to 150 inch-lb** (10.2 to 17 J).
 - d. Ultra-High Impact Resistance: More than **150 inch-lb** (17 J).
 12. Structural Performance Testing: EIFS assembly and components shall comply with ICC-ES AC219 when tested per ASTM E 330.
 13. **<Insert additional testing to suit products>**.
- C. Performance of Prefabricated Panels: Prefabricated panels shall be designed as follows and withstand the structural performance indicated for Class PB EIFS and thermal movement limits indicated below without failure due to defective manufacture, fabrication, installation, or other defects in construction.
1. Delegated Design: Design prefabricated panels, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 2. Structural Performance: EIFS shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to [**SEI/ASCE 7**] **<Insert requirement>**.
 - a. Wind Loads: Uniform pressure of **<Insert number> lbf/sq. ft.** (**<Insert number> Pa**), acting inward or outward.
 - b. Wind Loads: Uniform pressure as indicated on Drawings.
 3. Deflection Limits: Design prefabricated panels to withstand design loads without deflections greater than [**1/240**] **<Insert deflection limits>**.
 4. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - a. Temperature Change (Range): [**100 deg F (55 deg C)**] **<Insert temperature range>**.
- 1.5 ACTION SUBMITTALS
- A. Product Data: For each type and component of EIFS indicated.
 1. Include data substantiating that materials comply with requirements.
 - B. LEED Submittals:
 1. Product Data for Credit IEQ 4.1: For adhesives and sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
 2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants used inside the weatherproofing system, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Shop Drawings: For EIFS. Include plans, elevations, sections, details of components, details of penetration and termination, flashing details, joint locations and configurations, [**lifting points for prefabricated panels,**] fastening and anchorage details including mechanical fasteners, and connections and attachments to other work.
 - D. Panel Schedule: For prefabricated panel fabrication.
 - E. Samples for Initial Selection: For each type of finish-coat color and texture indicated.
 - 1. Include similar Samples of joint sealants [**and exposed accessories**] involving color selection.
 - F. Samples for Verification: **24-inch-** (600-mm-) square panels for each type of finish-coat color and texture indicated, prepared using same tools and techniques intended for actual work including [**custom trim, each profile,**] [**an aesthetic reveal,**] a typical control joint filled with sealant of color selected.
 - 1. Include sealants [**and exposed accessory**] Samples to verify color selected.
 - G. Delegated-Design Submittal: For prefabricated panels indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- 1.6 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For Installer [, **fabricator/erector,**] [, **professional engineer,**] and testing agency.
 - B. Manufacturer Certificates: Signed by manufacturers certifying that EIFS [**and joint sealants**] comply with requirements.
 - C. Material or Product Certificates: For [**cementitious materials and aggregates and for**] each insulation and joint sealant, from manufacturer.
 - D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each [**water-/weather-resistive barrier,**] insulation, reinforcing mesh, [**joint sealant,**] and coating.
 - E. Compatibility and Adhesion Test Reports: For joint sealants from sealant manufacturer indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
 - F. Field quality-control reports [**and special inspection reports**].

- G. Evaluation Reports: For **[exterior cement-board sheathing] [fasteners] [adhesive membrane flashing]** and EIFS (including insulation), from **<Insert applicable model code organization>**.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For EIFS to include in maintenance manuals.

1.8 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: **[An installer who is certified in writing by EIFS manufacturer as qualified to install manufacturer's system using trained workers] <Insert requirements>**.

1. A firm that has specialized in installation of types of EIFS required for Project for not less than five (5) years.
2. Fabricator/Erector Qualifications: Certified in writing by EIFS manufacturer as qualified to fabricate and erect manufacturer's prefabricated panel system using skilled and trained workers.

- B. Source Limitations: Obtain EIFS from single source from single EIFS manufacturer and from sources approved by EIFS manufacturer as compatible with system components.

- C. Fire-Test-Response Characteristics: Provide EIFS and system components with the following fire-test-response characteristics as determined by testing identical EIFS and system components per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Characteristics: Provide materials and construction tested for fire resistance per ASTM E 119.
2. Full-Scale Multistory Fire Test: Tested mockup, representative of completed multistory wall assembly of which EIFS is a part, complies with UBC Standard 26-4 for test method and required fire-test-response characteristics of exterior non-load-bearing wall panel assemblies containing foam-plastic insulation.
3. Full-Scale Diversified Fire Test: Tested mockup, representative of completed multistory wall assembly of which EIFS is a part, showing no significant contribution to vertical or horizontal flame spread per ASTM E 108 modified for testing vertical walls.

4. Intermediate-Scale Multistory Fire Test: Tested mockup, representative of completed multistory wall assembly of which EIFS is a part, complies with **[NFPA 285] [UBC Standard 26-9]** for test method and required fire-test-response characteristics of exterior non-load-bearing wall panel assemblies containing foam-plastic insulation.
 5. Radiant Heat Exposure: No ignition of EIFS when tested according to NFPA 268.
 6. Potential Heat: Acceptable level when tested according to NFPA 259.
 7. Surface-Burning Characteristics: Provide insulation board, adhesives, base coats, and finish coats with flame-spread index of 25 or less and smoke-developed index of 450 or less, per **[ASTM E 84] [UBC Standard 8-1] <Insert test method>**.
- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution and set quality standards for fabrication and installation.
1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]**
- F. **<Insert location>**.
- 1.10 DELIVERY, STORAGE, AND HANDLING
- A. Deliver materials in original, unopened packages with manufacturers' labels intact and clearly identifying products.
 - B. Store materials inside and under cover; keep them dry and protected from weather, direct sunlight, surface contamination, aging, corrosion, damaging temperatures, construction traffic, and other causes.
 1. Stack insulation board flat and off the ground.
 2. Protect plastic insulation against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.
- 1.11 PROJECT CONDITIONS
- A. Weather Limitations: Maintain ambient temperatures above **40 deg F (4.4 deg C)** for a minimum of 24 hours before, during, and after adhesives or coatings are applied. Do not apply EIFS adhesives or coatings during rainfall. Proceed with installation only when existing and forecasted weather conditions and ambient outdoor air, humidity, and substrate temperatures permit EIFS to be applied, dried, and cured according to manufacturers' written instructions and warranty requirements.

- B. Field Measurements: Verify actual dimensions required for prefabricated panels by field measurements before fabrication.

1.12 COORDINATION

- A. Coordinate installation of EIFS with related Work specified in other Sections to ensure that wall assemblies, including sheathing, [**weather-resistant sheathing paper,**] flashing, trim, joint sealants, windows, and doors, are protected against damage from the effects of weather, age, corrosion, moisture, and other causes. Do not allow water to penetrate behind flashing and barrier coating of EIFS.

1.13 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Acrocrete, Inc.
 2. Corev America, Inc.
 3. Dryvit Systems, Inc.
 4. El Rey Stucco Company, Inc.; a brand of ParexLahabra, Inc.
 5. Finestone; Degussa Wall Systems, Inc.
 6. Master Wall, Inc.
 7. Omega Products International, Inc.
 8. Parex, Inc.; a brand of ParexLahabra, Inc.
 9. Pleko LLC.
 10. Senergy; Degussa Wall Systems, Inc.
 11. SonoWall; Degussa Wall Systems, Inc.
 12. Sto Corp.
 13. Stuc-O-Flex International, Inc.
 14. TEC; an H. B. Fuller company.
 15. Total Wall Inc.
 16. **<Insert manufacturer's name>**.
 17. or approved equal.

2.2 MATERIALS

- A. Compatibility: Provide adhesive, fasteners, board insulation, reinforcing meshes, base-and finish-coat systems, sealants, and accessories that are compatible with one another and with substrates and approved for use by EIFS manufacturer for Project.
- B. Prefabricated Panels: Comply with requirements in Section 054000 "Cold-Formed Metal Framing" for metal framing and with requirements in Section 061600 "Sheathing" for **[gypsum sheathing] [and] [weather-resistant sheathing paper]**.
- C. Exterior Cement Board: Not less than **[5/16-inch- (8-mm-)] [7/16-inch- (11-mm-)]** **<Insert dimension>** thick, fiber cement board complying with ASTM C 1186, Type A, for exterior applications.
1. Fasteners: Wafer-head or flat-head steel drill screws complying with ASTM C 954, with an organic-polymer coating or other corrosion-protective coating having a salt-spray resistance of more than 500 hours per ASTM B 117.
 - a. Size and Length: **[As recommended by sheathing manufacturer for type and thickness of sheathing board to be attached] <Insert size and length>**.
- D. Primer/Sealer: EIFS manufacturer's standard substrate conditioner **[with VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24),] [that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers,"]** designed to seal substrates from moisture penetration and to improve the bond between substrate of type indicated and adhesive used for application of insulation.
- E. Flexible-Membrane Flashing: Cold-applied, fully self-adhering, self-healing, rubberized-asphalt and polyethylene-film composite sheet or tape and primer; EIFS manufacturer's standard or product recommended in writing by EIFS manufacturer.
- F. Insulation Adhesive: EIFS manufacturer's standard formulation designed for indicated use; compatible with substrate; **[with VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24);] [that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers";]** and complying with **[one of]** the following:
1. Job-mixed formulation of Portland cement complying with ASTM C 150, Type I, and polymer-based adhesive specified for base coat.
 2. Factory-blended dry formulation of Portland cement, dry polymer admixture, and fillers specified for base coat.
 3. Factory-mixed noncementitious formulation designed for adhesive attachment of insulation to substrates of type indicated, as recommended by EIFS manufacturer.

- G. Molded, Rigid Cellular Polystyrene Board Insulation: Comply with ASTM C 578, Type I; EIFS manufacturer's requirements; and EIMA's "EIMA Guideline Specification for Expanded Polystyrene (EPS) Insulation Board" for most stringent requirements for material performance and qualities of insulation, including dimensions and permissible variations, and the following:
1. Aging: Before cutting and shipping, age insulation in block form by air drying for not less than six weeks or by another method approved by EIMA that produces equivalent results.
 2. Flame-Spread and Smoke-Developed Indexes: 25 and 450 or less, respectively, per ASTM E 84.
 3. Dimensions: Provide insulation boards not more than **24 by 48 inches** (610 by 1219 mm) and in thickness indicated, but not more than **4 inches** (102 mm) thick or less than thickness allowed by ASTM C 1397.
 4. Foam Shapes: Provide with profiles and dimensions indicated on Drawings.
- H. Reinforcing Mesh: Balanced, alkali-resistant, open-weave, glass-fiber mesh treated for compatibility with other EIFS materials, made from continuous multiend strands with retained mesh tensile strength of not less than **120 lbf/in.** (21 dN/cm) per **[ASTM E 2098] [EIMA 105.01]**; complying with ASTM D 578 and the following:
1. Standard-Impact Reinforcing Mesh: Not less than **[4.0 oz./sq. yd. (136 g/sq. m)] <Insert weight>**.
 2. Intermediate-Impact Reinforcing Mesh: Not less than **[10 oz./sq. yd. (339 g/sq. m)] [12.0 oz./sq. yd. (407 g/sq. m)] <Insert weight>**.
 3. High-Impact Reinforcing Mesh: Not less than **[15 oz./sq. yd. (509 g/sq. m)] <Insert weight>**.
 4. Heavy-Duty Reinforcing Mesh: Not less than **[20 oz./sq. yd. (678 g/sq. m)] <Insert weight>**.
 5. Strip Reinforcing Mesh: Not less than **[3.75 oz./sq. yd. (127 g/sq. m)] <Insert weight>**.
 6. Detail Reinforcing Mesh: Not less than **[4.0 oz./sq. yd. (136 g/sq. m)] <Insert weight>**.
 7. Corner Reinforcing Mesh: Not less than **[7.2 oz./sq. yd. (244 g/sq. m)] <Insert weight>**.
- I. Base-Coat Materials: EIFS manufacturer's standard mixture complying with **[one of]** the following:
1. Job-mixed formulation of Portland cement complying with ASTM C 150, Type I, white or natural color; and manufacturer's standard polymer-emulsion adhesive designed for use with Portland cement.
 2. Job-combined formulation of manufacturer's standard polymer-emulsion adhesive and manufacturer's standard dry mix containing Portland cement.
 3. Factory-blended dry formulation of Portland cement, dry polymer admixture, and inert fillers to which only water is added at Project site.
 4. Factory-mixed noncementitious formulation of polymer-emulsion adhesive and inert fillers that is ready to use without adding other materials.

- J. Waterproof Adhesive/Base-Coat Materials: EIFS manufacturer's standard waterproof formulation[**with VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24);**] [**that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers";**] and complying with[**one of**] the following:
1. Job-mixed formulation of Portland cement complying with ASTM C 150, Type I, white or natural color; and manufacturer's standard polymer-emulsion adhesive designed for use with Portland cement.
 2. Job-combined formulation of manufacturer's standard polymer-emulsion adhesive and manufacturer's standard dry mix containing Portland cement.
- K. Primer: EIFS manufacturer's standard factory-mixed, elastomeric-polymer primer for preparing base-coat surface for application of finish coat.
- L. Finish-Coat Materials: EIFS manufacturer's [**standard acrylic-based coating**] [**standard acrylic-based coating with enhanced mildew resistance**] [**siliconized acrylic-based coating**] <Insert coating> complying with the following:
1. Factory-mixed formulation of polymer-emulsion binder, colorfast mineral pigments, sound stone particles, and fillers.
 2. Factory-mixed formulation of polymer-emulsion binder, colorfast mineral pigments, and fillers used with stone particles for embedding in finish coat to produce an applied-aggregate finish.
 - a. Aggregate: Marble chips of size and color [**as indicated by manufacturer's designations**] [**to match DEN Project Manager's samples**] [**as selected by DEN Project Manager from manufacturer's full range**].
 3. Sealer: Manufacturer's waterproof, clear acrylic-based sealer for protecting finish coat.
 4. Colors: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**].
- M. Water: Potable.
- N. Mechanical Fasteners: EIFS manufacturer's standard corrosion-resistant fasteners consisting of thermal cap, standard washer and shaft attachments, and fastener indicated below; selected for properties of pullout, tensile, and shear strength required to resist design loads of application indicated; capable of pulling fastener head below surface of insulation board; and of the following description:
1. For attachment to steel studs from **0.033 to 0.112 inch** (0.84 to 2.84 mm) in thickness, provide steel drill screws complying with ASTM C 954.
 2. For attachment to light-gage steel framing members not less than **0.0179 inch** (0.45 mm) in thickness, provide steel drill screws complying with ASTM C 1002.

3. For attachment to wood framing members and plywood sheathing, provide steel drill screws complying with ASTM C 1002, Type W.
 4. For attachment to masonry and concrete substrates, provide sheathing dowel in form of a plastic wing-tipped fastener with thermal cap, sized to fit insulation thickness indicated and to penetrate substrate to depth required to secure anchorage.
 5. For attachment, provide manufacturer's standard fasteners suitable for substrate.
 6. **<Insert fastener requirements>**.
- O. Trim Accessories: Type as designated or required to suit conditions indicated and to comply with EIFS manufacturer's written instructions; manufactured from UV-stabilized PVC; and complying with ASTM D 1784, manufacturer's standard Cell Class for use intended, and ASTM C 1063.
1. Casing Bead: Prefabricated, one-piece type for attachment behind insulation, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg.
 2. Drip Screed/Track: Prefabricated, one-piece type for attachment behind insulation with face leg extended to form a drip, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg.
 3. Expansion Joint: Prefabricated, one-piece V profile; designed to relieve stress of movement.
 4. Window Sill Flashing: Prefabricated type for both flashing and sloping sill over framing beneath windows; with end and back dams; designed to direct water to exterior.
 5. Parapet Cap Flashing: Type for both flashing and covering parapet top[**with design complying with ASTM C 1397**].
 6. **<Insert trim and requirements>**.

2.3 ELASTOMERIC SEALANTS

- A. Elastomeric Sealant Products: Provide EIFS manufacturer's listed and recommended chemically curing, elastomeric sealant that is compatible with joint fillers, joint substrates, and other related materials, and complies with requirements for products and testing indicated in ASTM C 1481 and with requirements in Section 079200 "Joint Sealants" for products corresponding to description indicated below:
1. Multicomponent, nonsag urethane sealant.
 2. Single-component, nonsag, neutral-curing silicone sealant.
 3. **<Insert sealant>**.
 4. Sealants used inside the weatherproofing system shall have a VOC content of **[250] <Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 5. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- B. Preformed Foam Sealant Products: Provide sealant compatible with adjacent materials and complying with requirements in Section 079200 "Joint Sealants."
- C. Sealant Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range].**

2.4 MIXING

- A. General: Comply with EIFS manufacturer's requirements for combining and mixing materials. Do not introduce admixtures, water, or other materials except as recommended by EIFS manufacturer. Mix materials in clean containers. Use materials within time period specified by EIFS manufacturer or discard.

2.5 PANEL FABRICATION

- A. Panel Framing: Fabricate panel framing to comply with requirements in Section 054000 "Cold-Formed Metal Framing."
 - 1. Connect panel framing by welding unless otherwise indicated.
 - 2. Connections: Provide connections capable of adjustment, complying with erection tolerance requirements, to anchor panels to structure.
- B. Exterior Cement Board: Install on metal framing to comply with requirements in "Exterior Cement-Board Installation" Article.
- C. EIFS Application: Apply EIFS to sheathed metal-framed panels to comply with requirements in "Trim Installation," "Insulation Installation," "Base-Coat Installation," and "Finish-Coat Installation" articles and as follows:
 - 1. Wrap base coat and reinforcing mesh at edges of panels and extend coverage not less than **4 inches** (100 mm) over backs of panels unless otherwise indicated.
 - 2. Wrap base coat and reinforcing mesh at edges of panels and extend coverage not less than full thickness to cover edges of metal framing unless otherwise indicated.
 - 3. Continue finish coat around corners at edges of panels, unless otherwise indicated, and extend to location indicated for sealant application. Do not extend finish coat over surfaces where sealant will be applied.
 - 4. Continue finish coat around corners at edges of panels and extend over edges to cover base coat unless otherwise indicated.
- D. Panel Fabrication Tolerances: Comply with the following:
 - 1. Overall Height and Width: Plus or minus **[1/8 inch (3.2 mm)] <Insert dimension>**.
 - 2. Cumulative Height and Width over Length of Building: Not more than **[3/8 inch (9.6 mm)] <Insert value>**.

3. Openings within One Unit: Plus or minus [**1/8 inch (3.2 mm)**] <Insert dimension> for window and doorframes.
 4. Out of Square: Plus or minus [**1/8 inch (3.2 mm)**] <Insert dimension>.
 5. Locations of Reveals and Architectural Features: Plus or minus [**1/8 inch (3.2 mm)**] <Insert dimension>.
 6. Thickness: Plus or minus [**1/16 inch (1.6 mm)**] <Insert dimension>.
 7. Flatness: Not more than [**1/8 inch in 8 feet (3.2 mm in 2.4 m)**] <Insert dimension> across face of panel.
- E. Source Quality Control: [**Owner will engage**] [**Engage**] a qualified testing agency to perform shop tests and inspections indicated below and prepare test reports.
1. Shop welds will be subject to testing and inspection.
 2. <Insert requirements>.
 3. Testing and inspecting agency shall interpret tests and report whether tested Work complies with or deviates from requirements.
 4. Correct deficiencies in or replace EIFS prefabricated panels that test reports and inspections indicated do not comply with requirements.
 5. Additional testing and inspection, at Contractor's expense, shall be performed to determine compliance of corrected Work with requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of EIFS.
- B. Examine roof edges, wall framing, flashings, openings, substrates, and junctures at other construction for suitable conditions where EIFS will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
 1. Begin coating application only after surfaces are dry.
 2. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Protect contiguous work from moisture deterioration and soiling caused by application of EIFS. Provide temporary covering and other protection needed to prevent spattering of exterior finish coats on other work.
- B. Protect EIFS, substrates, and wall construction behind them from inclement weather during installation. Prevent penetration of moisture behind EIFS and deterioration of substrates.

- C. Prepare and clean substrates to comply with EIFS manufacturer's written instructions to obtain optimum bond between substrate and adhesive for insulation.
 - 1. Concrete Substrates: Provide clean, dry, neutral-pH substrate for insulation installation. Verify suitability of substrate by performing bond and moisture tests recommended by EIFS manufacturer.

3.3 EXTERIOR CEMENT-BOARD INSTALLATION

- A. Exterior Cement Board: Install on metal framing to comply with cement-board manufacturer's written instructions and evaluation report acceptable to authorities having jurisdiction. Install board with steel drill screws spaced no more than **[8 inches (203 mm)] <Insert spacing>** o.c. along framing with perimeter fasteners at least **3/8 inch (9.6 mm)** but less than **5/8 inch (15.9 mm)** from edges of boards.

3.4 EIFS INSTALLATION, GENERAL

- A. Comply with ASTM C 1397 and EIFS manufacturer's written instructions for installation of EIFS as applicable to each type of substrate indicated.
- B. Install EIFS system as per approved shop drawings and in strict compliance with manufacturer's details approved for type of system, including type of products, and sequence and methods of installation.
 - 1. Contractor to maintain drawings of all applicable details at the Project site at all times for reference by workers.

3.5 SUBSTRATE PROTECTION APPLICATION

- A. Primer/Sealer: Apply over **[gypsum sheathing] <Insert substrate>** substrates to protect substrates from degradation and where required by EIFS manufacturer for improving adhesion of insulation to substrate.
- B. Waterproof Adhesive/Base Coat: Apply over **[sloped surfaces] [window sills] [parapets] [where indicated on Drawings] <Insert location>** to protect substrates from degradation.
- C. Flexible-Membrane Flashing: Install over weather-resistive barrier, applied and lapped to shed water; seal at openings, penetrations, terminations, and where indicated by EIFS manufacturer's written instructions to protect wall assembly from degradation. Prime substrates, if required, and install flashing to comply with EIFS manufacturer's written instructions and details.

3.6 TRIM INSTALLATION

- A. Trim: Apply trim accessories at perimeter of EIFS, at expansion joints, [**at window sills,**] and elsewhere as indicated, according to EIFS manufacturer's written instructions. Coordinate with installation of insulation.
1. Drip Screed/Track: Use at bottom edges of EIFS unless otherwise indicated.
 2. Window Sill Flashing: Use at windows unless otherwise indicated.
 3. Expansion Joint: Use where indicated on Drawings.
 4. Casing Bead: Use at other locations.
 5. Parapet Cap Flashing: Use where indicated on Drawings.
 6. **<Insert trim and requirements>**.

3.7 INSULATION INSTALLATION

- A. Board Insulation: [**Adhesively**] [**Mechanically**] [**Adhesively and mechanically**] attach insulation to substrate in compliance with ASTM C 1397, EIFS manufacturer's written instructions, and the following:
1. Apply adhesive to insulation by notched-trowel method in a manner that results in coating the entire surface of sheathing with adhesive once insulation is adhered to sheathing unless EIFS manufacturer's written instructions specify using primer/sealer with ribbon-and-dab method. Apply adhesive to a thickness of not less than **1/4 inch** (6.4 mm) for factory mixed and not less than **3/8 inch** (9.6 mm) for field mixed, measured from surface of insulation before placement.
 2. Press and slide insulation into place. Apply pressure over the entire surface of insulation to accomplish uniform contact, high initial grab, and overall level surface.
 3. Allow adhered insulation to remain undisturbed for period recommended by EIFS manufacturer, but not less than 24 hours, before [**installing mechanical fasteners,**] beginning rasping and sanding insulation, or applying base coat and reinforcing mesh.
 4. Mechanically attach insulation to substrate by method complying with EIFS manufacturer's written instructions. Install top surface of fastener heads flush with plane of insulation. Install fasteners into or through substrates with the following minimum penetration:
 - a. Steel Framing: **5/16 inch** (8 mm).
 - b. Wood Framing: **1 inch** (25 mm).
 - c. Concrete and Masonry: **1 inch** (25 mm).
 5. Apply insulation over dry substrates in courses with long edges of boards oriented horizontally.
 6. Begin first course of insulation from a level base line and work upward.
 7. Begin first course of insulation from screed/track and work upward. Work from perimeter casing beads toward interior of panels if possible.
 8. Stagger vertical joints of insulation boards in successive courses to produce running bond pattern. Locate joints so no piece of insulation is less than **12 inches** (300 mm) wide or **6 inches** (150 mm) high. Offset joints not less than **6**

inches (150 mm) from corners of window and door openings[**and not less than 4 inches** (100 mm) **from aesthetic reveals**].

- a. Adhesive Attachment: Offset joints of insulation not less than **6 inches** (150 mm) from horizontal and **4 inches** (100 mm) from vertical joints in sheathing.
 - b. Mechanical Attachment: Offset joints of insulation from horizontal joints in sheathing.
9. Interlock ends at internal and external corners.
 10. Abut insulation tightly at joints within and between each course to produce flush, continuously even surfaces without gaps or raised edges between boards. If gaps greater than **1/16 inch** (1.6 mm) occur, fill with insulation cut to fit gaps exactly; insert insulation without using adhesive or other material.
 11. Cut insulation to fit openings, corners, and projections precisely and to produce edges and shapes complying with details indicated.
 12. Rasp or sand flush entire surface of insulation to remove irregularities projecting more than [**1/32 inch** (0.8 mm)] [**1/16 inch** (1.6 mm)] from surface of insulation and to remove yellowed areas due to sun exposure; do not create depressions deeper than **1/16 inch** (1.6 mm).
 13. Cut aesthetic reveals in outside face of insulation with high-speed router and bit configured to produce grooves, rabbets, and other features that comply with profiles and locations indicated. Do not reduce insulation thickness at aesthetic reveals to less than **3/4 inch** (19 mm).
 14. Install foam shapes and attach to [**sheathing**] [**structure**].
 15. Interrupt insulation for expansion joints where indicated.
 16. Form joints for sealant application by leaving gaps between adjoining insulation edges and between insulation edges and dissimilar adjoining surfaces. Make gaps wide enough to produce joint widths indicated after encapsulating joint substrates with base coat and reinforcing mesh.
 17. Form joints for sealant application with back-to-back casing beads for joints within EIFS and with perimeter casing beads at dissimilar adjoining surfaces. Make gaps between casing beads and between perimeter casing beads and adjoining surfaces of width indicated.
 18. After installing insulation and before applying reinforcing mesh, fully wrap board edges with strip reinforcing mesh. Cover edges of board and extend encapsulating mesh not less than **2-1/2 inches** (64 mm) over front and back face unless otherwise indicated on Drawings.
 19. Treat exposed edges of insulation as follows:
 - a. Except for edges forming substrates of sealant joints, encapsulate with base coat, reinforcing mesh, and finish coat.
 - b. Encapsulate edges forming substrates of sealant joints within EIFS or between EIFS and other work with base coat and reinforcing mesh.
 - c. At edges trimmed by accessories, extend base coat, reinforcing mesh, and finish coat over face leg of accessories.
 20. Coordinate installation of flashing and insulation to produce wall assembly that does not allow water to penetrate behind flashing and EIFS protective-coating lamina.

- B. Expansion Joints: Install at locations indicated, where required by EIFS manufacturer, and as follows:
1. At expansion joints in substrates behind EIFS.
 2. Where EIFS adjoin dissimilar substrates, materials, and construction, including other EIFS.
 3. At floor lines in multilevel wood-framed construction.
 4. Where wall height or building shape changes.
 5. Where EIFS manufacturer requires joints in long continuous elevations.
 6. Where panels abut one another.
 7. **<Insert location>**.

3.8 BASE-COAT INSTALLATION

- A. Base Coat: Apply to exposed surfaces of insulation[**and foam shapes**] in minimum thickness recommended in writing by EIFS manufacturer, but not less than **[1/16-inch (1.6-mm)] <Insert dimension>** dry-coat thickness.
- B. Reinforcing Mesh: Embed type indicated below in wet base coat to produce wrinkle-free installation with mesh continuous at corners and overlapped not less than **2-1/2 inches (64 mm)** or otherwise treated at joints to comply with ASTM C 1397 and EIFS manufacturer's written instructions. Do not lap reinforcing mesh within **8 inches (204 mm)** of corners. Completely embed mesh, applying additional base-coat material if necessary, so reinforcing-mesh color and pattern are not visible.
1. Standard-impact reinforcing mesh [**unless otherwise indicated**] **<Insert location>**.
 2. Intermediate-impact reinforcing mesh [**where indicated**] **<Insert location>**.
 3. High-impact reinforcing mesh [**where indicated**] **<Insert location>**.
 4. Heavy-duty reinforcing mesh [**where indicated**] **<Insert location>**.
- C. Double-Layer Reinforcing Mesh Application: Where indicated, apply second base coat and second layer of [**standard**] [**intermediate**]-impact reinforcing mesh, overlapped not less than **2-1/2 inches (64 mm)** or otherwise treated at joints to comply with ASTM C 1397 and EIFS manufacturer's written instructions in same manner as first application. Do not apply until first base coat has cured.
- D. Additional Reinforcing Mesh: Apply strip reinforcing mesh around openings extending **4 inches (100 mm)** beyond perimeter. Apply additional **9-by-12-inch (230-by-300-mm)** strip reinforcing mesh diagonally at corners of openings (re-entrant corners). Apply **8-inch- (200-mm-)** wide strip reinforcing mesh at both inside and outside corners unless base layer of mesh is lapped not less than **4 inches (100 mm)** on each side of corners.
1. At aesthetic reveals, apply strip reinforcing mesh not less than **8 inches (200 mm)** wide.
 2. Embed strip reinforcing mesh in base coat before applying first layer of reinforcing mesh.
- E. Foam Shapes: Fully embed reinforcing mesh in base coat.

- F. Double Base-Coat Application: Where indicated, apply second base coat in same manner and thickness as first application except without reinforcing mesh. Do not apply until first base coat has cured.

3.9 FINISH-COAT INSTALLATION

- A. Primer: Apply over dry base coat according to EIFS manufacturer's written instructions.
- B. Finish Coat: Apply over dry **[primed]** base coat, maintaining a wet edge at all times for uniform appearance, in thickness required by EIFS manufacturer to produce a uniform finish of color and texture matching approved sample and free of cold joints, shadow lines, and texture variations.
1. Texture: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range]**.
 2. Embed aggregate in finish coat according to EIFS manufacturer's written instructions to produce a uniform applied-aggregate finish of color and texture matching approved sample.
- C. Sealer Coat: Apply over dry finish coat, in number of coats and thickness required by EIFS manufacturer.

3.10 INSTALLATION OF PREFABRICATED PANELS

- A. General: Install panels according to Shop Drawings. Install **[by welding metal framing to structural-steel frame] [by welding to steel-weld plates anchored in concrete]** <Insert requirements> to comply with requirements in Section 054000 "Cold-Formed Metal Framing" unless otherwise indicated.
1. Lift panels only as indicated on Shop Drawings.
 2. Do not warp or stress panels by forcing alignment.
 3. Adjust connections to align panels and maintain correct and uniform joint widths.
 4. Install bracing as panels are erected. Weld securely to panel framing and to structure.
- B. Erection Tolerances: Install panels level, plumb, and true to line with no variation in plane or alignment exceeding **1/16 inch** (1.6 mm) and no variation in position exceeding **1/8 inch** (3.2 mm).
1. Maintain clearance between panels required for installing joint sealants.

3.11 INSTALLATION OF JOINT SEALANTS

- A. Prepare joints and apply sealants, of type and at locations indicated, to comply with applicable requirements in Section 079200 "Joint Sealants" and in ASTM C 1481.

1. Apply joint sealants after base coat has cured but before applying finish coat.
2. Clean surfaces to receive sealants to comply with indicated requirements and EIFS manufacturer's written instructions.
3. Apply primer recommended in writing by sealant manufacturer for surfaces to be sealed.
4. Install sealant backing to control depth and configuration of sealant joint and to prevent sealant from adhering to back of joint.
5. Apply masking tape to protect areas adjacent to sealant joints. Remove tape immediately after tooling joints, without disturbing joint seal.
6. Recess sealant sufficiently from surface of EIFS so an additional sealant application, including cylindrical sealant backing, can be installed without protruding beyond EIFS surface.

3.12 FIELD QUALITY CONTROL

- A. Special Inspections: **Owner will engage** a qualified special inspector to perform the following special inspections:
1. According to **[ICC-ES AC24] [ICC-ES AC219]**.
 2. **<Insert special inspections>**.
- B. Testing Agency: **Owner will engage** a qualified testing agency to perform tests and inspections.
- C. EIFS Tests and Inspections: For the following:
1. According to **[ICC-ES AC24] [ICC-ES AC219]**.
 2. **<Insert testing requirements of authorities having jurisdiction>**.
- D. Prefabricated Panels: Test and inspect field welds.
- E. Remove and replace EIFS where test results indicate that EIFS do not comply with specified requirements.
- F. Prepare test and inspection reports.

3.13 CLEANING AND PROTECTION

- A. Remove temporary covering and protection of other work. Promptly remove coating materials from window and doorframes and other surfaces outside areas indicated to receive EIFS coatings.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 072413

SECTION 072419 - WATER-DRAINAGE EXTERIOR INSULATION AND FINISH SYSTEM (EIFS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes water-drainage exterior insulation and finish system (EIFS) applied over **[water-resistive coating over sheathing] [weather-resistant sheathing paper over sheathing] [weather-resistant sheathing paper over exterior cement board] [exterior cement board over weather-resistant sheathing paper] <Insert substrate>**.
- B. Related Sections:
 - 1. Section 061600 "Sheathing" for sheathing[**and weather-resistant sheathing paper**].
 - 2. Section 079200 "Joint Sealants" for sealing joints in EIFS with elastomeric joint sealants.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 SYSTEM DESCRIPTION

- A. Class PB EIFS: A non-load-bearing, exterior wall cladding system that consists of an insulation board attached adhesively, mechanically, or both to the substrate; an integrally reinforced base coat; and a textured protective finish coat.
- B. Water-Drainage EIFS: EIFS with a means that allows water entering into an EIFS assembly to drain to the exterior.

1.4 PERFORMANCE REQUIREMENTS

- A. EIFS Performance: Comply with the following:

1. Bond Integrity: Free from bond failure within EIFS components or between system and supporting wall construction, resulting from exposure to fire, wind loads, weather, or other in-service conditions.
 2. Weathertightness: Resistant to water penetration from exterior into water-drainage EIFS and assemblies behind it or through them into interior of building that results in deterioration of thermal-insulating effectiveness or other degradation of EIFS and assemblies behind it, including substrates, supporting wall construction, and interior finish, and including a means that allows water entering into an EIFS assembly to drain to the exterior.
- B. Class PB EIFS: Provide EIFS having physical properties and structural performance that comply with the following:
1. Abrasion Resistance: Sample consisting of **1-inch-** (25.4-mm-) thick EIFS mounted on **1/2-inch-** (12.7-mm-) thick gypsum board; cured for a minimum of 28 days; and showing no cracking, checking, or loss of film integrity after exposure to **528 quarts** (500 L) of sand when tested per ASTM D 968, Method A.
 2. Absorption-Freeze Resistance: No visible deleterious effects and negligible weight loss after 60 cycles per EIMA 101.01.
 3. Accelerated Weathering: Five samples per ICC-ES AC235 showing no cracking, checking, crazing, erosion, rusting, blistering, peeling, delamination, or other characteristics that might affect performance as a wall cladding after testing for 2000 hours when viewed under 5 times magnification per **[ASTM G 153 or ASTM G 154] [ASTM G 153 or ASTM G 155] <Insert test method>**.
 4. Freeze-Thaw: No surface changes, cracking, checking, crazing, erosion, rusting, blistering, peeling, or delamination, or indications of delamination between components when viewed under 5 times magnification after **[60 cycles per EIMA 101.01] [10 cycles per ICC-ES AC235]**.
 5. Mildew Resistance of Finish Coat: Sample applied to **2-by-2-inch** (50.8-by-50.8-mm) clean glass substrate, cured for 28 days, and showing no growth when tested per ASTM D 3273 and evaluated according to ASTM D 3274.
 6. Salt-Spray Resistance: No deleterious effects when tested according to ICC-ES AC235.
 7. Tensile Adhesion: No failure in the EIFS, adhesive, base coat, or finish coat when tested per **[EIMA 101.03] [ICC-ES AC235]**.
 8. Water Penetration: Sample consisting of **1-inch-** (25.4-mm-) thick EIFS mounted on **1/2-inch-** (12.7-mm-) thick gypsum board, cured for 28 days, and showing no water penetration into the plane of the base coat to expanded polystyrene board interface of the test specimen after 15 minutes at **6.24 lbf/sq. ft.** (299 Pa) of air pressure difference or 20 percent of positive design wind pressure, whichever is greater, across the specimen during a test period when tested per EIMA 101.02.
 9. Water Resistance: Three samples, each consisting of **1-inch-** (25.4-mm-) thick EIFS mounted on **1/2-inch-** (12.7-mm-) thick gypsum board; cured for 28 days; and showing no cracking, checking, crazing, erosion, rusting, blistering, peeling, or delamination after testing for 14 days per ASTM D 2247.
 10. Impact Resistance: Sample consisting of **1-inch-** (25.4-mm-) thick EIFS when constructed, conditioned, and tested per EIMA 101.86; and meeting or exceeding the following:

- a. Standard Impact Resistance: **25 to 49 inch-lb** (2.8 to 5.6 J).
 - b. Medium Impact Resistance: **50 to 89 inch-lb** (5.7 to 10.1 J).
 - c. High Impact Resistance: **90 to 150 inch-lb** (10.2 to 17 J).
 - d. Ultra-High Impact Resistance: More than **150 inch-lb** (17 J).
11. Drainage: According to **[ICC-ES AC24] [ICC-ES AC235]**.
 12. Structural Performance Testing: EIFS assembly and components shall comply with ICC-ES AC235 when tested per ASTM E 330.
 13. **<Insert additional testing to suit products>**.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type and component of EIFS indicated.
 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 1. Product Data for Credit IEQ 4.1: For adhesives and sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
 2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants used inside the weatherproofing system documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For EIFS. Include plans, elevations, sections, details of components, details of penetration and termination, flashing details, joint locations and configurations, fastening and anchorage details including mechanical fasteners, and connections and attachments to other work.
- D. Samples for Initial Selection: For each type of finish-coat color and texture indicated.
 1. Include similar Samples of joint sealants[**and exposed accessories**] involving color selection.
- E. Samples for Verification: **24-inch-** (600-mm-) square panels for each type of finish-coat color and texture indicated, prepared using same tools and techniques intended for actual work including **[custom trim, each profile,] [an aesthetic reveal,]** a typical control joint filled with sealant of color selected.
 1. Include sealants[**and exposed accessory**] Samples to verify color selected.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.

- B. **Manufacturer Certificates:** Signed by manufacturers certifying that EIFS[**and joint sealants**] comply with requirements.
 - C. **Material or Product Certificates:** For[**cementitious materials and aggregates and for**] each insulation and joint sealant, from manufacturer.
 - D. **Product Test Reports:** Based on evaluation of comprehensive tests performed by a qualified testing agency, for each [**water-/weather-resistive barrier,**]insulation, reinforcing mesh,[**joint sealant,**] and coating.
 - E. **Compatibility and Adhesion Test Reports:** For joint sealants from sealant manufacturer indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
 - F. **Field quality-control reports[and special inspection reports].**
 - G. **Evaluation Reports:** For [**exterior cement-board sheathing**] [**fasteners**] [**water-resistive coating**] [**adhesive membrane flashing**] and EIFS (including insulation), from <**Insert applicable model code organization**>.
- 1.7 CLOSEOUT SUBMITTALS
- A. **Maintenance Data:** For EIFS to include in maintenance manuals.
- 1.8 CLOSEOUT SUBMITTALS
- A. **As-Built Plans:** Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".
- 1.9 QUALITY ASSURANCE
- A. **Installer Qualifications:** [**An installer who is certified in writing by EIFS manufacturer as qualified to install manufacturer's system using trained workers**] <**Insert requirements**>.
 - 1. A firm that has specialized in installation of types of EIFS required for project for not less than five (5) years and which is acceptable to manufacturer(s) of primary materials.
 - B. **Source Limitations:** Obtain EIFS from single source from single EIFS manufacturer and from sources approved by EIFS manufacturer as compatible with system components.

- C. Fire-Test-Response Characteristics: Provide EIFS and system components with the following fire-test-response characteristics as determined by testing identical EIFS and system components per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.
1. Fire-Resistance Characteristics: Provide materials and construction tested for fire resistance per ASTM E 119.
 2. Full-Scale Multistory Fire Test: Tested mockup, representative of completed multistory wall assembly of which EIFS is a part, complies with UBC Standard 26-4 for test method and required fire-test-response characteristics of exterior non-load-bearing wall panel assemblies containing foam-plastic insulation.
 3. Full-Scale Diversified Fire Test: Tested mockup, representative of completed multistory wall assembly of which EIFS is a part, showing no significant contribution to vertical or horizontal flame spread per ASTM E 108 modified for testing vertical walls.
 4. Intermediate-Scale Multistory Fire Test: Tested mockup, representative of completed multistory wall assembly of which EIFS is a part, complies with **[NFPA 285] [UBC Standard 26-9]** for test method and required fire-test-response characteristics of exterior non-load-bearing wall panel assemblies containing foam-plastic insulation.
 5. Radiant Heat Exposure: No ignition of EIFS when tested according to NFPA 268.
 6. Potential Heat: Acceptable level when tested according to NFPA 259.
 7. Surface-Burning Characteristics: Provide insulation board, adhesives, base coats, and finish coats with flame-spread index of 25 or less and smoke-developed index of 450 or less, per **[ASTM E 84] [UBC Standard 8-1] <Insert test method>**.
- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution and set quality standards for fabrication and installation.
1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.
- 1.10 DELIVERY, STORAGE, AND HANDLING
- A. Deliver materials in original, unopened packages with manufacturers' labels intact and clearly identifying products.
 - B. Store materials inside and under cover; keep them dry and protected from weather, direct sunlight, surface contamination, aging, corrosion, damaging temperatures, construction traffic, and other causes.
 1. Stack insulation board flat and off the ground.

2. Protect plastic insulation against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.11 PROJECT CONDITIONS

- A. Weather Limitations: Maintain ambient temperatures above **40 deg F (4.4 deg C)** for a minimum of 24 hours before, during, and after adhesives or coatings are applied. Do not apply EIFS adhesives or coatings during rainfall. Proceed with installation only when existing and forecasted weather conditions and ambient outdoor air, humidity, and substrate temperatures permit EIFS to be applied, dried, and cured according to manufacturers' written instructions and warranty requirements.

1.12 COORDINATION

- A. Coordinate installation of EIFS with related Work specified in other Sections to ensure that wall assemblies, including sheathing, weather-resistant sheathing paper, flashing, trim, joint sealants, windows, and doors, are protected against damage from the effects of weather, age, corrosion, moisture, and other causes. Do not allow water to penetrate behind flashing and drainage plane that is behind water-drainage EIFS.

1.13 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Acrocrete, Inc.
 2. Corev America, Inc.
 3. Dryvit Systems, Inc.
 4. El Rey Stucco Company, Inc.; a brand of ParexLahabra, Inc.
 5. Finestone; Degussa Wall Systems, Inc.
 6. Master Wall, Inc.
 7. Omega Products International, Inc.
 8. Parex, Inc.; a brand of ParexLahabra, Inc.
 9. Pleko LLC.
 10. Senergy; Degussa Wall Systems, Inc.

11. SonoWall; Degussa Wall Systems, Inc.
12. Sto Corp.
13. Stuc-O-Flex International, Inc.
14. TEC; an H. B. Fuller company.
15. Total Wall Inc.
16. **<Insert manufacturer's name>**.
17. or approved equal.

2.2 MATERIALS

- A. Compatibility: Provide water-resistive coating, adhesive, fasteners, board insulation, reinforcing meshes, base- and finish-coat systems, sealants, and accessories that are compatible with one another and with substrates and approved for use by EIFS manufacturer for Project.
- B. Exterior Cement Board: Not less than **[5/16-inch- (8-mm-)] [7/16-inch- (11-mm-)]** **<Insert dimension>** thick, fiber cement board complying with ASTM C 1186, Type A, for exterior applications.
 1. Fasteners: Wafer-head or flat-head steel drill screws complying with ASTM C 954, with an organic-polymer coating or other corrosion-protective coating having a salt-spray resistance of more than 500 hours per ASTM B 117.
 - a. Size and Length: **[As recommended by sheathing manufacturer for type and thickness of sheathing board to be attached] <Insert size and length>**.
- C. Water-Resistive Coatings: EIFS manufacturer's standard formulation and accessories for use as water/weather-resistive barriers, compatible with substrate, and complying with physical and performance criteria of **[ICC-ES AC209] [ICC-ES AC212]**.
 1. Sheathing Joint **[Tape] [Compound and Tape]**: Type recommended by EIFS manufacturer for sealing joints between and penetrations through sheathing.
 2. VOC Content of Coatings Used as Insulation Adhesive: 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Low-Emitting Coatings Used as Insulation Adhesive: Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Primer/Sealer: EIFS manufacturer's standard substrate conditioner **[with VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24),] [that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers,"]** designed to seal substrates from moisture penetration and to improve the bond between substrate of type indicated and adhesive used for application of insulation.

- E. Flexible-Membrane Flashing: Cold-applied, fully self-adhering, self-healing, rubberized-asphalt and polyethylene-film composite sheet or tape and primer; EIFS manufacturer's standard or product recommended in writing by EIFS manufacturer.
- F. Drainage Mat: [**Three-dimensional, nonwoven, entangled filament, nylon or plastic**] [**Woven or fused, self-furring, PVC mesh lath**] <Insert type> mat designed to drain incidental moisture by gravity; EIFS manufacturer's standard or product recommended in writing by EIFS manufacturer[**with manufacturer's standard corrosion-resistant mechanical fasteners suitable for intended substrate**].
- G. Spacers: [**Closed-cell polyethylene**] [**Woven or fused, self-furring, PVC mesh lath**] <Insert type> furring strips; EIFS manufacturer's standard or product recommended in writing by EIFS manufacturer[**with manufacturer's standard corrosion-resistant mechanical fasteners suitable for intended substrate**].
- H. Insulation Adhesive: EIFS manufacturer's standard formulation designed for indicated use; compatible with substrate;[**with VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24);**] [**that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers";**] and complying with[**one of**] the following:
1. Job-mixed formulation of Portland cement complying with ASTM C 150, Type I, and polymer-based adhesive specified for base coat.
 2. Factory-blended dry formulation of Portland cement, dry polymer admixture, and fillers specified for base coat.
 3. Factory-mixed noncementitious formulation designed for adhesive attachment of insulation to substrates of type indicated, as recommended by EIFS manufacturer.
- I. Molded, Rigid Cellular Polystyrene Board Insulation: Comply with ASTM C 578, Type I; EIFS manufacturer's requirements; and EIMA's "EIMA Guideline Specification for Expanded Polystyrene (EPS) Insulation Board" for most stringent requirements for material performance and qualities of insulation, including dimensions and permissible variations, and the following:
1. Aging: Before cutting and shipping, age insulation in block form by air drying for not less than six weeks or by another method approved by EIMA that produces equivalent results.
 2. Flame-Spread and Smoke-Developed Indexes: 25 and 450 or less, respectively, per ASTM E 84.
 3. Dimensions: Provide insulation boards not more than **24 by 48 inches** (610 by 1219 mm) and in thickness indicated but not more than **4 inches** (102 mm) thick or less than thickness allowed by ASTM C 1397.
 4. Channeled Board Insulation: EIFS manufacturer's standard factory-fabricated profile with linear, vertical drainage channels, slots, or waves on the back side of board.

5. Board Insulation Closure Blocks: EIFS manufacturer's standard density, size, and configuration.
 6. Foam Shapes: Provide with profiles and dimensions indicated on Drawings.
- J. Reinforcing Mesh: Balanced, alkali-resistant, open-weave, glass-fiber mesh treated for compatibility with other EIFS materials, made from continuous multiend strands with retained mesh tensile strength of not less than **120 lbf/in.** (21 dN/cm) per **[ASTM E 2098] [EIMA 105.01]**; complying with ASTM D 578 and the following:
1. Standard-Impact Reinforcing Mesh: Not less than **[4.0 oz./sq. yd. (136 g/sq. m)] <Insert weight>**.
 2. Intermediate-Impact Reinforcing Mesh: Not less than **[10 oz./sq. yd. (339 g/sq. m)] [12.0 oz./sq. yd. (407 g/sq. m)] <Insert weight>**.
 3. High-Impact Reinforcing Mesh: Not less than **[15 oz./sq. yd. (509 g/sq. m)] <Insert weight>**.
 4. Heavy-Duty Reinforcing Mesh: Not less than **[20 oz./sq. yd. (678 g/sq. m)] <Insert weight>**.
 5. Strip Reinforcing Mesh: Not less than **[3.75 oz./sq. yd. (127 g/sq. m)] <Insert weight>**.
 6. Detail Reinforcing Mesh: Not less than **[4.0 oz./sq. yd. (136 g/sq. m)] <Insert weight>**.
 7. Corner Reinforcing Mesh: Not less than **[7.2 oz./sq. yd. (244 g/sq. m)] <Insert weight>**.
- K. Base-Coat Materials: EIFS manufacturer's standard mixture complying with **[one of]** the following requirements:
1. Job-mixed formulation of Portland cement complying with ASTM C 150, Type I, white or natural color; and manufacturer's standard polymer-emulsion adhesive designed for use with Portland cement.
 2. Job-combined formulation of manufacturer's standard polymer-emulsion adhesive and manufacturer's standard dry mix containing Portland cement.
 3. Factory-blended dry formulation of Portland cement, dry polymer admixture, and inert fillers to which only water is added at Project site.
 4. Factory-mixed noncementitious formulation of polymer-emulsion adhesive and inert fillers that is ready to use without adding other materials.
- L. Waterproof Adhesive/Base-Coat Materials: EIFS manufacturer's standard waterproof formulation **[with VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24);] [that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers"]**; and complying with **[one of]** the following:
1. Job-mixed formulation of Portland cement complying with ASTM C 150, Type I, white or natural color; and manufacturer's standard polymer-emulsion adhesive designed for use with Portland cement.

2. Job-combined formulation of manufacturer's standard polymer-emulsion adhesive and manufacturer's standard dry mix containing Portland cement.
- M. Primer: EIFS manufacturer's standard factory-mixed, elastomeric-polymer primer for preparing base-coat surface for application of finish coat.
- N. Finish-Coat Materials: EIFS manufacturer's **[standard acrylic-based coating]** **[standard acrylic-based coating with enhanced mildew resistance]** **[siliconized acrylic-based coating]** **<Insert coating>** complying with the following:
1. Factory-mixed formulation of polymer-emulsion binder, colorfast mineral pigments, sound stone particles, and fillers.
 2. Factory-mixed formulation of polymer-emulsion binder, colorfast mineral pigments, and fillers used with stone particles for embedding in finish coat to produce an applied-aggregate finish.
 - a. Aggregate: Marble chips of size and color **[as indicated by manufacturer's designations]** **[to match DEN Project Manager's samples]** **[as selected by DEN Project Manager from manufacturer's full range]**.
 3. Sealer: Manufacturer's waterproof, clear acrylic-based sealer for protecting finish coat.
 4. Colors: **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's samples]** **[As selected by DEN Project Manager from manufacturer's full range]**.
- O. Water: Potable.
- P. Mechanical Fasteners: EIFS manufacturer's standard corrosion-resistant fasteners consisting of thermal cap, standard washer and shaft attachments, and fastener indicated below; selected for properties of pullout, tensile, and shear strength required to resist design loads of application indicated; capable of pulling fastener head below surface of insulation board; and of the following description:
1. For attachment to steel studs from **0.033 to 0.112 inch** (0.84 to 2.84 mm) in thickness, provide steel drill screws complying with ASTM C 954.
 2. For attachment to light-gage steel framing members not less than **0.0179 inch** (0.45 mm) in thickness, provide steel drill screws complying with ASTM C 1002.
 3. For attachment to wood framing members and plywood sheathing, provide steel drill screws complying with ASTM C 1002, Type W.
 4. For attachment to masonry and concrete substrates, provide sheathing dowel in form of a plastic wing-tipped fastener with thermal cap, sized to fit insulation thickness indicated and to penetrate substrate to depth required to secure anchorage.
 5. For attachment, provide manufacturer's standard fasteners suitable for substrate.
 6. **<Insert fastener requirements>**.
- Q. Trim Accessories: Type as designated or required to suit conditions indicated and to comply with EIFS manufacturer's written instructions; manufactured from UV-stabilized

PVC; and complying with ASTM D 1784, manufacturer's standard Cell Class for use intended, and ASTM C 1063.

1. Casing Bead: Prefabricated, one-piece type for attachment behind insulation, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg.
2. Drip Screed/Track: Prefabricated, one-piece type for attachment behind insulation with face leg extended to form a drip, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg.
3. Weep Screed/Track: Prefabricated, one-piece type for attachment behind insulation with perforated face leg[**extended to form a drip**] and weep holes in track bottom, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg; designed to drain incidental moisture that gets into wall construction to the exterior at terminations of EIFS with drainage.
4. Expansion Joint: Prefabricated, one-piece V profile; designed to relieve stress of movement.
5. Window Sill Flashing: Prefabricated type for both flashing and sloping sill over framing beneath windows; with end and back dams; designed to direct water to exterior.
6. Parapet Cap Flashing: Type for both flashing and covering parapet top[**with design complying with ASTM C 1397**].
7. **<Insert trim and requirements>**.

2.3 ELASTOMERIC SEALANTS

- A. Elastomeric Sealant Products: Provide EIFS manufacturer's listed and recommended chemically curing, elastomeric sealant that is compatible with joint fillers, joint substrates, and other related materials, and complies with requirements for products and testing indicated in ASTM C 1481 and with requirements in Section 079200 "Joint Sealants" for products corresponding to description indicated below:
1. Multicomponent, nonsag urethane sealant.
 2. Single-component, nonsag, neutral-curing silicone sealant.
 3. **<Insert sealant>**.
 4. Sealants used inside the weatherproofing system shall have a VOC content of **[250] <Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 5. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Preformed Foam Sealant Products: Provide sealant compatible with adjacent materials and complying with requirements in Section 079200 "Joint Sealants."

- C. Sealant Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range].**

2.4 MIXING

- A. General: Comply with EIFS manufacturer's requirements for combining and mixing materials. Do not introduce admixtures, water, or other materials except as recommended by EIFS manufacturer. Mix materials in clean containers. Use materials within time period specified by EIFS manufacturer or discard.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of EIFS.
- B. Examine roof edges, wall framing, flashings, openings, substrates, and junctures at other construction for suitable conditions where EIFS will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Begin coating application only after surfaces are dry.
 - 2. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Protect contiguous work from moisture deterioration and soiling caused by application of EIFS. Provide temporary covering and other protection needed to prevent spattering of exterior finish coats on other work.
- B. Protect EIFS, substrates, and wall construction behind them from inclement weather during installation. Prevent penetration of moisture behind drainage plane of EIFS and deterioration of substrates.
- C. Prepare and clean substrates to comply with EIFS manufacturer's written instructions to obtain optimum bond between substrate and adhesive for insulation.

3.3 EXTERIOR CEMENT-BOARD INSTALLATION

- A. Exterior Cement Board: Install on metal framing to comply with cement-board manufacturer's written instructions and evaluation report acceptable to authorities having jurisdiction. Install board with steel drill screws spaced no more than **[8 inches**

(203 mm)] <Insert spacing> o.c. along framing with perimeter fasteners at least **3/8 inch** (9.6 mm) but less than **5/8 inch** (15.9 mm) from edges of boards.

3.4 EIFS INSTALLATION, GENERAL

- A. Comply with EIFS manufacturer's written instructions for installation of EIFS as applicable to each type of substrate indicated.
- B. Install EIFS system as per approved shop drawings and in strict compliance with manufacturer's details approved for type of system, including type of products, and sequence and methods of installation.
 - 1. Contractor to maintain drawings of all applicable details at the Project site at all times for reference by workers.

3.5 SUBSTRATE PROTECTION APPLICATION

- A. Primer/Sealer: Apply over [**gypsum sheathing**] <Insert substrate> substrates to protect substrates from degradation and where required by EIFS manufacturer for improving adhesion of insulation to substrate.
- B. Water-Resistive Coatings: Apply over substrates to protect substrates from degradation and to provide water-/weather-resistive barrier.
 - 1. Tape and seal joints, exposed edges, terminations, and inside and outside corners of sheathing unless otherwise indicated by EIFS manufacturer's written instructions.
- C. Waterproof Adhesive/Base Coat: Apply over [**sloped surfaces**] [**window sills**] [**parapets**] [**where indicated on Drawings**] <Insert locations> to protect substrates from degradation.
- D. Flexible-Membrane Flashing: Install over weather-resistive barrier, applied and lapped to shed water; seal at openings, penetrations, terminations, and where indicated by EIFS manufacturer's written instructions to protect wall assembly from degradation. Prime substrates, if required, and install flashing to comply with EIFS manufacturer's written instructions and details.

3.6 TRIM INSTALLATION

- A. Trim: Apply trim accessories at perimeter of EIFS, at expansion joints, [**at window sills,**] and elsewhere as indicated, according to EIFS manufacturer's written instructions. Coordinate with installation of insulation.
 - 1. Weep Screed/Track: Use at bottom termination edges, at window and door heads[, **and at floor line expansion joints**] of water-drainage EIFS unless otherwise indicated.

2. Window Sill Flashing: Use at windows unless otherwise indicated.
3. Expansion Joint: Use where indicated on Drawings.
4. Casing Bead: Use at other locations.
5. Parapet Cap Flashing: Use where indicated on Drawings.
6. <Insert trim and requirements>.

3.7 DRAINAGE MAT INSTALLATION

- A. Drainage Mat: Apply wrinkle free, continuously, with edges [**butted**] [**overlapped**] and [**adhesively secured**] [**mechanically secured with fasteners**] over water-/weather-resistive barrier according to manufacturer's written instructions.

3.8 INSULATION INSTALLATION

- A. Board Insulation: [**Adhesively**] [**Mechanically**] [**Adhesively and mechanically**] attach insulation to substrate in compliance with ASTM C 1397, EIFS manufacturer's written instructions, and the following:
 1. Apply adhesive to insulation by notched-trowel method in a manner that results in coating the entire surface of sheathing with adhesive once insulation is adhered to sheathing unless EIFS manufacturer's written instructions specify using primer/sealer with ribbon-and-dab method. Apply adhesive to a thickness of not less than **1/4 inch** (6.4 mm) for factory mixed and not less than **3/8 inch** (9.6 mm) for field mixed, measured from surface of insulation before placement.
 2. Apply adhesive to insulation by notched-trowel method in a manner that results in coating the entire surface of drainage mat with adhesive once insulation is adhered to drainage mat.
 3. Apply adhesive to ridges on back of insulation by notched-trowel method in a manner that results in full adhesive contact over the entire surface of ridges, leaving channels free of adhesive once insulation is adhered to substrate.
 4. Press and slide insulation into place. Apply pressure over the entire surface of insulation to accomplish uniform contact, high initial grab, and overall level surface.
 5. Allow adhered insulation to remain undisturbed for period recommended by EIFS manufacturer, but not less than 24 hours, before [**installing mechanical fasteners,**] beginning rasping and sanding insulation, or applying base coat and reinforcing mesh.
 6. Mechanically attach insulation to substrate by method complying with EIFS manufacturer's written instructions. Install top surface of fastener heads flush with plane of insulation. Install fasteners into or through substrates with the following minimum penetration:
 - a. Steel Framing: **5/16 inch** (8 mm).
 - b. Wood Framing: **1 inch** (25 mm).
 - c. Concrete and Masonry: **1 inch** (25 mm).
 7. Apply insulation over drainage mat and dry substrates in courses with long edges of boards oriented horizontally.

8. Begin first course of insulation from a level base line and work upward.
9. Begin first course of insulation from screed/track and work upward. Work from perimeter casing beads toward interior of panels if possible.
10. Stagger vertical joints of insulation boards in successive courses to produce running bond pattern. Locate joints so no piece of insulation is less than **12 inches** (300 mm) wide or **6 inches** (150 mm) high. Offset joints not less than **6 inches** (150 mm) from corners of window and door openings[**and not less than 4 inches** (100 mm) **from aesthetic reveals**].
 - a. Adhesive Attachment: Offset joints of insulation not less than **6 inches** (150 mm) from horizontal and **4 inches** (100 mm) from vertical joints in sheathing.
 - b. Mechanical Attachment: Offset joints of insulation from horizontal joints in sheathing.
11. Place insulation with adhesive strips and channels, slots, or waves aligned in the vertical position for drainage.[**Align drainage channels, slots, or waves with channels, slots, or waves in insulation boards above and below.**]
12. Interlock ends at internal and external corners.
13. Abut insulation tightly at joints within and between each course to produce flush, continuously even surfaces without gaps or raised edges between boards. If gaps greater than **1/16 inch** (1.6 mm) occur, fill with insulation cut to fit gaps exactly; insert insulation without using adhesive or other material.
14. Cut insulation to fit openings, corners, and projections precisely and to produce edges and shapes complying with details indicated.
15. Rasp or sand flush entire surface of insulation to remove irregularities projecting more than [**1/32 inch** (0.8 mm)] [**1/16 inch** (1.6 mm)] from surface of insulation and to remove yellowed areas due to sun exposure; do not create depressions deeper than **1/16 inch** (1.6 mm).
16. Cut aesthetic reveals in outside face of insulation with high-speed router and bit configured to produce grooves, rabbets, and other features that comply with profiles and locations indicated. Do not reduce insulation thickness at aesthetic reveals to less than **3/4 inch** (19 mm).
17. Install foam shapes and attach to [**sheathing**] [**structure**].
18. Interrupt insulation for expansion joints where indicated.
19. Install insulation closure blocks using ribbon-and-dab method to create air zones where indicated.
20. Form joints for sealant application by leaving gaps between adjoining insulation edges and between insulation edges and dissimilar adjoining surfaces. Make gaps wide enough to produce joint widths indicated after encapsulating joint substrates with base coat and reinforcing mesh.
21. Form joints for sealant application with back-to-back casing beads for joints within EIFS and with perimeter casing beads at dissimilar adjoining surfaces. Make gaps between casing beads and between perimeter casing beads and adjoining surfaces of width indicated.
22. After installing insulation and before applying field-applied reinforcing mesh, fully wrap board edges. Cover edges of board and extend encapsulating mesh not less than **2-1/2 inches** (64 mm) over front and back face unless otherwise indicated on Drawings.
23. Treat exposed edges of insulation as follows:

- a. Except for edges forming substrates of sealant joints, encapsulate with base coat, reinforcing mesh, and finish coat.
 - b. Encapsulate edges forming substrates of sealant joints within EIFS or between EIFS and other work with base coat and reinforcing mesh.
 - c. At edges trimmed by accessories, extend base coat, reinforcing mesh, and finish coat over face leg of accessories.
24. Coordinate installation of flashing and insulation to produce wall assembly that does not allow water to penetrate behind flashing and water-/weather-resistive barrier.
- B. Expansion Joints: Install at locations indicated, where required by EIFS manufacturer, and as follows:
1. At expansion joints in substrates behind EIFS.
 2. Where EIFS adjoin dissimilar substrates, materials, and construction, including other EIFS.
 3. At floor lines in multilevel wood-framed construction.
 4. Where wall height or building shape changes.
 5. Where EIFS manufacturer requires joints in long continuous elevations.
 6. **<Insert location>**.

3.9 BASE-COAT INSTALLATION

- A. Base Coat: Apply to exposed surfaces of insulation [**and foam shapes**] in minimum thickness recommended in writing by EIFS manufacturer, but not less than [**1/16-inch (1.6-mm)**] **<Insert dimension>** dry-coat thickness.
- B. Reinforcing Mesh: Embed type indicated below in wet base coat to produce wrinkle-free installation with mesh continuous at corners and overlapped not less than **2-1/2 inches (64 mm)** or otherwise treated at joints to comply with ASTM C 1397 and EIFS manufacturer's written instructions. Do not lap reinforcing mesh within **8 inches (204 mm)** of corners. Completely embed mesh, applying additional base-coat material if necessary, so reinforcing-mesh color and pattern are not visible.
1. Standard-impact reinforcing mesh [**unless otherwise indicated**] **<Insert location>**.
 2. Intermediate-impact reinforcing mesh [**where indicated**] **<Insert location>**.
 3. High-impact reinforcing mesh [**where indicated**] **<Insert location>**.
 4. Heavy-duty reinforcing mesh [**where indicated**] **<Insert location>**.
- C. Double-Layer Reinforcing Mesh Application: Where indicated, apply second base coat and second layer of [**standard**] [**intermediate**]-impact reinforcing mesh, overlapped not less than **2-1/2 inches (64 mm)** or otherwise treated at joints to comply with ASTM C 1397 and EIFS manufacturer's written instructions in same manner as first application. Do not apply until first base coat has cured.
- D. Additional Reinforcing Mesh: Apply strip reinforcing mesh around openings extending **4 inches (100 mm)** beyond perimeter. Apply additional **9-by-12-inch (230-by-300-mm)**

strip reinforcing mesh diagonally at corners of openings (re-entrant corners). Apply **8-inch-** (200-mm-) wide strip reinforcing mesh at both inside and outside corners unless base layer of mesh is lapped not less than **4 inches** (100 mm) on each side of corners.

1. At aesthetic reveals, apply strip reinforcing mesh not less than **8 inches** (200 mm) wide.
2. Embed strip reinforcing mesh in base coat before applying first layer of reinforcing mesh.

E. Foam Shapes: Fully embed reinforcing mesh in base coat.

F. Double Base-Coat Application: Where indicated, apply second base coat in same manner and thickness as first application except without reinforcing mesh. Do not apply until first base coat has cured.

3.10 FINISH-COAT INSTALLATION

A. Primer: Apply over dry base coat according to EIFS manufacturer's written instructions.

B. Finish Coat: Apply over dry **[primed]** base coat, maintaining a wet edge at all times for uniform appearance, in thickness required by EIFS manufacturer to produce a uniform finish of color and texture matching approved sample and free of cold joints, shadow lines, and texture variations.

1. Texture: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range]**.
2. Embed aggregate in finish coat according to EIFS manufacturer's written instructions to produce a uniform applied-aggregate finish of color and texture matching approved sample.

C. Sealer Coat: Apply over dry finish coat, in number of coats and thickness required by EIFS manufacturer.

3.11 INSTALLATION OF JOINT SEALANTS

A. Prepare joints and apply sealants, of type and at locations indicated, to comply with applicable requirements in Section 079200 "Joint Sealants" and in ASTM C 1481.

1. Apply joint sealants after base coat has cured but before applying finish coat.
2. Clean surfaces to receive sealants to comply with indicated requirements and EIFS manufacturer's written instructions.
3. Apply primer recommended in writing by sealant manufacturer for surfaces to be sealed.
4. Install sealant backing to control depth and configuration of sealant joint and to prevent sealant from adhering to back of joint.
5. Apply masking tape to protect areas adjacent to sealant joints. Remove tape immediately after tooling joints, without disturbing joint seal.

6. Recess sealant sufficiently from surface of EIFS so an additional sealant application, including cylindrical sealant backing, can be installed without protruding beyond EIFS surface.

3.12 FIELD QUALITY CONTROL

- A. Special Inspections: **Owner will engage** a qualified special inspector to perform the following special inspections:
 1. According to **[ICC-ES AC24] [ICC-ES AC235]**.
 2. **<Insert special inspections>**.
- B. Testing Agency: **Owner will engage** a qualified testing agency to perform tests and inspections.
- C. EIFS Tests and Inspections: For the following:
 1. According to **[ICC-ES AC24] [ICC-ES AC235]**.
 2. **<Insert testing requirements of authorities having jurisdiction>**.
- D. Remove and replace EIFS where test results indicate that EIFS do not comply with specified requirements.
- E. Prepare test and inspection reports.

3.13 CLEANING AND PROTECTION

- A. Remove temporary covering and protection of other work. Promptly remove coating materials from window and doorframes and other surfaces outside areas indicated to receive EIFS coatings.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 072419

SECTION 072500 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1.
2. Building wrap.
3. Flexible flashing.

- B. Related Requirements:

1. Section 061600 "Sheathing" for sheathing joint and penetration treatment.
2. Section 072713 "Modified Bituminous Sheet Air Barriers" for sheet air barrier applied over wall sheathing.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.
2. Include data substantiating that materials comply with specified requirements.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For [**water-resistive barrier**] [**and**] [**flexible flashing**], from ICC-ES.

1.5 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300

"Submittal Procedures".

1.6 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 WATER-RESISTIVE BARRIER

- A. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); Styrofoam Weathermate Plus Brand Housewrap.
 - b. DuPont (E. I. du Pont de Nemours and Company); Tyvek **[CommercialWrap] [StuccoWrap] [HomeWrap] [HomeWrap and HeaderWrap]**.
 - c. Ludlow Coated Products; **[Air Stop Housewrap] [Barricade Building Wrap] [EnergyWrap Housewrap] [R-Wrap Protective House Wrap]**.
 - d. Pactiv, Inc.; GreenGuard **[Classic Wrap] [RainDrop] [Ultra Wrap] [Value Wrap]**.
 - e. Raven Industries Inc.; Fortress Pro Weather Protective Barrier.
 - f. Reemay, Inc.; Typar HouseWrap.
 - g. **<Insert manufacturer's name; product name or designation>**.
 - h. or approved equal.
 2. Water-Vapor Permeance: Not less than **[500] [150] [125] [50] <Insert number> g** through 1 sq. m of surface in 24 hours per ASTM E 96/E 96M, Desiccant Method (Procedure A).
 3. Air Permeance: Not more than **0.004 cfm/sq. ft. at 0.3-inch wg** (0.02 L/s x sq. m at 75 Pa) when tested according to ASTM E 2178.
 4. Allowable UV Exposure Time: Not less than three months.
- B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.2 MISCELLANEOUS MATERIALS

- A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, **[butyl rubber] [or] [rubberized-asphalt]** compound, bonded to a high-density

polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than **[0.025 inch (0.6 mm)] [0.030 inch (0.8 mm)] [0.040 inch (1.0 mm)]**.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. DuPont (E. I. du Pont de Nemours and Company); DuPont Flashing Tape.
 - b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Vycor Butyl Self Adhered Flashing.
 - c. Protecto Wrap Company; BT-25 XL.
 - d. Raven Industries Inc.; Fortress Flashshield.
 - e. Advanced Building Products Inc.; Wind-o-wrap.
 - f. Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
 - g. Fiberweb, Clark Hammerbeam Corp.; Aquaflash 500.
 - h. Fortifiber Building Systems Group; **[Fortiflash 25] [Fortiflash 40]**.
 - i. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; **[Vycor Plus Self-Adhered Flashing] [Vycor V40 Self-Adhered Flashing]**.
 - j. MFM Building Products Corp.; Window Wrap.
 - k. Polyguard Products, Inc.; **[Polyguard JT-20 Tape] [Polyguard JT-30 Tape]**.
 - l. Sandell Manufacturing Co., Inc.; Presto-Seal.
 - m. **<Insert manufacturer's name; product name or designation>**.
 - n. or approved equal.
- B. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.
- C. Nails and Staples: ASTM F 1667.

PART 3 - EXECUTION

3.1 WATER-RESISTIVE BARRIER INSTALLATION

- A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.
- B. Cover sheathing with water-resistive barrier as follows:
 1. Cut back barrier **1/2 inch (13 mm)** on each side of the break in supporting members at expansion- or control-joint locations.
 2. Apply barrier to cover vertical flashing with a minimum **4-inch (100-mm)** overlap unless otherwise indicated.
- C. Building Wrap: Comply with manufacturer's written instructions.
 1. Seal seams, edges, fasteners, and penetrations with tape.
 2. Extend into jambs of openings and seal corners with tape.

3.2 FLEXIBLE FLASHING INSTALLATION

- A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
 - 1. Prime substrates as recommended by flashing manufacturer.
 - 2. Lap seams and junctures with other materials at least **4 inches** (100 mm) except that at flashing flanges of other construction, laps need not exceed flange width.
 - 3. Lap flashing over water-resistive barrier at bottom and sides of openings.
 - 4. Lap water-resistive barrier over flashing at heads of openings.
 - 5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 072500

SECTION 072713 - MODIFIED BITUMINOUS SHEET AIR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes self-adhering, vapor-retarding, modified bituminous sheet air barriers.
- B. Related Requirements:
 - 1. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.
 - 2. Section 072500 "Weather Barriers" for weather barriers, including [**building paper**] [**flexible flashing**] [**and**] [**building wraps with air-barrier properties**].
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 DEFINITIONS

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at [**Project site**] [**location and time as determined by DEN Project Manager**]<Insert location>.
 - 1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.
 - 2. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.2: For air-barrier products, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit IEQ 4: For air barriers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For air-barrier assemblies.
 - 1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
 - 2. Include details of interfaces with other materials that form part of air barrier.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer. [**Include list of ABAA-certified installers and supervisors employed by the Installer, who work on Project.**]
- B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with air barrier.
- C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

1.7 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. A firm that has specialized in installation of types of products required for Project for not less than five (5) years and which is acceptable to manufacturer(s) of primary materials.
 2. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.
- B. Mockups: Build mockups to set quality standards for materials and execution[**and for preconstruction testing**].
1. Build integrated mockups of exterior wall assembly [**as shown on Drawings**] [, **150 sq. ft. (14 sq. m)**] **<Insert requirement>**, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
 - a. Coordinate construction of mockups to permit inspection by Owner's testing agency of air barrier before external insulation and cladding are installed.
 - b. Include junction with roofing membrane[, **building corner condition,**] [**and foundation wall intersection**].
 - c. If DEN Project Manager determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on field mockups.
- B. Mockup Testing: Air-barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.
1. Qualitative Air-Leakage Testing: Mockups will be tested for evidence of air leakage according to [**ASTM E 1186, chamber pressurization or depressurization with smoke tracers**] [**ASTM E 1186, chamber depressurization with detection liquids**] **<Insert requirement>**.
 2. Quantitative Air-Leakage Testing: Mockups will be tested for air leakage according to [**ASTM E 783**] **<Insert test>**.
 3. Adhesion Testing: Mockups will be tested for minimum air-barrier adhesion of [**16 lbf/sq. in. (110 kPa)**] **<Insert value>** according to ASTM D 4541.
 4. Notify DEN Project Manager [**seven**] **<Insert number>** days in advance of the dates and times when mockups will be tested.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

1.11 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.
 - 1. Protect substrates from environmental conditions that affect air-barrier performance.
 - 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.
- B. VOC Content: [250] <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and complying with VOC content limits of authorities having jurisdiction.
- C. Low-Emitting Materials: Air barriers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 PERFORMANCE REQUIREMENTS

- A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier[**and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration**]. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations[, **tie-ins to installed**

waterproofing], and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

- B. Air-Barrier Assembly Air Leakage: Maximum **[0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa)]** <Insert value>, when tested according to **[ASTM E 283] [ASTM E 783] [or] [ASTM E 2357]** <Insert test>.

2.3 SELF-ADHERING SHEET AIR BARRIER

- A. Modified Bituminous Sheet: **40-mil-** (1.0-mm-) thick, self-adhering sheet consisting of **36 mils** (0.9 mm) of rubberized asphalt laminated to a **4-mil-** (0.1-mm-) thick, cross-laminated polyethylene film with release liner on adhesive side[**and formulated for application with primer that complies with VOC limits of authorities having jurisdiction**].

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Carlisle Coatings & Waterproofing Inc.; CCW-705.
- b. Grace, W. R. & Co. - Conn.; Perm-A-Barrier Wall Membrane.
- c. Henry Company; **[Blueskin SA] [or] [Blueskin SA LT]**.
- d. Meadows, W. R., Inc.; SealTight Air-Shield.
- e. Tremco Incorporated, an RPM company; ExoAir 110/110LT.
- f. **<Insert manufacturer's name; product name or designation>**.
- g. or approved equal.

2. Physical and Performance Properties:

- a. Air Permeance: Maximum **[0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa)]** <Insert value> pressure difference; ASTM E 2178.
- b. Tensile Strength: Minimum **[250 psi (1.7 MPa)]** <Insert value>; ASTM D 412, Die C.
- c. Ultimate Elongation: Minimum **[200]** <Insert number> percent; ASTM D 412, Die C.
- d. Puncture Resistance: Minimum **[40 lbf (180 N)]** <Insert value>; ASTM E 154.
- e. Water Absorption: Maximum **[0.15]** <Insert number> percent weight gain after 48-hour immersion at **70 deg F** (21 deg C); ASTM D 570.
- f. Vapor Permeance: Maximum **[0.05 perm (2.9 ng/Pa x s x sq. m)]** <Insert value>; ASTM E 96/E 96M, Water Method.

2.4 ACCESSORY MATERIALS

- A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier membrane.
- B. Primer: Liquid **[waterborne] [solvent-borne]** primer recommended for substrate by air-barrier material manufacturer.

- C. Counterflashing Strip: Modified bituminous **40-mil-** (1.0-mm-) thick, self-adhering sheet consisting of **32 mils** (0.8 mm) of rubberized asphalt laminated to an **8-mil-** (0.2-mm-) thick, cross-laminated polyethylene film with release liner backing.
- D. Butyl Strip: Vapor retarding, **30 to 40 mils** (0.76 to 1.0 mm) thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive, with release liner backing.
- E. Modified Bituminous Strip: Vapor retarding, **40 mils** (1.0 mm) thick, smooth surfaced, self-adhering; consisting of **36 mils** (0.9 mm) of rubberized asphalt laminated to a **4-mil-** (0.1-mm-) thick, cross-laminated polyethylene film with release liner backing.
- F. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.
- G. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.
- H. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.
- I. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, [**0.0187 inch** (0.5 mm)] [**0.0250 inch** (0.64 mm)] **<Insert dimension>** thick, and Series 300 stainless-steel fasteners.
- J. Sprayed Polyurethane Foam Sealant: One- or two-component, foamed-in-place, polyurethane foam sealant, **1.5- to 2.0-lb/cu. ft.** (24- to 32-kg/cu. m) density; flame-spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.
- K. Modified Bituminous Transition Strip: Vapor retarding, **40 mils** (1.0 mm) thick, smooth surfaced, self-adhering; consisting of **36 mils** (0.9 mm) of rubberized asphalt laminated to a **4-mil-** (0.1-mm-) thick polyethylene film with release liner backing.
- L. Elastomeric Flashing Sheet: ASTM D 2000, minimum **50- to 65-mil-** (1.3- to 1.6-mm-) thick, cured sheet neoprene with manufacturer-recommended contact adhesives and lap sealant with [**stainless-steel termination bars and fasteners**] [**aluminum termination bars and stainless-steel fasteners**] [**galvanized-steel termination bars and fasteners**].
- M. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 123 Silicone Seal.
 - b. Momentive Performance Materials Inc.; US11000 UltraSpan.
 - c. Pecora Corporation; Sil-Span.
 - d. Tremco Incorporated, an RPM company; Spectrem Simple Seal.
 - e. **<Insert manufacturer's name; product name or designation>**.

f. or approved equal.

- N. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 2. Verify that concrete has cured and aged for minimum time period recommended by air-barrier manufacturer.
 3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
1. Install modified bituminous strips and center over treated construction and contraction joints and cracks exceeding a width of **1/16 inch** (1.6 mm).
- G. Bridge and cover **[isolation joints] [expansion joints] [and]** discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with overlapping modified bituminous strips.

- H. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- I. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 INSTALLATION

- A. General: Install modified bituminous sheets and accessory materials according to air-barrier manufacturer's written instructions and according to recommendations in ASTM D 6135.
 - 1. When ambient and substrate temperatures range between 25 and 40 deg F (minus 4 and plus 5 deg C), install self-adhering, modified bituminous air-barrier sheet produced for low-temperature application. Do not install low-temperature sheet if ambient or substrate temperature is higher than 60 deg F (16 deg C).
- B. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
 - 1. Install modified bituminous strips centered over vertical inside corners. Install 3/4-inch (19-mm) fillets of termination mastic on horizontal inside corners.
- C. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations with termination mastic and according to ASTM D 6135.
- D. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Reprime areas exposed for more than 24 hours.
 - 1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- E. Apply and firmly adhere modified bituminous sheets horizontally over area to receive air barrier. Accurately align sheets and maintain uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure airtight installation.
 - 1. Apply sheets in a shingled manner to shed water without interception by any exposed sheet edges.
 - 2. Roll sheets firmly to enhance adhesion to substrate.
- F. Apply continuous modified bituminous sheets over modified bituminous strips bridging substrate cracks, construction, and contraction joints.
- G. CMU: Install air-barrier sheet horizontally against the CMU beginning at base of wall. Align top edge of air-barrier sheet immediately below protruding masonry ties or joint reinforcement or ties, and firmly adhere in place.

1. Overlap horizontally adjacent sheets a minimum of **2 inches** (50 mm) and roll seams.
 2. Apply overlapping sheets with bottom edge slit to fit around masonry reinforcing or ties. Roll firmly into place.
 3. Seal around masonry reinforcing or ties and penetrations with termination mastic.
 4. Continue the membrane into all openings in the wall, such as doors and windows, and terminate at points to maintain an airtight barrier that is not visible from interior.
- H. Seal top of through-wall flashings to air-barrier sheet with an additional **6-inch-** (150-mm-) wide, [**modified bituminous**] [**counterflashing**] strip.
- I. Seal exposed edges of sheet at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- J. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.
1. Coordinate air-barrier installation with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 2. Install [**butyl**] [**modified bituminous**] strip on roofing membrane or base flashing so that a minimum of **3 inches** (75 mm) of coverage is achieved over each substrate.
- K. Connect and seal exterior wall air-barrier membrane continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- L. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply [**modified bituminous transition strip**] [**elastomeric flashing sheet**] [**preformed silicone-sealant extrusion**] so that a minimum of **3 inches** (75 mm) of coverage is achieved over each substrate. Maintain **3 inches** (75 mm) of full contact over firm bearing to perimeter frames with not less than **1 inch** (25 mm) of full contact.
1. Modified Bituminous Transition Strip: Roll firmly to enhance adhesion.
 2. Elastomeric Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at **6 inches** (150 mm) o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.
 3. Preformed Silicone-Sealant Extrusion: Set in full bed of silicone sealant applied to walls, frame, and membrane.
- M. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of air-barrier membrane with foam sealant.
- N. At end of each working day, seal top edge of air-barrier material to substrate with termination mastic.

- O. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- P. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending **6 inches** (150 mm) beyond repaired areas in all directions.
- Q. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.
- R. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. [**Inspections may include the following:**]
 - 1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
 - 2. Continuous structural support of air-barrier system has been provided.
 - 3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
 - 4. Site conditions for application temperature and dryness of substrates have been maintained.
 - 5. Maximum exposure time of materials to UV deterioration has not been exceeded.
 - 6. Surfaces have been primed.
 - 7. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
 - 8. Termination mastic has been applied on cut edges.
 - 9. Air barrier has been firmly adhered to substrate.
 - 10. Compatible materials have been used.
 - 11. Transitions at changes in direction and structural support at gaps have been provided.
 - 12. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
 - 13. All penetrations have been sealed.
- C. Tests: As determined by Owner's testing agency from among the following tests:
 - 1. Qualitative Air-Leakage Testing: Air-barrier assemblies will be tested for evidence of air leakage according to [**ASTM E 1186, smoke pencil with**

pressurization or depressurization] [ASTM E 1186, chamber pressurization or depressurization with smoke tracers] [ASTM E 1186, chamber depressurization using detection liquids].

2. Quantitative Air-Leakage Testing: Air-barrier assemblies will be tested for air leakage according to **[ASTM E 783] <Insert test>**.
3. Adhesion Testing: Air-barrier assemblies will be tested for minimum air-barrier adhesion of **[16 lbf/sq. in. (110 kPa)] <Insert value>** according to ASTM D 4541 for each **[600 sq. ft. (56 sq. m)] <Insert value>** of installed air barrier or part thereof.

- D. Air barriers will be considered defective if they do not pass tests and inspections.
1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
 2. Remove and replace deficient air-barrier components for retesting as specified above.
- E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.5 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than **[30] <Insert number>** days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
 2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed Work, using cleaning agents and procedures recommended by manufacturer of affected construction.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 072713

SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes fluid-applied, [**vapor-retarding**] [**and**] [**vapor-permeable**] membrane air barriers.
- B. Related Requirements:
 - 1. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.
 - 2. Section 072500 "Weather Barriers" for weather barriers, including [**building paper**] [**flexible flashing**] [**and**] [**building wraps with air-barrier properties**].
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 DEFINITIONS

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at [**Project site**] [**location and time as determined by DEN Project Manager**]<Insert location>.
 - 1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.
 - 2. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.2: For air-barrier products, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit IEQ 4: For air barriers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For air-barrier assemblies.
 - 1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
 - 2. Include details of interfaces with other materials that form part of air barrier.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer. [**Include list of ABAA-certified installers and supervisors employed by the Installer, who work on Project.**]
- B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.
- C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

1.7 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. A firm that has specialized in installation of types of products required for Project for not less than five (5) years and which is acceptable to manufacturer(s) of primary materials.
 2. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.
- B. Mockups: Build mockups to set quality standards for materials and execution[**and for preconstruction testing**].
1. Build integrated mockups of exterior wall assembly [**as shown on Drawings**] [, **150 sq. ft. (14 sq. m)**] **<Insert area or dimensions>**, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
 - a. Coordinate construction of mockups to permit inspection by Owner's testing agency of air barrier before external insulation and cladding are installed.
 - b. Include junction with roofing membrane[, **building corner condition,**] [**and foundation wall intersection**].
 - c. If DEN Project Manager determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on field mockups.
- B. Mockup Testing: Air-barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.
 1. Qualitative Air-Leakage Testing: Mockups will be tested for evidence of air leakage according to [**ASTM E 1186, chamber pressurization or depressurization with smoke tracers**] [**ASTM E 1186, chamber depressurization with detection liquids**] **<Insert requirement>**.
 2. Quantitative Air-Leakage Testing: Mockups will be tested for air leakage according to [**ASTM E 783**] **<Insert test>**.
 3. Adhesion Testing: Mockups will be tested for minimum air-barrier adhesion of [**30 lbf/sq. in. (207 kPa)**] **<Insert value>** according to ASTM D 4541.

4. Notify DEN Project Manager [**seven**] <Insert number> days in advance of the dates and times when mockups will be tested.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

1.11 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.
 1. Protect substrates from environmental conditions that affect air-barrier performance.
 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.
- B. VOC Content: [**250**] <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and complying with VOC content limits of authorities having jurisdiction.
- C. Low-Emitting Materials: Air barriers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 PERFORMANCE REQUIREMENTS

- A. General: Air barrier shall be capable of performing as a continuous vapor-[retarding] [permeable] air barrier[and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration]. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations[, tie-ins to installed waterproofing], and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air-Barrier Assembly Air Leakage: Maximum **[0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa)] <Insert value>**, when tested according to **[ASTM E 283] [ASTM E 783] [or] [ASTM E 2357] <Insert test>**.

2.3 VAPOR-RETARDING MEMBRANE AIR BARRIER

- A. Fluid-Applied, Vapor-Retarding Membrane Air Barrier: **[Elastomeric, modified bituminous] [or] [synthetic polymer]** membrane.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Elastomeric, Modified Bituminous Membrane:
 - 1) Carlisle Coatings & Waterproofing Inc.; **[Barriseal R] [or] [Barriseal S]**.
 - 2) Epro Services, Inc.; **[Ecoflex-R] [or] [Ecoflex-S]**.
 - 3) Henry Company; **[Air-Bloc 06] [Air-Bloc 06 QS] [Air-Bloc 06 WB]**.
 - 4) Hohmann & Barnard, Inc.; Tetroflash Liquid.
 - 5) Meadows, W. R., Inc.; Air-Shield LM.
 - 6) Tremco Incorporated, an RPM company; ExoAir 120SP/R.
 - 7) **<Insert manufacturer's name; product name or designation>**.
 - 8) or approved equal.
 - b. Synthetic Polymer Membrane:
 - 1) Grace, W. R., & Co. - Conn.; Perm-A-Barrier Liquid.
 - 2) Henry Company; Air-Bloc 32.
 - 3) Rubber Polymer Corporation, Inc.; Rub-R-Wall Airtight.
 - 4) **<Insert manufacturer's name; product name or designation>**.
 - 5) or approved equal.
 2. Physical and Performance Properties:
 - a. Air Permeance: Maximum **[0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa)] <Insert value>** pressure difference; ASTM E 2178.
 - b. Vapor Permeance: Maximum **[0.1 perm (5.8 ng/Pa x s x sq. m)] <Insert value>**; ASTM E 96/E 96M.

- c. Ultimate Elongation: Minimum **[500]** <Insert number> percent; ASTM D 412, Die C.

2.4 VAPOR-PERMEABLE MEMBRANE AIR-BARRIER

- A. Fluid-Applied, Vapor-Permeable Membrane Air Barrier: **[Elastomeric, modified bituminous]** [or] **[synthetic polymer]** membrane.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Elastomeric, Modified Bituminous Membrane:

- 1) Henry Company; Air-Bloc 07.
- 2) Hohmann & Barnard, Inc.; Textroflash Liquid VP.
- 3) Meadows, W. R., Inc.; Air-Shield LMP.
- 4) Tremco Incorporated, an RPM company; ExoAir 220R.
- 5) **<Insert manufacturer's name; product name or designation>**.
- 6) or approved equal.

- b. Synthetic Polymer Membrane:

- 1) Carlisle Coatings & Waterproofing Inc.; Barritech VP.
- 2) Grace, W. R., & Co. - Conn.; Perm-A-Barrier VP.
- 3) Henry Company; **[Air-Bloc 31]** [or] **[Air-Bloc 33]**.
- 4) Rubber Polymer Corporation, Inc.; Rub-R-Wall Airtight VP.
- 5) Tremco Incorporated, an RPM company; ExoAir 230.
- 6) **<Insert manufacturer's name; product name or designation>**.
- 7) or approved equal.

2. Physical and Performance Properties:

- a. Air Permeance: Maximum **[0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa)]** <Insert value> pressure difference; ASTM E 2178.
- b. Vapor Permeance: Minimum **[10 perms (580 ng/Pa x s x sq. m)]** **[5.5 perms (320 ng/Pa x s x sq. m)]** <Insert value>; ASTM E 96/E 96M.
- c. Ultimate Elongation: Minimum **[200]** <Insert number> percent; ASTM D 412, Die C.

2.5 ACCESSORY MATERIALS

- A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.
- B. Primer: Liquid **[waterborne]** **[solvent-borne]** primer recommended for substrate by air-barrier material manufacturer.

- C. Counterflashing Strip: Modified bituminous, **40-mil-** (1.0-mm-) thick, self-adhering sheet consisting of **32 mils** (0.8 mm) of rubberized asphalt laminated to an **8-mil-** (0.2-mm-) thick, cross-laminated polyethylene film with release liner backing.
- D. Butyl Strip: Vapor retarding, **30 to 40 mils** (0.76 to 1.0 mm) thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive with release liner backing.
- E. Modified Bituminous Strip: Vapor retarding, **40 mils** (1.0 mm) thick, smooth surfaced, self-adhering; consisting of **36 mils** (0.9 mm) of rubberized asphalt laminated to a **4-mil-** (0.1-mm-) thick polyethylene film with release liner backing.
- F. Joint Reinforcing Strip: Air-barrier manufacturer's glass-fiber-mesh tape.
- G. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.
- H. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.
- I. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, [**0.0187 inch (0.5 mm)**] [**0.0250 inch (0.64 mm)**] <Insert dimension> thick, and Series 300 stainless-steel fasteners.
- J. Sprayed Polyurethane Foam Sealant: One- or two-component, foamed-in-place, polyurethane foam sealant, **1.5- to 2.0-lb/cu. ft** (24- to 32-kg/cu. m) density; flame-spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.
- K. Modified Bituminous Transition Strip: Vapor retarding, **40 mils** (1.0 mm) thick, smooth surfaced, self-adhering; consisting of **36 mils** (0.9 mm) of rubberized asphalt laminated to a **4-mil-** (0.1-mm-) thick polyethylene film with release liner backing.
- L. Adhesive-Coated Transition Strip: Vapor-permeable, **17-mil-** (0.43-mm-) thick, self-adhering strip consisting of an adhesive coating over a permeable laminate with a permeance value of **37 perms** (2145 ng/Pa x s x sq. m).
- M. Elastomeric Flashing Sheet: ASTM D 2000, minimum **50- to 65-mil-** (1.3- to 1.6-mm-) thick, cured sheet neoprene with manufacturer-recommended contact adhesives and lap sealant with [**stainless-steel termination bars and fasteners**] [**aluminum termination bars and stainless-steel fasteners**] [**galvanized-steel termination bars and fasteners**].
- N. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 123 Silicone Seal.
 - b. Momentive Performance Materials Inc.; US11000 UltraSpan.
 - c. Pecora Corporation; Sil-Span.

- d. Tremco Incorporated, an RPM company; Spectrem Simple Seal.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
- O. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 079200 "Joint Sealants."
- P. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 - 2. Verify that concrete has cured and aged for minimum time period recommended by air-barrier manufacturer.
 - 3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 - 4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

- G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT

- A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air-barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.
 - 1. Prime substrate and apply a single thickness of air-barrier manufacturer's recommended preparation coat extending a minimum of **3 inches** (75 mm) along each side of joints and cracks. Apply a double thickness of fluid air-barrier material and embed a joint reinforcing strip in preparation coat.
- B. Gypsum Sheathing: Fill joints greater than **1/4 inch** (6 mm) with sealant according to ASTM C 1193 and air-barrier manufacturer's written instructions. Apply first layer of fluid air-barrier material at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air-barrier material over joint reinforcing strip.

3.4 TRANSITION STRIP INSTALLATION

- A. General: Install strips, transition strips, and accessory materials according to air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.
 - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 - 2. Install [**butyl**] [**modified bituminous**] strip on roofing membrane or base flashing so that a minimum of **3 inches** (75 mm) of coverage is achieved over each substrate.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.
 - 1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- C. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

- E. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- F. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply [**modified bituminous transition strip**] [**adhesive-coated transition strip**] [**elastomeric flashing sheet**] [**preformed silicone-sealant extrusion**] so that a minimum of **3 inches** (75 mm) of coverage is achieved over each substrate. Maintain **3 inches** (75 mm) of full contact over firm bearing to perimeter frames with not less than **1 inch** (25 mm) of full contact.
 - 1. Modified Bituminous Transition Strip: Roll firmly to enhance adhesion.
 - 2. Adhesive-Coated Transition Strip: Roll firmly to enhance adhesion.
 - 3. Elastomeric Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at **6 inches** (150 mm) o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.
 - 4. Preformed Silicone-Sealant Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.
- G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- H. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
- I. Seal top of through-wall flashings to air barrier with an additional **6-inch-** (150-mm-) wide, [**modified bituminous**] [**counterflashing**] strip.
- J. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- K. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending **6 inches** (150 mm) beyond repaired areas in strip direction.

3.5 FLUID AIR-BARRIER MEMBRANE INSTALLATION

- A. General: Apply fluid air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions. Apply fluid air-barrier material within manufacturer's recommended application temperature ranges.
 - 1. Apply primer to substrates at required rate and allow it to dry.
 - 2. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.
 - 3. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

- B. Membrane Air Barriers: Apply a continuous unbroken air-barrier membrane to substrates according to the following thickness. Apply air-barrier membrane in full contact around protrusions such as masonry ties.
1. Vapor-Retarding Membrane Air Barrier: Total **[dry film thickness as recommended in writing by manufacturer to meet performance requirements, but not less than 40-mil (1.0-mm) dry film thickness] [40-mil (1.0-mm) dry film thickness] [45-mil (1.1-mm) dry film thickness]** <Insert dimension>, applied in **[one coat] [two equal coats] [one or more equal coats]**.
 2. Vapor-Permeable Membrane Air Barrier: Total **[dry film thickness as recommended in writing by manufacturer to meet performance requirements, but not less than 40-mil (1.0-mm) dry film thickness] [40-mil (1.0-mm) dry film thickness] [45-mil (1.1-mm) dry film thickness]** <Insert dimension>, applied in **[one coat] [two equal coats] [one or more equal coats]**.
- C. Apply **[strip and transition strip a minimum of 1 inch (25 mm) onto cured air-barrier material] [or] [strip and transition strip over cured air-barrier material overlapping 3 inches (75 mm) onto each surface]** according to air-barrier manufacturer's written instructions.
- D. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.
- E. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. **[Inspections may include the following:]**
1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
 2. Continuous structural support of air-barrier system has been provided.
 3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
 4. Site conditions for application temperature and dryness of substrates have been maintained.
 5. Maximum exposure time of materials to UV deterioration has not been exceeded.
 6. Surfaces have been primed, if applicable.
 7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.

8. Termination mastic has been applied on cut edges.
9. Strips and transition strips have been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

C. Tests: As determined by Owner's testing agency from among the following tests:

1. Qualitative Air-Leakage Testing: Air-barrier assemblies will be tested for evidence of air leakage according to **[ASTM E 1186, smoke pencil with pressurization or depressurization]** **[ASTM E 1186, chamber pressurization or depressurization with smoke tracers]** **[ASTM E 1186, chamber depressurization using detection liquids]**.
2. Quantitative Air-Leakage Testing: Air-barrier assemblies will be tested for air leakage according to **[ASTM E 783]** **<Insert test>**.
3. Adhesion Testing: Air-barrier assemblies will be tested for minimum air-barrier adhesion of **[30 lbf/sq. in. (207 kPa)]** **<Insert value>** according to ASTM D 4541 for each **[600 sq. ft. (56 sq. m)]** **<Insert value>** of installed air barrier or part thereof.

D. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.7 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than **[30]** **[60]** **<Insert number>** days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.
- C. Remove masking materials after installation.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 072726

SECTION 072729 - AIR-BARRIER COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes [**vapor-retarding**] [**and**] [**vapor-permeable**] air-barrier coatings.
- B. Related Requirements:
 - 1. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.
 - 2. Section 072500 "Weather Barriers" for weather barriers, including [**building paper**] [**flexible flashing**] [**and**] [**building wraps with air-barrier properties**].
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 DEFINITIONS

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at [**Project site**] [**location and time as determined by DEN Project Manager**] <Insert location>
 - 1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.
 - 2. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.2: For air-barrier products, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit IEQ 4: For air barriers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For air-barrier assemblies.
 - 1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
 - 2. Include details of interfaces with other materials that form part of air barrier.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer. [**Include list of ABAA-certified installers and supervisors employed by the Installer, who work on Project.**]
- B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.
- C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

1.7 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. A firm that has specialized in installation of types of products required for Project for not less than five (5) years and which is acceptable to manufacturer(s) of primary materials.
 2. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.
- B. Mockups: Build mockups to set quality standards for materials and execution[**and for preconstruction testing**].
1. Build integrated mockups of exterior wall assembly [**as shown on Drawings**] [, **150 sq. ft. (14 sq. m)**] **<Insert area or dimensions>**, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
 - a. Coordinate construction of mockups to permit inspection by Owner's testing agency of air barrier before external insulation and cladding are installed.
 - b. Include junction with roofing membrane[, **building corner condition,**] [**and foundation wall intersection**].
 - c. If DEN Project Manager determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on field mockups.
- B. Mockup Testing: Air-barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.
1. Qualitative Air-Leakage Testing: Mockups will be tested for evidence of air leakage according to [**ASTM E 1186, chamber pressurization or depressurization with smoke tracers**] [**ASTM E 1186, chamber depressurization with detection liquids**] **<Insert requirement>**.
 2. Quantitative Air-Leakage Testing: Mockups will be tested for air leakage according to [**ASTM E 783**] **<Insert test>**.
 3. Adhesion Testing: Mockups will be tested for minimum air-barrier adhesion of [**30 lbf/sq. in. (207 kPa)**] **<Insert value>** according to ASTM D 4541.

4. Notify DEN Project Manager [**seven**] <Insert number> days in advance of the dates and times when mockups will be tested.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

1.11 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.
 1. Protect substrates from environmental conditions that affect air-barrier performance.
 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.
- B. VOC Content: [**250**] <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and complying with VOC content limits of authorities having jurisdiction.
- C. Low-Emitting Materials: Air barriers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 PERFORMANCE REQUIREMENTS

- A. General: Air barrier shall be capable of performing as a continuous vapor-[**retarding**]

[permeable] air barrier[**and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration**]. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations[, **tie-ins to installed waterproofing**], and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

- B. Air-Barrier Assembly Air Leakage: Maximum **[0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa)]** <Insert value>, when tested according to **[ASTM E 283] [ASTM E 783] [or] [ASTM E 2357]** <Insert test>.

2.3 VAPOR-RETARDING, AIR-BARRIER COATING

- A. Vapor-Retarding, Air-Barrier Coating: Synthetic polymer membrane.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Protective Coatings Technology, Inc.; Poly-Wall Airloc Flex.
 - b. Sto Corp.; VaporSeal in [**two-**] [**three-**]component assembly.
 - c. <Insert manufacturer's name; product name or designation>.
 - d. or approved equal.
2. Physical and Performance Properties:
 - a. Air Permeance: Maximum **[0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa)]** <Insert value> pressure difference; ASTM E 2178.
 - b. Vapor Permeance: Maximum **[0.1 perm (5.8 ng/Pa x s x sq. m)]** <Insert value>; ASTM E 96/E 96M.
 - c. Ultimate Elongation: Minimum **[140]** <Insert number> percent; ASTM D 412, Die C.

2.4 VAPOR-PERMEABLE, AIR-BARRIER COATING

- A. Vapor-Permeable, Air-Barrier Coating: Synthetic polymer membrane.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Prosoco, Inc.; [**R-Guard Spray Wrap in two-component, System II**] [**R-Guard Spray Wrap in three-component, System I**] [**R-Guard MVP in two-component, System II**] [**R-Guard MVP in three-component, System I**] assembly.
 - b. Protective Coatings Technology, Inc.; Poly-Wall Airloc Flex VP.
 - c. Sto Corp.; [**Emerald Coat**] [or] [**Gold Coat**] in [**two-**] [**three-**]component assembly.
 - d. <Insert manufacturer's name; product name or designation>.
 - e. or approved equal.
2. Physical and Performance Properties:

- a. Air Permeance: Maximum [**0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa)**] <Insert value> pressure difference; ASTM E 2178.
- b. Vapor Permeance: Minimum [**5.7 perms (327 ng/Pa x s x sq. m)**] <Insert value>; ASTM E 96/E 96M.
- c. Ultimate Elongation: Minimum [**500**] <Insert number> percent; ASTM D 412, Die C.

2.5 ACCESSORY MATERIALS

- A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.
- B. Primer: Liquid [**waterborne**] [**solvent-borne**] primer recommended for substrate by air-barrier material manufacturer.
- C. Butyl Strip: Vapor retarding, **30 to 40 mils** (0.76 to 1.0 mm) thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive with release liner backing.
- D. Joint Reinforcing Fabric: Air-barrier manufacturer's nonwoven, reinforcement fabric.
- E. Joint Reinforcing Strip: Air-barrier manufacturer's self-adhering glass-fiber-mesh tape.
- F. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.
- G. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.
- H. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, [**0.0187 inch (0.5 mm)**] [**0.0250 inch (0.64 mm)**] <Insert dimension> thick, and Series 300 stainless-steel fasteners.
- I. Sprayed Polyurethane Foam Sealant: One- or two-component, foamed-in-place, polyurethane foam sealant, **1.5- to 2.0-lb/cu. ft** (24- to 32-kg/cu. m) density; flame-spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.
- J. Modified Bituminous Transition Strip: Vapor retarding, **40 mils** (1.0 mm) thick, smooth surfaced, self-adhering; consisting of **36 mils** (0.9 mm) of rubberized asphalt laminated to a **4-mil-** (0.1-mm-) thick polyethylene film with release liner backing.
- K. Elastomeric Flashing Sheet: ASTM D 2000, minimum **50- to 65-mil-** (1.3- to 1.6-mm-) thick, cured sheet neoprene with manufacturer-recommended contact adhesives and lap sealant with [**stainless-steel termination bars and fasteners**] [**aluminum termination bars and stainless-steel fasteners**] [**galvanized-steel termination bars and fasteners**].
- L. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a

single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 123 Silicone Seal.
 - b. Momentive Performance Materials Inc.; US11000 UltraSpan.
 - c. Pecora Corporation; Sil-Span.
 - d. Tremco Incorporated, an RPM company; Spectrem Simple Seal.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
- M. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 079200 "Joint Sealants."
- N. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 2. Verify that concrete has cured and aged for minimum time period recommended by air-barrier manufacturer.
 3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT

- A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air-barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.
 - 1. Prime substrate and apply a single thickness of air-barrier manufacturer's recommended preparation coat extending a minimum of **3 inches** (75 mm) along each side of joints and cracks. Apply a double thickness of air-barrier coating material and embed joint reinforcing in preparation coat.
- B. Gypsum Sheathing: Fill joints greater than **1/4 inch** (6 mm) with sealant according to ASTM C 1193 and air-barrier manufacturer's written instructions. Apply first layer of air-barrier coating material at joints. Tape joints with joint reinforcing after first layer is dry. Apply a second layer of air-barrier coating material over joint reinforcing.

3.4 TRANSITION STRIP INSTALLATION

- A. General: Install strips, transition strips, and accessory materials according to air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.
 - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 - 2. Install [**butyl**] [**modified bituminous transition**] strip on roofing membrane or base flashing so that a minimum of **3 inches** (75 mm) of coverage is achieved over each substrate.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier coating material on same day. Reprime areas exposed for more than 24 hours.
 - 1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- C. Connect and seal exterior wall air-barrier material continuously to roofing-membrane

air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

- D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- E. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- F. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply [**modified bituminous transition strip**] [**elastomeric flashing sheet**] [**preformed silicone-sealant extrusion**] so that a minimum of **3 inches** (75 mm) of coverage is achieved over each substrate. Maintain **3 inches** (75 mm) of full contact over firm bearing to perimeter frames with not less than **1 inch** (25 mm) of full contact.
 - 1. Modified Bituminous Transition Strip: Roll firmly to enhance adhesion.
 - 2. Elastomeric Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at **6 inches** (150 mm) o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.
 - 3. Preformed Silicone-Sealant Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.
- G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- H. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
- I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending **6 inches** (150 mm) beyond repaired areas in strip direction.

3.5 AIR-BARRIER COATING INSTALLATION

- A. General: Apply air-barrier coating to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions. Apply air-barrier coating within manufacturer's recommended application temperature ranges.
 - 1. Apply primer to substrates at required rate and allow it to dry.
 - 2. Limit priming to areas that will be covered by air-barrier coating on same day. Reprime areas exposed for more than 24 hours.

3. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- B. Air-Barrier Coatings: Apply a continuous unbroken air-barrier coating to substrates according to the following thickness. Apply an increased thickness of air-barrier coating in full contact around protrusions such as masonry ties.
1. Vapor-Retarding, Air-Barrier Coating: Total **[dry film thickness as recommended in writing by manufacturer to meet performance requirements] [17-mil (0.4-mm) dry film thickness] [20-mil (0.5-mm) dry film thickness]** <Insert dimension>, applied in **[one coat] [two equal coats] [one or more equal coats]**.
 2. Vapor-Permeable, Air-Barrier Coating: Total **[dry film thickness as recommended in writing by manufacturer to meet performance requirements] [14-mil (0.4-mm) dry film thickness]** <Insert dimension>, applied in **[one coat] [two equal coats] [one or more equal coats]**.
 3. Apply additional coats as needed to achieve void- and pinhole-free surface.
- C. Apply **[strip and transition strip a minimum of 1 inch (25 mm) onto cured air-barrier material] [or] [strip and transition strip over cured air-barrier material overlapping 3 inches (75 mm) onto each surface]** according to air-barrier manufacturer's written instructions.
- D. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.
- E. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.
- 3.6 FIELD QUALITY CONTROL
- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. **[Inspections may include the following:]**
1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
 2. Continuous structural support of air-barrier system has been provided.
 3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
 4. Site conditions for application temperature and dryness of substrates have been maintained.
 5. Maximum exposure time of materials to UV deterioration has not been exceeded.
 6. Surfaces have been primed, if applicable.

7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Strips and transition strips have been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

C. Tests: As determined by Owner's testing agency from among the following tests:

1. Qualitative Air-Leakage Testing: Air-barrier assemblies will be tested for evidence of air leakage according to **[ASTM E 1186, smoke pencil with pressurization or depressurization]** **[ASTM E 1186, chamber pressurization or depressurization with smoke tracers]** **[ASTM E 1186, chamber depressurization using detection liquids]**.
2. Quantitative Air-Leakage Testing: Air-barrier assemblies will be tested for air leakage according to **[ASTM E 783]** **<Insert test>**.
3. Adhesion Testing: Air-barrier assemblies will be tested for minimum air-barrier adhesion of **[30 lbf/sq. in. (207 kPa)]** **<Insert value>** according to ASTM D 4541 for each **[600 sq. ft. (56 sq. m)]** **<Insert value>** of installed air barrier or part thereof.

D. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.7 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than **[30]** **[60]** **<Insert number>** days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.

2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.
 - C. Remove masking materials after installation.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 072729

SECTION 073116 - METAL SHINGLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal-shingle panels.
2. Individual metal shingles.
3. Underlayment.
4. Ridge vents.
5. Snow guards.

B. Related Sections:

1. Section 061600 "Sheathing" for [**sheathing**] [**substrate board**] [**and**] [**building wrap**].
2. Section 072100 "Thermal Insulation" for roof insulation and sheet vapor retarders separate from self-adhering underlayments.
3. Section 074113.13 "Formed Metal Roof Panels" for factory-formed horizontal-seam (Bermuda-type) metal roof panels.
4. Section 074113.16 "Standing-Seam Metal Roof Panels" for factory-formed standing-seam metal roof panels.
5. Section 074113.19 "Batten-Seam Metal Roof Panels" for factory-formed batten-seam metal roof panels.
6. [**Section 076200 "Sheet Metal Flashing and Trim"**] [**Section 077100 "Roof Specialties"**] for gutters, downspouts, reglets, and counterflashings.
7. Section 077200 "Roof Accessories" for roof ventilators and accessories.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. Roofing Terminology: See ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Metal shingles shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Wind-Uplift Resistance: Provide metal-shingle assemblies that comply with the following wind-uplift requirements.
 - 1. Class: [15] [30] [60] [90] when tested according to UL 580.
 - 2. Uplift Resistance: [75 lbf/sq. ft. (3.6 kPa)] [120 lbf/sq. ft. (5.75 kPa)] [165 lbf/sq. ft. (7.9 kPa)] <Insert value> when tested according to UL 1897.
- C. Impact Resistance: [Class 3] [Class 4] <Insert value> when tested according to UL 2218.
- D. Solar Reflectance Index: Not less than 29 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.
- E. Energy Performance, ENERGY STAR: Provide roofing system that is listed on the DOE's "Roof Products Qualified Product List" for steep-slope roof products.
- F. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Test Reports for Credit SS 7.2: For metal shingles, documentation indicating compliance with Solar Reflectance Index requirement.
 - 2. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
- C. Shop Drawings: For metal shingles. Show roof plans[**and wall elevations**]; sections at hips, gables, ridges, valleys, and eaves; details of metal shingles, flashing, trim, and accessories; and attachments to other work.
- D. Samples for Initial Selection: For each type of metal shingle and accessory indicated with factory-applied color finishes.

- E. Samples for Verification: Full-size components of each type of metal shingle indicated, including visible accessories.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency or performed by a qualified testing agency, for metal shingles, demonstrating compliance with requirements specified in "Performance Requirements" Article.
- B. Warranty: Sample of special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials from the same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Metal Shingles: [100 sq. ft. (9.3 sq. m)] <Insert dimension> of exposed area, in each type and color, in unbroken bundles.

1.9 QUALITY ASSURANCE

- A. Source Limitations: Obtain metal shingles from single source from single manufacturer.
- B. Installer: A firm which has specialized in installation of types of products required for Project for not less than five (5) years and which is acceptable to manufacturer(s) of primary materials.
- C. Fire-Test Exposure Rating: [Class A] [Class B] [Class C]; for application and roof slopes indicated, as determined by testing identical products per test method UL 790 or ASTM E 108 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects.
 - 1. Build mockups of metal shingles, including related roofing materials.

- a. Size: **[48 inches (1200 mm) long by 96 inches (2400 mm) wide]** <Insert dimensions>.
 - b. Include gutter and downspout complying with requirements in Section 076200 "Sheet Metal Flashing and Trim."
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
 - E. Preinstallation Conference: Conduct conference at **[Project site]** **[location and time as determined by DEN Project Manager]**<Insert location>.
- 1.10 DELIVERY, STORAGE, AND HANDLING
- A. Do not store metal-shingle materials in contact with other materials that might cause staining, denting, or other surface damage. Store metal-shingle materials away from uncured concrete and masonry.
 - B. Protect strippable protective covering on metal shingles from exposure to sunlight and high humidity, except to the extent necessary for the period of metal-shingle installation.
- 1.11 PROJECT CONDITIONS
- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing to be performed according to manufacturer's written instructions and warranty requirements.
 1. Install self-adhering sheet underlayment within the range of ambient and substrate temperatures recommended by manufacturer.
- 1.12 WARRANTY
- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace metal shingles and accessories that fail in materials within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including wind uplift.
 - b. Water penetration[**and hail perforation**].
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. **<Insert failure modes>**.

2. Materials-Only Warranty Period: Minimum **[15] [25] [50]** <Insert number> years from date of Substantial Completion.
- B. Special Project Warranty: Roofing Installer's Warranty, on warranty form at end of this Section, signed by roofing Installer, covering Work of this Section, in which Installer agrees to repair or replace components of roofing that fail in materials or workmanship within the following warranty period:
 1. Warranty Period: Minimum **[Two] [Five]** <Insert number> years from date of Substantial Completion.
- C. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal shingles that show evidence of deterioration of factory-applied finishes within specified warranty period.
 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Warranty Period: Minimum **[10] [20]** <Insert number> years from date of Substantial Completion.

1.13 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

- A. Recycled Content of Sheet Metal Materials: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent by weight.
- B. Aluminum Sheet: [ASTM B 209](#) (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.
 1. Mill Finish: Uncoated aluminum sheet.
 2. High-Performance Organic Coating (Coil-Coated Finishes): Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

- a. Two-Coat Fluoropolymer: AAMA 620. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
 - b. Three-Coat Fluoropolymer: AAMA 620. System consisting of primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent PVDF resin by weight.
 - c. Concealed Surface: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat and with a minimum total dry film thickness of **0.5 mil (0.013 mm)**.
- C. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, **Class AZ50 coating designation, Grade 37** (Class AZM150 coating designation, Grade 255); structural quality.
1. Mill Finish: Satin-finish, aluminum-zinc alloy-coated steel sheet without additional coating.
 2. Granular-Coating Finish: Entire upper surface of shingle, including flange edges, coated with ceramic-colored quartz granules or crushed stone chips bonded to shingle with a resin adhesive and sealed with a clear overglaze.
- D. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, **G90 (Z275)** coating designation; structural quality.
1. Mill Finish: Zinc-coated (galvanized) steel sheet [**without additional coating**] [**with manufacturer's standard mill-phosphatized finish**].
 2. High-Performance Organic Coating, (Coil-Coated Finishes): Prepainted by the coil-coating process to comply with ASTM A 755/A 755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Two-Coat Fluoropolymer: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
 - b. Three-Coat Fluoropolymer: AAMA 621. System consisting of primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent PVDF resin by weight.
- E. Copper Sheet: ASTM B 370; Temper H00, cold rolled, unless Temper 060 is required for forming.
1. Mill Finish: Nonpatinated and exposed.
 2. Pre-Patinated Finish: [**Dark brown**] [**Verdigris**] <Insert color>, pre-patinated according to ASTM B 882.
- F. Zinc-Alloy Sheet: [**Alloy of 99.995 percent pure electrolytic high-grade zinc with alloy additives of copper (0.08 to 0.20 percent), titanium (0.07 to 0.12 percent), and aluminum (0.015 percent)**] [**Zinc alloy consisting of 99 percent pure zinc with 0.08 to 1.00 percent copper, 0.06 to 0.20 percent titanium, and up to 0.015**

percent aluminum]; with manufacturer's standard factory-applied, flexible, protective back coating.

1. Bright-Rolled Finish: Uncoated, bright-rolled zinc-alloy sheet.
2. Preweathered Finish: Factory-applied preweathering to uniform color.

2.2 METAL SHINGLES

A. Aluminum Shingles: Factory-formed, interlocking [**shingle panels**] [**individual shingles**].

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. [ATAS International, Inc.](#)
- b. [Classic Metal Roofing Systems.](#)
- c. [Custom-Bilt Metals Inc.](#)
- d. [Paradigm Shingles, Inc.](#)
- e. [Reinke Shakes; Div. of Jame Kari LLC.](#)
- f. [Zappone Manufacturing.](#)
- g. <Insert manufacturer's name>.
- h. or approved equal.

2. Shingle Panels: Stamped panels resembling multiple [**shakes**] [**shingles**] [**Spanish tiles**] [**flat tiles**] [**scalloped tiles**] <Insert description>.

- a. Material: Formed aluminum, [**0.020 inch (0.51 mm) thick**] [**0.032 inch (0.81 mm) thick**] [**thickness as needed to meet performance requirements**] <Insert thickness>.
- b. Reinforcement: Manufacturer's standard insert material in units to increase rigidity.
- c. Exposure: [**48 by 12 inches (1219 by 305 mm)**] <Insert dimensions>.
- d. Finish: [**Mill**] [**High-performance organic coating**].
- e. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.

3. Individual Shingles: [**Rectangular**] [**Diamond**] shingle units.

- a. Material: Formed aluminum, [**0.020 inch (0.51 mm) thick**] [**0.032 inch (0.81 mm) thick**] [**thickness as needed to meet performance requirements**] <Insert thickness>.
- b. Reinforcement: Manufacturer's standard insert material in units to increase rigidity.
- c. Exposure: [**14 by 14 inches (356 by 356 mm)**] <Insert dimensions>.
- d. Finish: [**Mill**] [**High-performance organic coating**].
- e. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.

- B. Steel Shingles: Factory-formed, interlocking [**shingle panels**] [**individual shingles**].
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [ATAS International, Inc.](#)
 - b. [Berridge Manufacturing Company.](#)
 - c. [Classic Metal Roofing Systems.](#)
 - d. [Custom-Bilt Metals Inc.](#)
 - e. [Decra Roofing Systems, Inc.:](#) a Fletcher Building company.
 - f. [Dura-Loc Roofing Systems Limited;](#) a division of Metals USA Building Products Canada Inc.
 - g. [Gerard Roofing Technologies, Inc.:](#) a Metals USA company.
 - h. [Metro Roof Products.](#)
 - i. [Met-Tile, Inc.](#)
 - j. [Millennium Tiles LLC.](#)
 - k. [Paradigm Shingles, Inc.](#)
 - l. [TAMKO Building Products Inc.](#)
 - m. <Insert manufacturer's name>.
 - n. or approved equal.
 2. Shingle Panels: Stamped panels resembling multiple [**shakes**] [**shingles**] [**Spanish tiles**] [**flat tiles**] [**scalloped tiles**] <Insert description>.
 - a. Material: [**Aluminum-zinc alloy-coated**] [**Zinc-coated (galvanized)**] steel sheet, nominal [**0.022 inch (0.56 mm) thick**] [**0.028 inch (0.71 mm) thick**] [**thickness as needed to meet performance requirements**] <Insert thickness>.
 - b. Exposure: [**47-1/4 by 15-13/16 inches (1200 by 402 mm)**] <Insert dimensions>.
 - c. Finish: [**Mill**] [**Granular coating**] [**High-performance organic coating**].
 - d. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 3. Individual Shingles: Rectangular shingle units.
 - a. Material: [**Aluminum-zinc alloy coated**] [**Zinc-coated (galvanized)**] steel sheet, nominal [**0.022 inch (0.56 mm) thick**] [**0.028 inch (0.71 mm) thick**] [**thickness as needed to meet performance requirements**] <Insert thickness>.
 - b. Exposure: [**9 by 12 inches (229 by 305 mm)**] <Insert dimensions>.
 - c. Finish: [**Mill**] [**Granular coating**] [**High-performance organic coating**].
 - d. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
- C. Copper Shingles: Factory-formed, interlocking [**shingle panels**] [**individual shingles**].

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [ATAS International, Inc.](#)
 - b. [Classic Metal Roofing Systems.](#)
 - c. [Custom-Bilt Metals Inc.](#)
 - d. [Dura-Loc Roofing Systems Limited; a division of Metals USA Building Products Canada Inc.](#)
 - e. [Paradigm Shingles, Inc.](#)
 - f. [Reinke Shakes; Div. of Jame Kari LLC.](#)
 - g. [Zappone Manufacturing.](#)
 - h. **<Insert manufacturer's name>.**
 - i. or approved equal.

2. Shingle Panels: Stamped panels resembling multiple [**shakes**] [**shingles**] **<Insert description>.**
 - a. Material: Copper sheet, [**12 oz./sq. ft. (0.41 mm thick)**] [**16 oz./sq. ft. (0.55 mm thick)**] [**weight (thickness) as needed to meet performance requirements**] **<Insert weight (thickness)>.**
 - b. Exposure: [**33-1/4 by 10 inches (845 by 254 mm)**] **<Insert dimensions>.**
 - c. Finish: [**Mill**] [**Pre-patinated dark brown**] [**Pre-patinated verdigris**] **<Insert finish>.**

3. Individual Shingles: [**Rectangular**] [**Diamond**] shingle units.
 - a. Material: Copper sheet, [**12 oz./sq. ft. (0.41 mm thick)**] [**16 oz./sq. ft. (0.55 mm-thick)**] [**weight (thickness) as needed to meet performance requirements**] **<Insert weight (thickness)>.**
 - b. Exposure: [**9-1/2 by 7-1/4 inches (241 by 184 mm)**] **<Insert dimensions>.**
 - c. Finish: [**Mill**] [**Pre-patinated dark brown**] [**Pre-patinated verdigris**] **<Insert finish>.**

- D. Zinc Shingles: Factory-formed, interlocking [**shingle panels**] [**individual shingles**].
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [ATAS International, Inc.](#)
 - b. [Dura-Loc Roofing Systems Limited; a division of Metals USA Building Products Canada Inc.](#)
 - c. [Rheinzink America Inc.](#)
 - d. [Umicore Building Products USA, Inc.](#)
 - e. **<Insert manufacturer's name>.**
 - f. or approved equal.

 2. Shingle Panels: Stamped panels resembling multiple [**shakes**] [**shingles**] **<Insert description>.**

- a. Material: Zinc-alloy sheet, **[0.027 inch (0.70 mm) thick]** **[thickness as needed to meet performance requirements]** <Insert thickness>.
 - b. Exposure: **[47-1/4 by 15-13/16 inches (1200 by 402 mm)]** <Insert dimensions>.
 - c. Finish: **[Bright rolled]** **[Preweathered gray]** **[Preweathered black]** <Insert finish>.
3. Individual Shingles: **[Rectangular]** **[Diamond]** shingle units.
- a. Material: Zinc-alloy sheet, **[0.027 inch (0.70 mm) thick]** **[thickness as needed to meet performance requirements]** <Insert thickness>.
 - b. Exposure: **[14 by 14 inches (356 by 356 mm)]** <Insert dimensions>.
 - c. Finish: **[Bright rolled]** **[Preweathered gray]** **[Preweathered black]** <Insert finish>.

2.3 UNDERLAYMENT

- A. Felt Underlayment: **[ASTM D 226]** **[or]** **[ASTM D 4869]**, **[Type I]** **[Type II]**, asphalt-saturated organic felt, nonperforated.
- B. Self-Adhering Sheet Underlayment, Polyethylene Faced: ASTM D 1970, a minimum of **40-mil-** (1.0-mm-) thick, slip-resisting, polyethylene-film-reinforced top surface laminated to SBS-modified asphalt adhesive, with release paper backing; cold applied. **[Provide primer for adjoining concrete or masonry surfaces to receive underlayment.]**
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Carlisle Coatings & Waterproofing.](#)
 - b. [Grace Construction Products; a unit of W. R. Grace & Co.](#)
 - c. [Henry Company.](#)
 - d. [Johns Manville.](#)
 - e. [Owens Corning.](#)
 - f. [Polyguard Products, Inc.](#)
 - g. [Protecto Wrap Company.](#)
 - h. **<Insert manufacturer's name>.**
 - i. or approved equal.
- C. Self-Adhering Sheet Underlayment, High Temperature: A minimum of **30- to 40-mil-** (0.76- to 1.0-mm-) thick, slip-resisting, polyethylene-film-reinforced top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release paper backing; cold applied. Provide primer **[for adjoining concrete or masonry surfaces to receive underlayment and]** when recommended by underlayment manufacturer.
1. Thermal Stability: Stable after testing at **240 deg F** (116 deg C); ASTM D 1970.
 2. Low-Temperature Flexibility: Passes after testing at minus **20 deg F** (29 deg C); ASTM D 1970.

3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Carlisle Coatings & Waterproofing.
- b. Grace Construction Products; a unit of W. R. Grace & Co.
- c. Henry Company.
- d. Metal-Fab Manufacturing, LLC.
- e. Owens Corning.
- f. **<Insert manufacturer's name>.**
- g. or approved equal.

D. Slip Sheet: Building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum, rosin sized.

2.4 ACCESSORIES

A. General: Provide materials and types of fasteners, protective coatings, separators, sealants, and other accessory items as required for a complete roofing system and as recommended by metal-shingle manufacturer unless otherwise indicated.

B. Sheet Metal Flashing and Trim: Metal-shingle manufacturer's flashing and trim components matching shingle material, color, and finish unless otherwise indicated or recommended in writing by metal-shingle manufacturer. Fabricate to sizes and configurations shown or required. Unless otherwise indicated, fabricate sheet metal flashing and trim to comply with recommendations that apply to design, dimensions, metal, and other characteristics of the item in SMACNA's "Architectural Sheet Metal Manual."

C. Ridge Vents: Metal-shingle manufacturer's continuous vented ridge caps matching material and finish of metal shingles[**with insect screen or insect-resisting geotextile filter strips**] [and] [with external deflector baffles]; for use with specified metal shingles.

1. Minimum Net Free Area: **<Insert free area>.**
2. Accessories: Splices, end caps, and other accessories matching metal and finish.

D. Snow Guards: [**Stop**] [**Bar**]-type, prefabricated [**aluminum**] [**copper**] [**cast-bronze**] [**zinc**] [**stainless-steel**] **<Insert material>** units, designed to be installed without penetrating metal shingles.

1. Attachment: Designed to be [**attached to surface of metal shingles using construction adhesive, silicone or polyurethane sealant, or adhesive tape**] [**mechanically anchored through predrilled holes concealed by the metal shingles**] **<Insert requirement>.**
2. Finish: [**Matching the metal shingles**] **<Insert finish>.**

E. Wood Battens: Pressure-preservative-treated wood complying with requirements in [**Section 061000 "Rough Carpentry."**] [**Section 061053 "Miscellaneous Rough Carpentry."**]

1. Contoured Rigid Foam: Manufacturers standard rigid foam formed to match underside contour of metal shingles.
 - F. Metal Battens: Hat channels formed from zinc-coated (galvanized) steel sheet; ASTM A 653/A 653M, G90 (Z275) coating designation, not less than **[0.025-inch (0.64-mm)]** <Insert dimension> nominal thickness, and complying with requirements in Section 054000 "Cold-Formed Metal Framing."
 - G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.
 - H. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.
 - I. Sealant: ASTM C 920, one-part elastomeric polymer joint sealant as recommended by metal-shingle manufacturer for installation indicated; of type, grade, class, and use classifications required to seal joints in metal shingles and remain watertight. Where sealant will be exposed, provide in color matching shingle.
 - J. Sheet Metal Fasteners: Noncorrosive screws, nails, and anchors designed to withstand design loads as recommended in writing by metal-shingle manufacturer.
 1. Exposed Fasteners: Heads matching color of metal shingles using plastic caps or factory-applied coating. Provide metal-backed **[neoprene]** **[or]** **[EPDM]** washers under heads of exposed fasteners bearing on weather side of shingles.
 2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 3. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 4. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 5. Fasteners for **[Aluminum-Zinc Alloy-Coated]** **[Zinc-Coated]** Steel Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M, ASTM F 2329, or Series 300 stainless steel.
 6. Fasteners for Copper Sheet: Copper, hardware bronze, or Series 300 stainless steel.
 7. Fasteners for Zinc Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M, ASTM F 2329, or Series 300 stainless steel.
 - K. Felt Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized-steel wire with low-profile capped heads or disc caps, **1-inch (25-mm)** minimum diameter.
 1. Where nails are in contact with metal shingles or flashing, use nails made from same metal as metal shingles.
 - L. Wood Batten Nails: ASTM F 1667; common or box, steel wire, flat head, and smooth shank; hot-dip galvanized.
- 2.5 GENERAL FINISH REQUIREMENTS
- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking, that tops of fasteners are flush with surface, and that installation is within flatness tolerances.
 - 2. Verify that substrate is sound, dry to the maximum moisture content recommended by metal-shingle manufacturer, smooth, clean, sloped for drainage, and completely anchored and that provision has been made for flashings and penetrations through metal shingles.
 - 3. Verify that vent stacks and other penetrations through metal shingles have been installed and are securely fastened.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

- A. General: Comply with metal-shingle and underlayment manufacturers' written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
- B. Single-Layer Felt Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides a minimum of **2 inches** (50 mm) over underlying course. Lap ends a minimum of **4 inches** (100 mm). Stagger end laps between succeeding courses at least **72 inches** (1830 mm). Fasten with felt underlayment nails.
 - 1. Install felt underlayment on roof deck not covered by self-adhering sheet underlayment. Lap sides of felt over self-adhering sheet underlayment not less than **3 inches** (75 mm) in direction to shed water. Lap ends of felt not less than **6 inches** (152 mm) over self-adhering sheet underlayment.
- C. Double-Layer Felt Underlayment: Install on roof deck parallel with and starting at the eaves. Install a **19-inch-** (485-mm-) wide starter course at eaves and completely cover with full-width second course. Install succeeding courses lapping previous courses **19 inches** (485 mm) in shingle fashion. Lap ends a minimum of **6 inches** (152 mm). Stagger

end laps between succeeding courses at least **72 inches** (1830 mm). Fasten with felt underlayment nails.

1. Apply a continuous layer of asphalt roofing cement over starter course and on felt underlayment surface to be concealed by succeeding courses as each felt course is installed. Apply [**over entire roof**] [**at locations indicated on Drawings**].
 2. Install felt underlayment on roof sheathing not covered by self-adhering sheet underlayment. Lap edges over self-adhering sheet underlayment not less than **3 inches** (75 mm) in direction to shed water.
 3. Terminate felt underlayment [**flush**] [**extended up not less than 4 inches** (100 mm)] against sidewalls, curbs, chimneys, and other roof projections.
- D. Self-Adhering Sheet Underlayment: Install wrinkle free; comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install at locations indicated [**below**] [**on Drawings**], lapped in direction to shed water. Lap sides not less than **3-1/2 inches** (89 mm). Lap ends not less than **6 inches** (152 mm), staggered **24 inches** (610 mm) between courses. Roll laps with roller. Cover underlayment within seven days.
1. Prime concrete and masonry surfaces to receive self-adhering sheet underlayment.
 2. Eaves: Extend from edges of eaves [**24 inches** (610 mm)] [**36 inches** (914 mm)] <Insert dimension> beyond interior face of exterior wall.
 3. Rakes: Extend from edges of rakes [**24 inches** (610 mm)] [**36 inches** (914 mm)] <Insert dimension> beyond interior face of exterior wall.
 4. Valleys: Extend from lowest to highest point [**18 inches** (455 mm)] <Insert dimension> on each side.
 5. Hips: Extend [**18 inches** (455 mm)] <Insert dimension> on each side.
 6. Ridges: Extend [**36 inches** (914 mm)] <Insert dimension> on each side[**without obstructing continuous ridge vent slot**].
 7. Sidewalls: Extend [**18 inches** (455 mm)] <Insert dimension> beyond sidewalls and return vertically against sidewalls not less than [**4 inches** (100 mm)] <Insert dimension>.
 8. Dormers, Chimneys, Skylights, and Other Roof-Penetrating Elements: Extend [**18 inches** (455 mm)] <Insert dimension> beyond penetrating elements and return vertically against penetrating elements not less than [**4 inches** (100 mm)] <Insert dimension>.
 9. Roof-Slope Transitions: Extend [**18 inches** (455 mm)] <Insert dimension> on each roof slope.
- E. Metal-Flashed, Open-Valley Underlayment: Install one layer of **36-inch-** (914-mm-) wide [**felt underlayment**] [**or**] [**self-adhering sheet underlayment**] centered in valley and running the full length of valley in addition to the underlayment required for metal shingles. Stagger end laps between layers and lap ends of each layer at least **12 inches** (305 mm) in direction to shed water.
1. Solidly cement valley felt underlayment with asphalt roofing cement to the underlayment required for metal shingles.

- F. Apply slip sheet with adhesive or tape before installing metal flashing and shingles.

3.3 METAL-SHINGLE INSTALLATION

- A. General: Install metal shingles according to manufacturer's written instructions applicable to products and applications indicated; install level, plumb, and true to line.
- B. Felt Interlayment: Install 18-inch- (455-mm-) wide strip of felt underlayment over top portion of first and each succeeding course. Stagger fasten to roof deck with felt underlayment nails.
- C. Maintain uniform exposure and coursing of metal shingles throughout roof.
- D. Apply sealant between shingles, flashing, trim, and exposed fasteners to achieve a weathertight system.
- E. Interlock and overlap shingles and [**stagger end joints from**] [**align joints of tile-form**] shingle courses above and below.
- F. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with bituminous coating, by applying self-adhering sheet underlayment to each contact surface, or by other permanent separation as recommended by manufacturer of metal shingles or of the metals in contact.
 - 1. Do not use graphite pencils to mark metal surfaces.

3.4 ACCESSORY INSTALLATION

- A. General: Install accessories according to manufacturers' written instructions unless more stringent requirements are indicated.
- B. Metal Flashings and Trim: Install metal flashings and trim according to recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual" unless more stringent requirements are indicated.
- C. Ridge Vents: Install ridge vents with end closures at locations indicated.
- D. Stop-Type Snow Guards: Install <Insert number> rows of snow guards at locations indicated. Space rows <Insert dimension> apart horizontally, beginning <Insert dimension> from gutter. Space snow guards <Insert dimension> apart in each row, offsetting by half this dimension between succeeding rows.
- E. Bar-Type Snow Guards: Install <Insert number> rows of snow guards at locations indicated. Space rows <Insert dimension> apart horizontally, beginning <Insert dimension> from gutter.
- F. Battens: Install battens according to metal-shingle manufacturer's written instructions and as needed to meet performance requirements.

1. Wood Battens: Install [**nominal 2-by-2-inch (38-by-38-mm)**] <Insert dimensions> wood battens horizontally over installed underlayment with ends separated by **1/2 inch (13 mm)**, at spacing required by metal-shingle manufacturer, and securely fasten to roof deck with wood batten nails.
 2. Metal Battens: Install [**1-1/2-inch (38-mm)**] <Insert dimension> metal battens horizontally over installed underlayment with ends separated by **1/2 inch (13 mm)**, at spacing required by metal-shingle manufacturer, and securely fasten to roof deck with sheet metal fasteners.
 3. Intermediate Battens: Install [**nominal 1-inch- (19-mm-)**] <Insert dimension> thick wood battens[**with double strip of contoured rigid foam**] horizontally with ends separated by **1/2 inch (13 mm)**, at spacing required by metal-shingle manufacturer to uniformly support underside of metal shingles between main battens, and securely fasten to roof deck with wood batten nails.
- G. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with bituminous coating, by applying self-adhering sheet underlayment to each contact surface, or by other permanent separation as recommended by manufacturer of metal shingles or of the metals in contact.

3.5 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal shingles within installed tolerance of **1/4 inch in 20 feet (6 mm in 6 m)** on slope and location lines as indicated and within **1/8-inch (3-mm)** offset of adjoining faces and of alignment of matching profiles.
- B. Installation Tolerances: Shim and align metal shingles within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.6 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed metal shingles or metal shingles that do not comply with specified requirements. Replace shingles with damaged or deteriorated finishes and other components of the Work that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as metal shingles are installed unless otherwise indicated in manufacturer's written installation instructions.
- C. On completion of installation, clean exposed surfaces of metal shingles according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Remove excess sealants. Maintain metal shingles in a clean condition during construction.
- D. Remove excess metal shingles and debris from Project site.

3.7 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS **<Insert name>** of **<Insert address>**, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
1. Owner: **<Insert name of Owner>**.
 2. Address: **<Insert address>**.
 3. Building Name/Type: **<Insert information>**.
 4. Address: **<Insert address>**.
 5. Area of Work: **<Insert information>**.
 6. Acceptance Date: **<Insert date>**.
 7. Warranty Period: **<Insert time>**.
 8. Expiration Date: **<Insert date>**.
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
 - a. Lightning;
 - b. Peak gust wind speed exceeding **<Insert wind speed> mph (m/s)**;
 - c. Fire;
 - d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
 - e. Faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
 - f. Vapor condensation on bottom of roofing; and
 - g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
 2. When work has been damaged by any of the foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
 3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.

4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this **<Insert day>** day of **<Insert month>**, **<Insert year>**.

1. Authorized Signature: **<Insert signature>**.
2. Name: **<Insert name>**.
3. Title: **<Insert title>**.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 073116

SECTION 074113.13 - FORMED METAL ROOF PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Exposed-fastener, lap-seam, metal roof panels.
 - 2. Horizontal-seam (Bermuda-type) metal roof panels.
- B. Related Sections:
 - 1. Section 074213.53 "Metal Soffit Panels" for metal panels used in horizontal soffit applications.
 - 2. Section 077253 "Snow Guards" for prefabricated devices designed to hold snow on the roof surface, allowing it to melt and drain off slowly.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.
 - 1. Meet with DEN Project Manager, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
 - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 5. Review structural loading limitations of **[deck] [purlins and rafters]** during and after roofing.

6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
8. Review temporary protection requirements for metal panel systems during and after installation.
9. Review procedures for repair of metal panels damaged after installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
2. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Test Reports for Credit SS 7.2: For roofing materials, documentation indicating that roofing materials comply with Solar Reflectance Index requirement.

C. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than **1-1/2 inches per 12 inches (1:10)**.

D. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Metal Panels: **12 inches (305 mm)** long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 - 1. A firm that has specialized in installation of types of products required for Project for not less than five (5) years and which is acceptable to manufacturer(s) of primary materials.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical roof area and eave[, **including fascia,**] [**and soffit**] as shown on Drawings; approximately [**48 inches (1200 mm)**] [**12 feet (3.5 m)**] **<Insert dimension>** square by full thickness, including attachments[, **underlayment,**] and accessories.
 - 2. Build mockups for typical roof area only, including accessories.
 - a. Size: [**12 feet (3.5 m) long by 6 feet (1.75 m)**] **<Insert dimension>**.
 - b. [**Each type of exposed seam and seam termination**] **<Insert mockup item>**.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.

4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.
- E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Minimum **[two (2)] <Insert number>** years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: Minimum **[20] [10] <Insert number>** years from date of Substantial Completion.
- 1.12 CONSTRUCTION WASTE MANAGEMENT
- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

- 2.1 PERFORMANCE REQUIREMENTS
- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25] <Insert number>** percent.
 - B. Solar Reflectance Index: Not less than **[78] [29]** according to ASTM E 1980.
 - C. Energy Performance: Provide roof panels that are listed on the EPA/DOE's ENERGY STAR "Roof Product List" for **[low] [steep]**-slope roof products.
 - D. Energy Performance: Provide roof panels with an aged Solar Reflectance Index of not less than **[0.64] <Insert value>** when tested according to CRRC-1.
 - E. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 1. Wind Loads: 115 mph with gust factor of 1.3.
 2. Other Design Loads: **[As indicated on Drawings] <Insert loads>**.
 3. Deflection Limits: For wind loads, no greater than **[1/180] [1/240] <Insert deflection>** of the span.
 4. Ambient Temperature Range: Minus 30 deg F (minus 35 deg C) to 120 deg F (49 deg C).

5. <Insert serviceability requirements>.

- F. Air Infiltration: Air leakage of not more than **0.06 cfm/sq. ft.** (0.3 L/s per sq. m) when tested according to ASTM E 1680[**or ASTM E 283**] at the following test-pressure difference:
1. Test-Pressure Difference: [**1.57 lbf/sq. ft. (75 Pa)**] [**6.24 lbf/sq. ft. (300 Pa)**].
- G. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646[**or ASTM E 331**] at the following test-pressure difference:
1. Test-Pressure Difference: [**2.86 lbf/sq. ft. (137 Pa)**] [**6.24 lbf/sq. ft. (300 Pa)**].
- H. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.
- I. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
1. Uplift Rating: [**UL 30**] [**UL 60**] [**UL 90**].
- J. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
1. Fire/Windstorm Classification: Class 1A-[**60**] [**75**] [**90**] [**105**] [**120**] <Insert number>.
 2. Hail Resistance: [**MH**] [**SH**].
- K. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): [**120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces**] <Insert temperature range>.

2.2 EXPOSED-FASTENER, LAP-SEAM, METAL ROOF PANELS

- A. General: Provide factory-formed metal roof panels designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.
- B. Corrugated-Profile, Exposed-Fastener Metal Roof Panels <Insert drawing designation>: Formed with alternating curved ribs spaced at [**2.67 inches (68 mm)**] <Insert dimension> o.c. across width of panel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [AEP Span; a BlueScope Steel company.](#)
 - b. [Alcoa Inc.](#)
 - c. [CENTRIA Architectural Systems.](#)
 - d. [Fabral.](#)
 - e. [Firestone Metal Products, LLC.](#)
 - f. [Flexospan Steel Buildings, Inc.](#)
 - g. [MBCI; a division of NCI Building Systems, L.P.](#)
 - h. [McElroy Metal, Inc.](#)
 - i. [Metal Sales Manufacturing Corporation.](#)
 - j. [Morin; a Kingspan Group company.](#)
 - k. [Union Corrugating Company.](#)
 - l. [VICWEST.](#)
 - m. <Insert manufacturer's name>.
 - n. or approved equal.

2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, [G90 \(Z275\)](#) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, [Class AZ50 \(Class AZM150\)](#) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: [**0.022 inch (0.56 mm)**] [**0.028 inch (0.71 mm)**] [**0.034 inch (0.86 mm)**] [**0.040 inch (1.02 mm)**] [**0.052 inch (1.32 mm)**].
 - b. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Siliconized polyester**] <Insert finish>.
 - c. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.

3. Aluminum Sheet: Coil-coated sheet, [ASTM B 209 \(ASTM B 209M\)](#), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: [**0.032 inch (0.81 mm)**] [**0.040 inch (1.02 mm)**].
 - b. Surface: [**Smooth, flat**] [**Embossed**] finish.
 - c. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Siliconized polyester**] [**Clear anodized**] [**Color anodized**] <Insert finish>.
 - d. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.

4. Stainless-Steel Sheet: ASTM A 240/A 240M, [**Type 304**] [**Type 316**], fully annealed.

- a. Nominal Thickness: [0.019 inch (0.48 mm)] [0.025 inch (0.64 mm)] [0.031 inch (0.79 mm)] [0.38 inch (0.96 mm)] [0.50 inch (1.27 mm)].
 - b. Exterior Finish: [4] [2B] <Insert finish>.
5. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.
- a. Thickness: [16 oz./sq. ft. (0.55 mm thick)] [20 oz./sq. ft. (0.68 mm thick)].
 - b. Exposed Finish: [Mill] [Prepatinated].
 - c. Prepatinated Color: [Dark brown] [Verdigris] <Insert color>.
6. Panel Coverage: [21.3 inches (541 mm)] [29.3 inches (744 mm)] [34.67 inches (881 mm)] [37.3 inches (947 mm)] [42.67 inches (1084 mm)] [45.3 inches (1151 mm)] <Insert dimension>.
7. Panel Height: [0.5 inch (13 mm)] [0.875 inch (22 mm)] <Insert dimension>.
- C. Tapered-Rib-Profile, Exposed-Fastener Metal Roof Panels <Insert drawing designation>: Formed with raised, trapezoidal major ribs and [intermediate stiffening ribs symmetrically spaced] [flat pan] between major ribs.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [AEP Span; a BlueScope Steel company.](#)
 - b. [Architectural Metal Systems; a Nucor company.](#)
 - c. [Berridge Manufacturing Company.](#)
 - d. [Butler Manufacturing; a BlueScope Steel company.](#)
 - e. [CENTRIA Architectural Systems.](#)
 - f. [Fabral.](#)
 - g. [Firestone Metal Products, LLC.](#)
 - h. [Flexospan Steel Buildings, Inc.](#)
 - i. [MBCI; a division of NCI Building Systems, L.P.](#)
 - j. [McElroy Metal, Inc.](#)
 - k. [Metal Sales Manufacturing Corporation.](#)
 - l. [Morin; a Kingspan Group company.](#)
 - m. [Petersen Aluminum Corporation.](#)
 - n. [Union Corrugating Company.](#)
 - o. [VICWEST.](#)
 - p. <Insert manufacturer's name>.
 - q. or approved equal.
 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: [0.022 inch (0.56 mm)] [0.028 inch (0.71 mm)] [0.034 inch (0.86 mm)] [0.040 inch (1.02 mm)] [0.052 inch (1.32 mm)].

- b. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Siliconized polyester**] <Insert finish>.
 - c. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 3. Aluminum Sheet: Coil-coated sheet, **ASTM B 209** (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: [**0.032 inch (0.81 mm)**] [**0.040 inch (1.02 mm)**].
 - b. Surface: [**Smooth, flat**] [**Embossed**] finish.
 - c. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Siliconized polyester**] [**Clear anodized**] [**Color anodized**] <Insert finish>.
 - d. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 4. Stainless-Steel Sheet: ASTM A 240/A 240M, [**Type 304**] [**Type 316**], fully annealed.
 - a. Nominal Thickness: [**0.019 inch (0.48 mm)**] [**0.025 inch (0.64 mm)**] [**0.031 inch (0.79 mm)**] [**0.38 inch (0.96 mm)**] [**0.50 inch (1.27 mm)**].
 - b. Exterior Finish: [**4**] [**2B**] <Insert finish>.
 5. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.
 - a. Thickness: [**16 oz./sq. ft. (0.55 mm thick)**] [**20 oz./sq. ft. (0.68 mm thick)**].
 - b. Exposed Finish: [**Mill**] [**Prepatinated**].
 - c. Prepatinated Color: [**Dark brown**] [**Verdigris**] <Insert color>.
 6. Major-Rib Spacing: [**6 inches (152 mm)**] [**8 inches (203 mm)**] [**9 inches (229 mm)**] [**12 inches (305 mm)**] <Insert dimension> o.c.
 7. Panel Coverage: [**24 inches (610 mm)**] [**36 inches (914 mm)**] <Insert dimension>.
 8. Panel Height: [**0.625 inch (16 mm)**] [**0.75 inch (19 mm)**] [**1.0 inch (25 mm)**] [**1.25 inches (32 mm)**] [**1.5 inches (38 mm)**] <Insert dimension>.
- D. Vee-Rib-Profile, Exposed-Fastener Metal Roof Panels <Insert drawing designation>:
Formed with raised, V-shaped ribs and recesses that are approximately same size, evenly spaced across panel width, and with rib/recess sides angled at approximately 45 degrees.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [AEP Span; a BlueScope Steel company.](#)

- b. [Alcoa Inc.](#)
 - c. [Berridge Manufacturing Company.](#)
 - d. [CENTRIA Architectural Systems.](#)
 - e. [Fabral.](#)
 - f. [Flexospan Steel Buildings, Inc.](#)
 - g. [MBCI; a division of NCI Building Systems, L.P.](#)
 - h. [Metal Sales Manufacturing Corporation.](#)
 - i. [Morin; a Kingspan Group company.](#)
 - j. [Petersen Aluminum Corporation.](#)
 - k. [VICWEST.](#)
 - l. **<Insert manufacturer's name>.**
 - m. or approved equal.
2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, **Class AZ50 (Class AZM150)** coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: **[0.022 inch (0.56 mm)] [0.028 inch (0.71 mm)] [0.034 inch (0.86 mm)] [0.040 inch (1.02 mm)] [0.052 inch (1.32 mm)].**
 - b. Exterior Finish: **[Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] <Insert finish>.**
 - c. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.**
3. Aluminum Sheet: Coil-coated sheet, **ASTM B 209 (ASTM B 209M)**, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: **[0.032 inch (0.81 mm)] [0.040 inch (1.02 mm)].**
 - b. Surface: **[Smooth, flat] [Embossed] finish.**
 - c. Exterior Finish: **[Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] [Clear anodized] [Color anodized] <Insert finish>.**
 - d. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.**
4. Stainless-Steel Sheet: ASTM A 240/A 240M, **[Type 304] [Type 316]**, fully annealed.
 - a. Nominal Thickness: **[0.019 inch (0.48 mm)] [0.025 inch (0.64 mm)] [0.031 inch (0.79 mm)] [0.38 inch (0.96 mm)] [0.50 inch (1.27 mm)].**
 - b. Exterior Finish: **[4] [2B] <Insert finish>.**
5. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.

- a. Thickness: [**16 oz./sq. ft. (0.55 mm thick)**] [**20 oz./sq. ft. (0.68 mm thick)**].
 - b. Exposed Finish: [**Mill**] [**Prepatinated**].
 - c. Prepatinated Color: [**Dark brown**] [**Verdigris**] <Insert color>.
6. Rib Spacing: [**5.3 inches (135 mm)**] [**7.2 inches (183 mm)**] [**12 inches (305 mm)**] <Insert dimension> o.c.
 7. Panel Coverage: [**30 inches (762 mm)**] [**32 inches (813 mm)**] [**36 inches (914 mm)**] [**40 inches (1016 mm)**] <Insert dimension>.
 8. Panel Height: [**1.375 inches (35 mm)**] [**1.5 inches (38 mm)**] [**1.75 inches (44 mm)**] [**2.0 inches (51 mm)**] [**3.0 inches (76 mm)**] <Insert dimension>.
- E. Box-Rib-Profile, Exposed-Fastener Metal Roof Panels <Insert drawing designation>:
Formed with raised, box-shaped ribs that are wider than recesses, evenly spaced across panel width, and with rib/recess sides angled 60 degrees or more.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Alcoa Inc.](#)
 - b. [Fabral.](#)
 - c. [MBCI; a division of NCI Building Systems, L.P.](#)
 - d. [Metal Sales Manufacturing Corporation.](#)
 - e. <Insert manufacturer's name>.
 - f. or approved equal.
 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, [G90 \(Z275\)](#) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, [Class AZ50 \(Class AZM150\)](#) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: [**0.022 inch (0.56 mm)**] [**0.028 inch (0.71 mm)**] [**0.034 inch (0.86 mm)**] [**0.040 inch (1.02 mm)**] [**0.052 inch (1.32 mm)**].
 - b. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Siliconized polyester**] <Insert finish>.
 - c. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 3. Aluminum Sheet: Coil-coated sheet, [ASTM B 209 \(ASTM B 209M\)](#), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: [**0.032 inch (0.81 mm)**] [**0.040 inch (1.02 mm)**].
 - b. Surface: [**Smooth, flat**] [**Embossed**] finish.
 - c. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Siliconized polyester**] [**Clear anodized**] [**Color anodized**] <Insert finish>.

- d. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
4. Stainless-Steel Sheet: ASTM A 240/A 240M, **[Type 304] [Type 316]**, fully annealed.
 - a. Nominal Thickness: **[0.019 inch (0.48 mm)] [0.025 inch (0.64 mm)] [0.031 inch (0.79 mm)] [0.38 inch (0.96 mm)] [0.50 inch (1.27 mm)]**.
 - b. Exterior Finish: **[4] [2B] <Insert finish>**.
 5. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.
 - a. Thickness: **[16 oz./sq. ft. (0.55 mm thick)] [20 oz./sq. ft. (0.68 mm thick)]**.
 - b. Exposed Finish: **[Mill] [Prepatinated]**.
 - c. Prepatinated Color: **[Dark brown] [Verdigris] <Insert color>**.
 6. Rib Spacing: **[2.67 inches (68 mm)] [4.0 inches (102 mm)] [5.3 inches (135 mm)] [6.0 inches (152 mm)] <Insert dimension> o.c.**
 7. Panel Coverage: **[24 inches (610 mm)] [28 inches (711 mm)] [30 inches (762 mm)] [32 inches (813 mm)] [36 inches (914 mm)] <Insert dimension>**.
 8. Panel Height: **[0.625 inch (16 mm)] [1.0 inch (25 mm)] [1.5 inches (38 mm)] [2.0 inches (51 mm)] <Insert dimension>**.
- F. Deep-Box-Rib-Profile, Exposed-Fastener Metal Roof Panels **<Insert drawing designation>**: Formed with raised, box-shaped ribs that are wider than recesses, evenly spaced across panel width, and with rib/recess sides angled more than 60 degrees.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [CENTRIA Architectural Systems](#).
 - b. [Fabral](#).
 - c. [Metal Sales Manufacturing Corporation](#).
 - d. [Morin; a Kingspan Group company](#).
 - e. **<Insert manufacturer's name>**.
 - f. or approved equal.
 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, **Class AZ50 (Class AZM150)** coating designation; structural quality. Prepatinated by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: **[0.022 inch (0.56 mm)] [0.028 inch (0.71 mm)] [0.034 inch (0.86 mm)] [0.040 inch (1.02 mm)] [0.052 inch (1.32 mm)]**.
 - b. Exterior Finish: **[Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] <Insert finish>**.

- c. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
3. Aluminum Sheet: Coil-coated sheet, **ASTM B 209** (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: **[0.032 inch (0.81 mm)] [0.040 inch (1.02 mm)]**.
 - b. Surface: **[Smooth, flat] [Embossed]** finish.
 - c. Exterior Finish: **[Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] [Clear anodized] [Color anodized] <Insert finish>**.
 - d. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 4. Stainless-Steel Sheet: ASTM A 240/A 240M, **[Type 304] [Type 316]**, fully annealed.
 - a. Nominal Thickness: **[0.019 inch (0.48 mm)] [0.025 inch (0.64 mm)] [0.031 inch (0.79 mm)] [0.38 inch (0.96 mm)] [0.50 inch (1.27 mm)]**.
 - b. Exterior Finish: **[4] [2B] <Insert finish>**.
 5. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.
 - a. Thickness: **[16 oz./sq. ft. (0.55 mm thick)] [20 oz./sq. ft. (0.68 mm thick)]**.
 - b. Exposed Finish: **[Mill] [Prepatinated]**.
 - c. Prepatinated Color: **[Dark brown] [Verdigris] <Insert color>**.
 6. Rib Spacing: **[12 inches (305 mm)] <Insert dimension>** o.c.
 7. Panel Coverage: **[24 inches (610 mm)] <Insert dimension>**.
 8. Panel Height: **[3 inches (76 mm)] [4 inches (102 mm)] <Insert dimension>**.

2.3 HORIZONTAL-SEAM (BERMUDA-TYPE) METAL ROOF PANELS

- A. Horizontal-Seam (Bermuda-Type) Metal Roof Panels **<Insert drawing designation>**: Formed with horizontal seam at panel edges and smooth, flat pan; designed to be installed in sequential installation by engaging lower edge of each panel to upper edge of panel below and mechanically attaching panels to supports using concealed clips located under upper edge of panels.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Berridge Manufacturing Company](#).
 - b. [Metal-Fab Manufacturing, LLC](#).
 - c. [Ultra Seam, Inc](#).

- d. **<Insert manufacturer's name>**.
 - e. or approved equal.
2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, **Class AZ50 (Class AZM150)** coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: **[0.022 inch (0.56 mm)] [0.028 inch (0.71 mm)] [0.034 inch (0.86 mm)] [0.040 inch (1.02 mm)] [0.052 inch (1.32 mm)]**.
 - b. Exterior Finish: **[Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] <Insert finish>**.
 - c. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
3. Aluminum Sheet: Coil-coated sheet, **ASTM B 209 (ASTM B 209M)**, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: **[0.032 inch (0.81 mm)] [0.040 inch (1.02 mm)]**.
 - b. Surface: **[Smooth, flat] [Embossed]** finish.
 - c. Exterior Finish: **[Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] [Clear anodized] [Color anodized] <Insert finish>**.
 - d. Color: **[As indicated by manufacturer's designations] [Match DiA Project Manager's samples] [As selected by DiA Project Manager from manufacturer's full range] <Insert color>**.
4. Stainless-Steel Sheet: ASTM A 240/A 240M, **[Type 304] [Type 316]**, fully annealed.
 - a. Nominal Thickness: **[0.019 inch (0.48 mm)] [0.025 inch (0.64 mm)] [0.031 inch (0.79 mm)] [0.38 inch (0.96 mm)] [0.50 inch (1.27 mm)]**.
 - b. Exterior Finish: **[4] [2B] <Insert finish>**.
5. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.
 - a. Thickness: **[16 oz./sq. ft. (0.55 mm thick)] [20 oz./sq. ft. (0.68 mm thick)]**.
 - b. Exposed Finish: **[Mill] [Prepatinated]**.
 - c. Prepatinated Color: **[Dark brown] [Verdigris] <Insert color>**.
6. Clips: One piece.
 - a. Material: **0.028-inch- (0.71-mm-) nominal thickness, [zinc-coated (galvanized)] [or] [aluminum-zinc alloy-coated]** steel sheet.
 - b. Material: **0.025-inch- (0.64-mm-) thick, stainless-steel sheet.**

7. Seal: Factory-applied sealant or vinyl weatherseal in seam.
8. Exposure: [9.5 inches (241 mm)] [11 inches (279 mm)] <Insert dimension> nominal.
9. Seam Height: [1.0 inch (25 mm)] [1.5 inches (38 mm)] <Insert dimension>.

2.4 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils (0.76 mm) thick, specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer when recommended by underlayment manufacturer.
1. Thermal Stability: Stable after testing at 220 deg F (111 deg C); ASTM D 1970.
 2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
 3. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
 - b. Grace Construction Products, a unit of W. R. Grace & Co.; [Grace Ice and Water Shield HT] [Ultra].
 - c. Henry Company; Blueskin PE200 HT.
 - d. Kirsch Building Products, LLC; Sharkskin Ultra SA.
 - e. Metal-Fab Manufacturing, LLC; MetShield.
 - f. Owens Corning; WeatherLock Specialty Tile and Metal Underlayment.
 - g. <Insert manufacturer's name; product name or designation>.
 - h. or approved equal.
- B. Felt Underlayment: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felts.
- C. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.5 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.

2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum **1-inch-** (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from **same material as metal panels** as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum **96-inch-** (2400-mm-) long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of **36 inches** (914 mm) o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match **[metal roof panels] [roof fascia and rake trim]**.
- E. Downspouts: Formed from same material as roof panels. Fabricate in **10-foot-** (3-m-) long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.
- F. Roof Curbs: Fabricated from same material as roof panels, **[0.048-inch- (1.2-mm-)]** **<Insert dimension>** nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb subframing of **0.060-inch-** (1.52-mm-) nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.
1. Insulate roof curb with **1-inch-** (25-mm-) thick, rigid insulation.
- G. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- H. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape **1/2 inch** (13 mm) wide and **1/8 inch** (3 mm) thick.
 2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and

remain weathertight; and as recommended in writing by metal panel manufacturer.

3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.6 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.7 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:
1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 2. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 3. Mica Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 4. Metallic Fluoropolymer: AAMA 621. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 5. FEVE Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish containing 100 percent fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 6. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than **0.2 mil** (0.005 mm) for primer and **0.8 mil** (0.02 mm) for topcoat.
 7. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of **0.5 mil** (0.013 mm).
- D. Aluminum Panels and Accessories:
1. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 2. Three-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.

- Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
3. Mica Fluoropolymer: AAMA 620. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 4. Metallic Fluoropolymer: AAMA 620. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 5. FEVE Fluoropolymer: AAMA 620. Two-coat fluoropolymer finish containing 100 percent fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 6. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than **0.2 mil (0.005 mm)** for primer and **0.8 mil (0.02 mm)** for topcoat.
 7. Exposed Anodized Finish:
 - a. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
 - b. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.
- E. Stainless-Steel Panels and Accessories:
1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - c. Directional Satin Finish: No. 4.
 3. Bright, Cold-Rolled, Unpolished Finish: No. 2B.
- F. Copper Panels and Accessories:
1. Prepatination: Factory prepatinate according to ASTM B 882 to convert the copper surface to an inorganic crystalline structure with the appearance and durability of naturally formed patina.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 - 1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
 - 2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated [below] [on Drawings], wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). [Extend underlayment into gutter trough.] Roll laps with roller. Cover underlayment within 14 days.
 - 1. Apply over the entire roof surface.
 - 2. Apply over the roof area indicated below:
 - a. Roof perimeter for a distance up from eaves of [24 inches (610 mm)] [36 inches (914 mm)] <Insert dimension> beyond interior wall line.

- b. Valleys, from lowest point to highest point, for a distance on each side of [18 inches (460 mm)] <Insert dimension>. Overlap ends of sheets not less than 6 inches (152 mm).
 - c. Rake edges for a distance of [18 inches (460 mm)] <Insert dimension>.
 - d. Hips and ridges for a distance on each side of [12 inches (305 mm)] <Insert dimension>.
 - e. Roof-to-wall intersections for a distance from wall of [18 inches (460 mm)] <Insert dimension>.
 - f. Around dormers, chimneys, skylights, and other penetrating elements for a distance from element of [18 inches (460 mm)] <Insert dimension>.
- B. Felt Underlayment: Apply at locations indicated [below] [on Drawings], in shingle fashion to shed water, and with lapped joints of not less than 2 inches (50 mm).
1. Apply over the entire roof surface.
 2. Apply on roof not covered by self-adhering sheet underlayment. Lap over edges of self-adhering sheet underlayment not less than 3 inches (75 mm), in shingle fashion to shed water.
- C. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.
- D. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.4 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Shim or otherwise plumb substrates receiving metal panels.
 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air or water-resistive barriers and flashings that are concealed by metal panels are installed.
 3. Install screw fasteners in predrilled holes.
 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 5. Install flashing and trim as metal panel work proceeds.
 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

2. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
 3. Copper Panels: Use copper, stainless-steel, or hardware-bronze fasteners.
 4. Stainless-Steel Panels: Use stainless-steel fasteners.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
 5. Flash and seal panels with weather closures at perimeter of all openings.
 6. Watertight Installation:
 - a. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.
 - b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 - c. At panel splices, nest panels with minimum **6-inch (152-mm)** end lap, sealed with sealant and fastened together by interlocking clamping plates.
- E. Horizontal-Seam (Bermuda-Type) Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each horizontal-seam joint at location, spacing, and with fasteners recommended by manufacturer. Start at eave and work upward toward ridge.
1. Install clips to supports with self-drilling fasteners.
- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended in writing by metal panel manufacturer.

- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that are permanently watertight.
1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of **10 feet (3 m)** with no joints allowed within **24 inches (610 mm)** of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than **1 inch (25 mm)** deep, filled with mastic sealant (concealed within joints).
- H. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than **36 inches (914 mm)** o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- I. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely **1 inch (25 mm)** away from walls; locate fasteners at top and bottom and at approximately **60 inches (1524 mm)** o.c. in between.
1. Provide elbows at base of downspouts to direct water away from building.
 2. Connect downspouts to underground drainage system indicated.
- J. Roof Curbs: Install flashing around bases where they meet metal roof panels.
- K. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.5 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal panel units within installed tolerance of **1/4 inch in 20 feet (6 mm in 6 m)** on slope and location lines and within **1/8-inch (3-mm)** offset of adjoining faces and of alignment of matching profiles.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal panel installation, including accessories. Report results in writing.
- B. Remove and replace applications where tests and inspections indicate that they do not comply with specified requirements.

- C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

3.7 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 074113.13

SECTION 074113.16 - STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes standing-seam metal roof panels.
- B. Related Sections:
 - 1. Section 074213.53 "Metal Soffit Panels" for metal panels used in horizontal soffit applications.
 - 2. Section 077253 "Snow Guards" for prefabricated devices designed to hold snow on the roof surface, allowing it to melt and drain off slowly.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>**.
 - 1. Meet with DEN Project Manager Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
 - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 5. Review structural loading limitations of **[deck] [purlins and rafters]** during and after roofing.
 - 6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
 - 7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.

8. Review temporary protection requirements for metal panel systems during and after installation.
9. Review procedures for repair of metal panels damaged after installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
2. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Test Reports for Credit SS 7.2: For roofing materials, documentation indicating that roofing materials comply with Solar Reflectance Index requirement.

C. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than **1-1/2 inches per 12 inches (1:10)**.

D. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Panels: **12 inches (305 mm)** long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 - 1. A firm that has specialized in installation of types of products required for Project for not less than five (5) years and which is acceptable to manufacturer(s) of primary materials.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical roof area and eave[, **including fascia,**] [**and soffit**] as shown on Drawings; approximately [**48 inches (1200 mm)**] [**12 feet (3.5 m)**] **<Insert dimension>** square by full thickness, including attachments[, **underlayment,**] and accessories.
 - 2. Build mockups for typical roof area only, including accessories.
 - a. Size: [**12 feet (3.5 m) long by 6 feet (1.75 m)**] **<Insert dimension>**.
 - b. [**Each type of exposed seam and seam termination**] **<Insert mockup item>**.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 - 4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.
- E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Minimum **[two (2)]** <Insert number> years from date of Substantial Completion.

- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: Minimum **[20]** **[10]** **<Insert number>** years from date of Substantial Completion.
- C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
1. Warranty Period: Minimum **[20]** **<Insert number>** years from date of Substantial Completion.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25]** **<Insert number>** percent.
- B. Solar Reflectance Index: Not less than **[78]** **[29]** when calculated according to ASTM E 1980.
- C. Energy Performance: Provide roof panels that are listed on the EPA/DOE's ENERGY STAR "Roof Product List" for **[low]** **[steep]**-slope roof products.
- D. Energy Performance: Provide roof panels with an aged Solar Reflectance Index of not less than **[0.64]** **<Insert value>** when tested according to CRRC-1.
- E. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
1. Wind Loads: 115 mph with gust factor of 1.3.

2. Other Design Loads: [**As indicated on Drawings**] <Insert loads>.
 3. Deflection Limits: For wind loads, no greater than [**1/180**] [**1/240**] <Insert deflection> of the span.
 4. Ambient Temperature Range: Minus 30 deg F (minus 35 deg C) to 120 deg F (49 deg C).
 5. <Insert serviceability requirements>.
- F. Air Infiltration: Air leakage of not more than **0.06 cfm/sq. ft.** (0.3 L/s per sq. m) when tested according to ASTM E 1680[**or ASTM E 283**] at the following test-pressure difference:
1. Test-Pressure Difference: [**1.57 lbf/sq. ft. (75 Pa)**] [**6.24 lbf/sq. ft. (300 Pa)**].
- G. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646[**or ASTM E 331**] at the following test-pressure difference:
1. Test-Pressure Difference: [**2.86 lbf/sq. ft. (137 Pa)**] [**6.24 lbf/sq. ft. (300 Pa)**].
- H. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.
- I. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
1. Uplift Rating: [**UL 30**] [**UL 60**] [**UL 90**].
- J. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
1. Fire/Windstorm Classification: Class 1A-[**60**] [**75**] [**90**] [**105**] [**120**] <Insert number>.
 2. Hail Resistance: [**MH**] [**SH**].
- K. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): [**120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces**] <Insert temperature range>.
- ## 2.2 STANDING-SEAM METAL ROOF PANELS
- A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.
 2. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1637.
- B. Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels **<Insert drawing designation>**: Formed with vertical ribs at panel edges and **[intermediate stiffening ribs symmetrically spaced]** **[a flat pan]** between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and snapping panels together.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Advanced Architectural Products.](#)
 - b. [AEP Span; a BlueScope Steel company.](#)
 - c. [Architectural Building Components.](#)
 - d. [Architectural Metal Systems; a Nucor company.](#)
 - e. [CENTRIA Architectural Systems.](#)
 - f. [Dimensional Metals, Inc.](#)
 - g. [Englert, Inc.](#)
 - h. [Fabral.](#)
 - i. [Garland Company, Inc. \(The\)](#)
 - j. [IMETCO.](#)
 - k. [MBCI; a division of NCI Building Systems, L.P.](#)
 - l. [McElroy Metal, Inc.](#)
 - m. [Merchant & Evans.](#)
 - n. [Metal-Fab Manufacturing, LLC.](#)
 - o. [Metal Sales Manufacturing Corporation.](#)
 - p. [Morin; a Kingspan Group company.](#)
 - q. [Petersen Aluminum Corporation.](#)
 - r. [Ryerson, Inc.](#)
 - s. [Ultra Seam, Inc.](#)
 - t. [Union Corrugating Company.](#)
 - u. [VICWEST.](#)
 - v. **<Insert manufacturer's name>**.
 - w. or approved equal.
 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, **Class AZ50 (Class AZM150)** coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: **[0.022 inch (0.56 mm)] [0.028 inch (0.71 mm)] [0.034 inch (0.86 mm)] [0.040 inch (1.02 mm)] [0.052 inch (1.32 mm)]**.
 - b. Exterior Finish: **[Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] <Insert finish>**.

- c. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
3. Aluminum Sheet: Coil-coated sheet, **ASTM B 209 (ASTM B 209M)**, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: **[0.032 inch (0.81 mm)] [0.040 inch (1.02 mm)]**.
 - b. Surface: **[Smooth, flat] [Embossed]** finish.
 - c. Exterior Finish: **[Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] [Clear anodized] [Color anodized] <Insert finish>**.
 - d. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 4. Stainless-Steel Sheet: ASTM A 240/A 240M, **[Type 304] [Type 316]**, fully annealed.
 - a. Nominal Thickness: **[0.019 inch (0.48 mm)] [0.025 inch (0.64 mm)] [0.031 inch (0.79 mm)] [0.38 inch (0.96 mm)] [0.50 inch (1.27 mm)]**.
 - b. Exterior Finish: **[4] [2B] <Insert finish>**.
 5. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.
 - a. Thickness: **[16 oz./sq. ft. (0.55 mm thick)] [20 oz./sq. ft. (0.68 mm thick)]**.
 - b. Exposed Finish: **[Mill] [Prepatinated]**.
 - c. Prepatinated Color: **[Dark brown] [Verdigris] <Insert color>**.
 6. Clips: **[One-piece fixed] [Two-piece floating]** to accommodate thermal movement.
 - a. Material: **[0.028-inch- (0.71-mm-)] [0.064-inch- (1.63-mm-)]** nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
 - b. Material: **[0.025-inch- (0.64-mm-)] [0.062-inch- (1.59-mm-)]** thick, stainless-steel sheet.
 7. Panel Coverage: **[10 inches (254 mm)] [12 inches (305 mm)] [14 inches (356 mm)] [16 inches (406 mm)] [18 inches (457 mm)] [24 inches (610 mm)] <Insert dimension>**.
 8. Panel Height: **[1.0 inch (25 mm)] [1.5 inches (38 mm)] [1.75 inches (44 mm)] <Insert dimension>**.
- C. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels **<Insert drawing designation>**: Formed with vertical ribs at panel edges and **[intermediate stiffening ribs symmetrically spaced] [a flat pan]** between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located

under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Advanced Architectural Products.](#)
 - b. [AEP Span; a BlueScope Steel company.](#)
 - c. [Architectural Building Components.](#)
 - d. [Architectural Metal Systems; a Nucor company.](#)
 - e. [ATAS International, Inc.](#)
 - f. [Berridge Manufacturing Company.](#)
 - g. [CENTRIA Architectural Systems.](#)
 - h. [Dimensional Metals, Inc.](#)
 - i. [Englert, Inc.](#)
 - j. [Fabral.](#)
 - k. [Firestone Metal Products, LLC.](#)
 - l. [Flexospan Steel Buildings, Inc.](#)
 - m. [Garland Company, Inc. \(The\)](#)
 - n. [IMETCO.](#)
 - o. [MBCI; a division of NCI Building Systems, L.P.](#)
 - p. [McElroy Metal, Inc.](#)
 - q. [Merchant & Evans.](#)
 - r. [Metal-Fab Manufacturing, LLC.](#)
 - s. [Metal Sales Manufacturing Corporation.](#)
 - t. [Morin; a Kingspan Group company.](#)
 - u. [Petersen Aluminum Corporation.](#)
 - v. [Ryerson, Inc.](#)
 - w. [Ultra Seam, Inc.](#)
 - x. [Union Corrugating Company](#)
 - y. **<Insert manufacturer's name>.**
 - z. or approved equal.

2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, **Class AZ50 (Class AZM150)** coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: **[0.022 inch (0.56 mm)] [0.028 inch (0.71 mm)] [0.034 inch (0.86 mm)] [0.040 inch (1.02 mm)] [0.052 inch (1.32 mm)].**
 - b. Exterior Finish: **[Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] <Insert finish>.**
 - c. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.**

3. Aluminum Sheet: Coil-coated sheet, **ASTM B 209** (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: **[0.032 inch (0.81 mm)] [0.040 inch (1.02 mm)]**.
 - b. Surface: **[Smooth, flat] [Embossed]** finish.
 - c. Exterior Finish: **[Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] [Clear anodized] [Color anodized] <Insert finish>**.
 - d. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.

 4. Stainless-Steel Sheet: ASTM A 240/A 240M, **[Type 304] [Type 316]**, fully annealed.
 - a. Nominal Thickness: **[0.019 inch (0.48 mm)] [0.025 inch (0.64 mm)] [0.031 inch (0.79 mm)] [0.38 inch (0.96 mm)] [0.50 inch (1.27 mm)]**.
 - b. Exterior Finish: **[4] [2B] <Insert finish>**.

 5. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.
 - a. Thickness: **[16 oz./sq. ft. (0.55 mm thick)] [20 oz./sq. ft. (0.68 mm thick)]**.
 - b. Exposed Finish: **[Mill] [Prepatinated]**.
 - c. Prepatinated Color: **[Dark brown] [Verdigris] <Insert color>**.

 6. Clips: **[One-piece fixed] [Two-piece floating]** to accommodate thermal movement.
 - a. Material: **[0.028-inch- (0.71-mm-)] [0.064-inch- (1.63-mm-)]** nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
 - b. Material: **[0.025-inch- (0.64-mm-)] [0.062-inch- (1.59-mm-)]** thick, stainless-steel sheet.

 7. Joint Type: **[Single folded] [Double folded] [As standard with manufacturer]**.
 8. Panel Coverage: **[12 inches (305 mm)] [14 inches (356 mm)] [16 inches (406 mm)] [18 inches (457 mm)] [20 inches (508 mm)] [24 inches (610 mm)] <Insert dimension>**.
 9. Panel Height: **[1.5 inches (38 mm)] [2.0 inches (51 mm)] [2.5 inches (64 mm)] <Insert dimension>**.
- D. Trapezoidal-Rib, Snap-Joint, Standing-Seam Metal Roof Panels **<Insert drawing designation>**: Formed with raised trapezoidal ribs at panel edges and **[intermediate stiffening ribs symmetrically spaced] [a flat pan]** between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and snapping panels together.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [AEP Span; a BlueScope Steel company.](#)
 - b. [MBCI; a division of NCI Building Systems, L.P.](#)
 - c. [McElroy Metal, Inc.](#)
 - d. <Insert manufacturer's name>.
 - e. or approved equal.

2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, [G90 \(Z275\)](#) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, [Class AZ50 \(Class AZM150\)](#) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: [[0.022 inch \(0.56 mm\)](#)] [[0.028 inch \(0.71 mm\)](#)] [[0.034 inch \(0.86 mm\)](#)] [[0.040 inch \(1.02 mm\)](#)] [[0.052 inch \(1.32 mm\)](#)].
 - b. Exterior Finish: [[Two-coat fluoropolymer](#)] [[Three-coat fluoropolymer](#)] [[Mica fluoropolymer](#)] [[Metallic fluoropolymer](#)] [[FEVE fluoropolymer](#)] [[Siliconized polyester](#)] <Insert finish>.
 - c. Color: [[As indicated by manufacturer's designations](#)] [[Match DEN Project Manager's samples](#)] [[As selected by DEN Project Manager from manufacturer's full range](#)] <Insert color>.

3. Aluminum Sheet: Coil-coated sheet, [ASTM B 209 \(ASTM B 209M\)](#), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: [[0.032 inch \(0.81 mm\)](#)] [[0.040 inch \(1.02 mm\)](#)].
 - b. Surface: [[Smooth, flat](#)] [[Embossed](#)] finish.
 - c. Exterior Finish: [[Two-coat fluoropolymer](#)] [[Three-coat fluoropolymer](#)] [[Mica fluoropolymer](#)] [[Metallic fluoropolymer](#)] [[FEVE fluoropolymer](#)] [[Siliconized polyester](#)] [[Clear anodized](#)] [[Color anodized](#)] <Insert finish>.
 - d. Color: [[As indicated by manufacturer's designations](#)] [[Match DEN Project Manager's samples](#)] [[As selected by DEN Project Manager from manufacturer's full range](#)] <Insert color>.

4. Stainless-Steel Sheet: ASTM A 240/A 240M, [[Type 304](#)] [[Type 316](#)], fully annealed.
 - a. Nominal Thickness: [[0.019 inch \(0.48 mm\)](#)] [[0.025 inch \(0.64 mm\)](#)] [[0.031 inch \(0.79 mm\)](#)] [[0.38 inch \(0.96 mm\)](#)] [[0.50 inch \(1.27 mm\)](#)].
 - b. Exterior Finish: [[4](#)] [[2B](#)] <Insert finish>.

5. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.
 - a. Thickness: [[16 oz./sq. ft. \(0.55 mm thick\)](#)] [[20 oz./sq. ft. \(0.68 mm thick\)](#)].
 - b. Exposed Finish: [[Mill](#)] [[Prepatinated](#)].
 - c. Prepatinated Color: [[Dark brown](#)] [[Verdigris](#)] <Insert color>.

6. Clips: [**One-piece fixed**] [**Two-piece floating**] to accommodate thermal movement.
 - a. Material: [**0.028-inch- (0.71-mm-)**] [**0.064-inch- (1.63-mm-)**] nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
 - b. Material: [**0.025-inch- (0.64-mm-)**] [**0.062-inch- (1.59-mm-)**] thick, stainless-steel sheet.
 7. Panel Coverage: [**12 inches (305 mm)**] [**18 inches (457 mm)**] [**24 inches (610 mm)**] <Insert dimension>.
 8. Panel Height: [**3 inches (76 mm)**] <Insert dimension>.
- E. Trapezoidal-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels <Insert drawing designation>: Formed with raised trapezoidal ribs at panel edges and [**intermediate stiffening ribs symmetrically spaced**] [**a flat pan**] between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Butler Manufacturing; a BlueScope Steel company.](#)
 - b. [MBCI; a division of NCI Building Systems, L.P.](#)
 - c. [Metal Sales Manufacturing Corporation.](#)
 - d. [Morin; a Kingspan Group company.](#)
 - e. [VICWEST.](#)
 - f. <Insert manufacturer's name>.
 - g. or approved equal.
 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, **Class AZ50 (Class AZM150)** coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: [**0.022 inch (0.56 mm)**] [**0.028 inch (0.71 mm)**] [**0.034 inch (0.86 mm)**] [**0.040 inch (1.02 mm)**] [**0.052 inch (1.32 mm)**].
 - b. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Siliconized polyester**] <Insert finish>.
 - c. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 3. Aluminum Sheet: Coil-coated sheet, **ASTM B 209 (ASTM B 209M)**, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

- a. Thickness: [**0.032 inch (0.81 mm)**] [**0.040 inch (1.02 mm)**].
 - b. Surface: [**Smooth, flat**] [**Embossed**] finish.
 - c. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Siliconized polyester**] [**Clear anodized**] [**Color anodized**] <Insert finish>.
 - d. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
4. Stainless-Steel Sheet: ASTM A 240/A 240M, [**Type 304**] [**Type 316**], fully annealed.
- a. Nominal Thickness: [**0.019 inch (0.48 mm)**] [**0.025 inch (0.64 mm)**] [**0.031 inch (0.79 mm)**] [**0.38 inch (0.96 mm)**] [**0.50 inch (1.27 mm)**].
 - b. Exterior Finish: [**4**] [**2B**] <Insert finish>.
5. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.
- a. Thickness: [**16 oz./sq. ft. (0.55 mm thick)**] [**20 oz./sq. ft. (0.68 mm thick)**].
 - b. Exposed Finish: [**Mill**] [**Prepatinated**].
 - c. Prepatinated Color: [**Dark brown**] [**Verdigris**] <Insert color>.
6. Clips: [**One-piece fixed**] [**Two-piece floating**] to accommodate thermal movement.
- a. Material: [**0.028-inch- (0.71-mm-)**] [**0.064-inch- (1.63-mm-)**] nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
 - b. Material: [**0.025-inch- (0.64-mm-)**] [**0.062-inch- (1.59-mm-)**] thick, stainless-steel sheet.
7. Joint Type: [**Single folded**] [**Double folded**] [**As standard with manufacturer**].
8. Panel Coverage: [**12 inches (305 mm)**] [**18 inches (457 mm)**] [**24 inches (610 mm)**] <Insert dimension>.
9. Panel Height: [**2.7 inches (69 mm)**] [**3.0 inches (76 mm)**] <Insert dimension>.
- F. Integral-Standing-Seam Metal Roof Panels <Insert drawing designation>: Formed with integral ribs at panel edges and [**intermediate stiffening ribs symmetrically spaced**] [**a flat pan**] between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and lapping and interconnecting side edges of adjacent panels.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Architectural Metal Systems; a Nucor company.](#)
 - b. [ATAS International, Inc.](#)
 - c. [Cheney Flashing Company.](#)
 - d. [McElroy Metal, Inc.](#)

- e. [Petersen Aluminum Corporation](#).
 - f. <Insert manufacturer's name>.
 - g. or approved equal.
2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, [G90 \(Z275\)](#) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, [Class AZ50 \(Class AZM150\)](#) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
- a. Nominal Thickness: [[0.022 inch \(0.56 mm\)](#)] [[0.028 inch \(0.71 mm\)](#)] [[0.034 inch \(0.86 mm\)](#)] [[0.040 inch \(1.02 mm\)](#)] [[0.052 inch \(1.32 mm\)](#)].
 - b. Exterior Finish: [[Two-coat fluoropolymer](#)] [[Three-coat fluoropolymer](#)] [[Mica fluoropolymer](#)] [[Metallic fluoropolymer](#)] [[FEVE fluoropolymer](#)] [[Siliconized polyester](#)] <Insert finish>.
 - c. Color: [[As indicated by manufacturer's designations](#)] [[Match DEN Project Manager's samples](#)] [[As selected by DEN Project Manager from manufacturer's full range](#)] <Insert color>.
3. Aluminum Sheet: Coil-coated sheet, [ASTM B 209 \(ASTM B 209M\)](#), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
- a. Thickness: [[0.032 inch \(0.81 mm\)](#)] [[0.040 inch \(1.02 mm\)](#)].
 - b. Surface: [[Smooth, flat](#)] [[Embossed](#)] finish.
 - c. Exterior Finish: [[Two-coat fluoropolymer](#)] [[Three-coat fluoropolymer](#)] [[Mica fluoropolymer](#)] [[Metallic fluoropolymer](#)] [[FEVE fluoropolymer](#)] [[Siliconized polyester](#)] [[Clear anodized](#)] [[Color anodized](#)] <Insert finish>.
 - d. Color: [[As indicated by manufacturer's designations](#)] [[Match DEN Project Manager's samples](#)] [[As selected by DEN Project Manager from manufacturer's full range](#)] <Insert color>.
4. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.
- a. Thickness: [[16 oz./sq. ft. \(0.55 mm thick\)](#)] [[20 oz./sq. ft. \(0.68 mm thick\)](#)].
 - b. Exposed Finish: [[Mill](#)] [[Prepatinated](#)].
 - c. Prepatinated Color: [[Dark brown](#)] [[Verdigris](#)] <Insert color>.
5. Clips: [[One-piece fixed](#)] [[Two-piece floating](#)] to accommodate thermal movement.
- a. Material: [[0.028-inch- \(0.71-mm-\)](#)] [[0.064-inch- \(1.63-mm-\)](#)] nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
 - b. Material: [[0.025-inch- \(0.64-mm-\)](#)] [[0.062-inch- \(1.59-mm-\)](#)] thick, stainless-steel sheet.
6. Panel Coverage: [[12 inches \(305 mm\)](#)] [[16 inches \(406 mm\)](#)] [[18 inches \(457 mm\)](#)] <Insert dimension>.

7. Panel Height: [**1.0 inch (25 mm)**] [**1.5 inches (38 mm)**] [**2.0 inches (51 mm)**]
<Insert dimension>.

G. Clipless, Integral-Standing-Seam Metal Roof Panels <Insert drawing designation>:
Formed with integral ribs at panel edges and [**intermediate stiffening ribs
symmetrically spaced**] [**a flat pan**] between ribs; designed for sequential installation
by mechanically attaching panels to supports using screw fasteners located under
concealed side of panels and lapping and interconnecting side edges of adjacent
panels.

1. Manufacturers: Subject to compliance with requirements, provide products by
one of the following:
 - a. [Dimensional Metals, Inc.](#)
 - b. [Englert, Inc.](#)
 - c. [Firestone Metal Products, LLC.](#)
 - d. [Metal-Fab Manufacturing, LLC.](#)
 - e. [Metal Sales Manufacturing Company.](#)
 - f. <Insert manufacturer's name>.
 - g. or approved equal.

2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with
ASTM A 653/A 653M, **G90 (Z275)** coating designation, or aluminum-zinc
alloy-coated steel sheet complying with ASTM A 792/A 792M, **Class AZ50** (Class
AZM150) coating designation; structural quality. Prepainted by the coil-coating
process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: [**0.022 inch (0.56 mm)**] [**0.028 inch (0.71 mm)**] [**0.034
inch (0.86 mm)**].
 - b. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**]
[**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**]
[**Siliconized polyester**] <Insert finish>.
 - c. Color: [**As indicated by manufacturer's designations**] [**Match DEN
Project Manager's samples**] [**As selected by DEN Project Manager
from manufacturer's full range**] <Insert color>.

3. Aluminum Sheet: Coil-coated sheet, **ASTM B 209** (ASTM B 209M), alloy as
standard with manufacturer, with temper as required to suit forming operations
and structural performance required.
 - a. Thickness: [**0.032 inch (0.81 mm)**].
 - b. Surface: [**Smooth, flat**] [**Embossed**] finish.
 - c. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**]
[**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**]
[**Siliconized polyester**] [**Clear anodized**] [**Color anodized**] <Insert
finish>.
 - d. Color: [**As indicated by manufacturer's designations**] [**Match DEN
Project Manager's samples**] [**As selected by DEN Project Manager
from manufacturer's full range**] <Insert color>.

4. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.
 - a. Thickness: [16 oz./sq. ft. (0.55 mm thick)] [20 oz./sq. ft. (0.68 mm thick)].
 - b. Exposed Finish: [Mill] [Prepatinated].
 - c. Prepatinated Color: [Dark brown] [Verdigris] <Insert color>.
5. Panel Coverage: [9.75 inches (248 mm)] [10.63 inches (406 mm)] [11.63 inches (270 mm)] [12 inches (305 mm)] [14 inches (356 mm)] [16 inches (406 mm)] [17.75 inches (451 mm)] [18 inches (457 mm)] [19 inches (483 mm)] [20 inches (508 mm)] <Insert dimension>.
6. Panel Height: [0.87 inch (38 mm)] [1.0 inch (25 mm)] [1.25 inches (32 mm)] [1.5 inches (38 mm)] [1.9 inches (51 mm)] <Insert dimension>.

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils (0.76 mm) thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
 1. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D 1970.
 2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
 3. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
 - b. Grace Construction Products, a unit of W. R. Grace & Co.; [Grace Ice and Water Shield HT] [Ultra].
 - c. Henry Company; Blueskin PE200 HT.
 - d. Kirsch Building Products, LLC; Sharkskin Ultra SA.
 - e. Metal-Fab Manufacturing, LLC; MetShield.
 - f. Owens Corning; WeatherLock Metal High Temperature Underlayment.
 - g. <Insert manufacturer's name; product name or designation>.
 - h. or approved equal.
- B. Felt Underlayment: ASTM D 226/D 22M, Type II (No. 30), asphalt-saturated organic felts.
- C. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation

unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum **1-inch-** (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum **96-inch-** (2400-mm-) long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of **36 inches** (914 mm) o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match **[metal roof panels] [roof fascia and rake trim]**.
- E. Downspouts: Formed from same material as roof panels. Fabricate in **10-foot-** (3-m-) long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.
- F. Roof Curbs: Fabricated from same material as roof panels, **[0.048-inch (1.2-mm)]** **<Insert dimension>** nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb subframing of **0.060-inch-** (1.52-mm-) nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.
1. Insulate roof curb with **1-inch-** (25-mm-) thick, rigid insulation.
- G. Panel Fasteners: Self-tapping screws designed to withstand design loads.
- H. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape **1/2 inch (13 mm)** wide and **1/8 inch (3 mm)** thick.
2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.5 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

- a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.6 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:
 1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 2. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 3. Mica Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 4. Metallic Fluoropolymer: AAMA 621. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 5. FEVE Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish containing 100 percent fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 6. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.
 7. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).
- D. Aluminum Panels and Accessories:
 1. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply

- coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Three-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 3. Mica Fluoropolymer: AAMA 620. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 4. Metallic Fluoropolymer: AAMA 620. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 5. FEVE Fluoropolymer: AAMA 620. Two-coat fluoropolymer finish containing 100 percent fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 6. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than **0.2 mil (0.005 mm)** for primer and **0.8 mil (0.02 mm)** for topcoat.
 7. Exposed Anodized Finish:
 - a. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
 - b. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.
- E. Stainless-Steel Panels and Accessories:
1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - c. Directional Satin Finish: No. 4.
 3. Bright, Cold-Rolled, Unpolished Finish: No. 2B.
- F. Copper Panels and Accessories:
1. Prepatination: Factory prepatinate according to ASTM B 882 to convert the copper surface to an inorganic crystalline structure with the appearance and durability of naturally formed patina.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 - 1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
 - 2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated [below] [on Drawings], wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). [Extend underlayment into gutter trough.] Roll laps with roller. Cover underlayment within 14 days.
 - 1. Apply over the entire roof surface.
 - 2. Apply over the roof area indicated below:
 - a. Roof perimeter for a distance up from eaves of [24 inches (610 mm)] [36 inches (914 mm)] <Insert dimension> beyond interior wall line.

- b. Valleys, from lowest point to highest point, for a distance on each side of [18 inches (460 mm)] <Insert dimension>. Overlap ends of sheets not less than 6 inches (152 mm).
 - c. Rake edges for a distance of [18 inches (460 mm)] <Insert dimension>.
 - d. Hips and ridges for a distance on each side of [12 inches (305 mm)] <Insert dimension>.
 - e. Roof-to-wall intersections for a distance from wall of [18 inches (460 mm)] <Insert dimension>.
 - f. Around dormers, chimneys, skylights, and other penetrating elements for a distance from element of [18 inches (460 mm)] <Insert dimension>.
- B. Felt Underlayment: Apply at locations indicated [below] [on Drawings], in shingle fashion to shed water, and with lapped joints of not less than 2 inches (50 mm).
1. Apply over the entire roof surface.
 2. Apply on roof not covered by self-adhering sheet underlayment. Lap over edges of self-adhering sheet underlayment not less than 3 inches (75 mm), in shingle fashion to shed water.
- C. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.
- D. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.4 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Shim or otherwise plumb substrates receiving metal panels.
 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 3. Install screw fasteners in predrilled holes.
 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 5. Install flashing and trim as metal panel work proceeds.
 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

2. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
 3. Copper Panels: Use copper, stainless-steel, or hardware-bronze fasteners.
 4. Stainless-Steel Panels: Use stainless-steel fasteners.
- C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.
- D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
1. Install clips to supports with self-tapping fasteners.
 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
 4. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
 5. Watertight Installation:
 - a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
 - b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 - c. At panel splices, nest panels with minimum **6-inch (152-mm)** end lap, sealed with sealant and fastened together by interlocking clamping plates.
- F. Clipless Metal Panel Installation: Fasten metal panels to supports with screw fasteners at each lapped joint at location and spacing recommended by manufacturer.
- G. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.
- H. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide

concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of **10 feet (3 m)** with no joints allowed within **24 inches (610 mm)** of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than **1 inch (25 mm)** deep, filled with mastic sealant (concealed within joints).
- I. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than **36 inches (914 mm)** o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- J. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely **1 inch (25 mm)** away from walls; locate fasteners at top and bottom and at approximately **60 inches (1524 mm)** o.c. in between.
1. Provide elbows at base of downspouts to direct water away from building.
 2. Connect downspouts to underground drainage system indicated.
- K. Roof Curbs: Install flashing around bases where they meet metal roof panels.
- L. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.5 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal panel units within installed tolerance of **1/4 inch in 20 feet (6 mm in 6 m)** on slope and location lines as indicated and within **1/8-inch (3-mm)** offset of adjoining faces and of alignment of matching profiles.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.
- B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.
- C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

- D. Prepare test and inspection reports.

3.7 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 074113.16

SECTION 074113.23 - INSULATED METAL ROOF PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes insulated metal roof panels.
- B. Related Sections:
 - 1. Section 074213.53 "Metal Soffit Panels" for metal panels used in horizontal soffit applications.
 - 2. Section 077253 "Snow Guards" for prefabricated devices designed to hold snow on the roof surface, allowing it to melt and drain off slowly.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.
 - 1. Meet with DEN Project Manager Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
 - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 5. Review structural loading limitations of purlins and rafters during and after roofing.
 - 6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
 - 7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.

8. Review temporary protection requirements for metal panel systems during and after installation.
9. Review of procedures for repair of metal panels damaged after installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
2. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Test Reports for Credit SS 7.2: For roofing materials, documentation indicating that roofing materials comply with Solar Reflectance Index requirement.

C. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than **1-1/2 inches per 12 inches (1:10)**.

D. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Panels: **12 inches (305 mm)** long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 - 1. A firm that has specialized in installation of types of products required for Project for not less than five (5) years and which is acceptable to manufacturer(s) of primary materials.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical roof area and eave[, **including fascia,**] [**and soffit**] as shown on Drawings; approximately [**48 inches (1200 mm)**] [**12 feet (3.5 m)**] **<Insert dimension>** square by full thickness, including attachments[, **underlayment,**] and accessories.
 - 2. Build mockups for typical roof area only, including accessories.
 - a. Size: [**12 feet (3.5 m) long by 6 feet (1.75 m)**] **<Insert dimension>**.
 - b. [**Each type of exposed seam and seam termination**] **<Insert mockup item>**.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 - 4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Minimum **[two (2)]** <Insert number> years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: Minimum **[20]** **[10]** **<Insert number>** years from date of Substantial Completion.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25]** **<Insert number>** percent.
- B. Solar Reflectance Index: Not less than **[78]** **[29]** when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.
- C. Energy Performance: Provide roof panels that are listed on the EPA/DOE's ENERGY STAR "Roof Product List" for **[low]** **[steep]**-slope roof products.
- D. Energy Performance: Provide roof panels with an aged Solar Reflectance Index of not less than **[0.64]** **<Insert value>** when tested according to CRR-1.
- E. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 72:
 1. Wind Loads: 115 mph with gust factor of 1.3.
 2. Other Design Loads: **[As indicated on Drawings]** **<Insert loads>**.
 3. Deflection Limits: For wind loads, no greater than **[1/180]** **[1/240]** **<Insert deflection>** of the span.
 4. Ambient Temperature Range: Minus 30 deg F (minus 35 deg C) to 120 deg F (49 deg C).
 5. **<Insert serviceability requirements>**.
- F. Air Infiltration: Air leakage of not more than **0.06 cfm/sq. ft.** (0.3 L/s per sq. m) when tested according to ASTM E 1680[**or ASTM E 283**] at the following test-pressure difference:
 1. Test-Pressure Difference: **[1.57 lbf/sq. ft. (75 Pa)]** **[6.24 lbf/sq. ft. (300 Pa)]**.
- G. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646[**or ASTM E 331**] at the following test-pressure difference:
 1. Test-Pressure Difference: **[2.86 lbf/sq. ft. (137 Pa)]** **[6.24 lbf/sq. ft. (300 Pa)]**.

- H. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
1. Uplift Rating: **[UL 30] [UL 60] [UL 90]**.
- I. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
1. Fire/Windstorm Classification: Class 1A-**[60] [75] [90] [105] [120] <Insert number>**.
 2. Hail Resistance: **[MH] [SH]**.
- J. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): **[120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces] <Insert temperature range>**.

2.2 FOAMED-INSULATION-CORE METAL ROOF PANELS

- A. General: Provide factory-formed and -assembled metal roof panels fabricated from two sheets of metal with insulation core foamed in place during fabrication with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.
1. Panel Performance:
 - a. Flatwise Tensile Strength: **30 psi (200 kPa)** when tested according to ASTM C 297/C 297M.
 - b. Humid Aging: Volume increase not greater than 6.0 percent and no delamination or metal corrosion when tested for seven days at **140 deg F (60 deg C)** and 100 percent relative humidity according to ASTM D 2126.
 - c. Heat Aging: Volume increase not greater than 2.0 percent and no delamination, surface blistering, or permanent bowing when tested for seven days at **200 deg F (93 deg C)** according to ASTM D 2126.
 - d. Cold Aging: Volume decrease not more than 1.0 percent and no delamination, surface blistering, or permanent bowing when tested for seven days at minus **20 deg F (29 deg C)** according to ASTM D 2126.
 - e. Fatigue: No evidence of delamination, core cracking, or permanent bowing when tested to a **20-lbf/sq. ft. (958-kPa)** positive and negative wind load and with deflection of L/180 for 2 million cycles.
 - f. Autoclave: No delamination when exposed to **2-psi (13.8-kPa)** pressure at a temperature of **212 deg F (100 deg C)** for 2-1/2 hours.
 - g. Fire-Test-Response Characteristics: Class A according to ASTM E 108.

2. Insulation Core: Modified isocyanurate or polyurethane foam using a non-CFC blowing agent, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.
 - a. Closed-Cell Content: 90 percent when tested according to ASTM D 6226.
 - b. Density: 2.0 to 2.6 lb/cu. ft. (32 to 42 kg/cu. m) when tested according to ASTM D 1622.
 - c. Compressive Strength: Minimum 20 psi (140 kPa) when tested according to ASTM D 1621.
 - d. Shear Strength: 26 psi (179 kPa) when tested according to ASTM C 273.

- B. Lap-Seam-Profile, Foamed-Insulation-Core Metal Roof Panels **<Insert drawing designation>**: Formed for lapping side edges of adjacent panels and mechanically attaching to supports using exposed fasteners in side laps.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. IPS - Insulated Panel Systems; an NCI company.
 - b. Kingspan.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.

 2. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: [0.022 inch (0.56 mm)] [0.028 inch (0.71 mm)] [0.034 inch (0.86 mm)].
 - b. Exterior Finish: [Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] **<Insert finish>**.
 - 1) Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] **<Insert color>**.
 - c. Interior Finish: [Siliconized polyester] [Acrylic or polyester] **<Insert finish>**.
 - 1) Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] **<Insert color>**.

 3. Batten: Same material, finish, and color as exterior facings of roof panels.
 4. Panel Coverage: [24 inches (610 mm)] [30 inches (762 mm)] [36 inches (914 mm)] [39.6 inches (1000 mm)] [40 inches (1016 mm)] [44.5 inches (1130 mm)] **<Insert dimension>**.

5. Panel Thickness: [1.0 inch (25 mm)] [1.5 inches (38 mm)] [2.0 inches (51 mm)] [2.5 inches (64 mm)] [3.0 inches (76 mm)] [4.0 inches (102 mm)] [5.0 inches (127 mm)] [6.0 inches (152 mm)] <Insert dimension>.
 6. Thermal-Resistance Value (R-Value): <Insert number> according to ASTM C 1363.
- C. Standing-Seam-Profile, Foamed-Insulation-Core Metal Roof Panels <Insert drawing designation>: Formed with vertical tongue-and-groove ribs at panel edges and [intermediate stiffening ribs symmetrically spaced] [a flat pan] between ribs; designed for sequential installation by interlocking tongue-and-groove panel edges and mechanically attaching panels to supports using concealed clips located between panels and engaging edges of adjacent panels, and mechanically seaming panels together.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Butler Manufacturing; a BlueScope Steel company.](#)
 - b. [IPS - Insulated Panel Systems; an NCI company.](#)
 - c. [Metl-Span.](#)
 - d. <Insert manufacturer's name>.
 - e. or approved equal.
 2. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: [0.022 inch (0.56 mm)] [0.028 inch (0.71 mm)] [0.034 inch (0.86 mm)].
 - b. Exterior Finish: [Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] <Insert finish>.
 - 1) Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.
 - c. Interior Finish: [Siliconized polyester] [Acrylic or polyester] <Insert finish>.
 - 1) Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.
 3. Joint Type: [Single folded] [Double folded] [As standard with manufacturer].
 4. Panel Coverage: [36 inches (914 mm)] [42 inches (1067 mm)] <Insert dimension>.

5. Panel Thickness: [2.0 inches (51 mm)] [2.5 inches (64 mm)] [3.0 inches (76 mm)] [4.0 inches (102 mm)] [5.0 inches (127 mm)] [6.0 inches (152 mm)] <Insert dimension>.
 6. Thermal-Resistance Value (R-Value): <Insert number> according to ASTM C 1363.
- D. Batten-Seam-Profile, Foamed-Insulation-Core Metal Roof Panels <Insert drawing designation>: Formed with vertical or tapered tongue-and-groove ribs at panel edges and [intermediate stiffening ribs symmetrically spaced] [a flat pan] between ribs; designed for sequential installation by interlocking tongue-and-groove panel edges and mechanically attaching panels to supports using concealed clips located between panels and engaging edges of adjacent panels, and installing snap-on battens over panel joints.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [CENTRIA Architectural Systems](#).
 - b. <Insert manufacturer's name>.
 - c. or approved equal.
 2. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: 0.022 inch (0.56 mm).
 - b. Exterior Finish: [Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] <Insert finish>.
 - 1) Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.
 - c. Interior Finish: [Siliconized polyester] [Acrylic or polyester] <Insert finish>.
 - 1) Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.
 3. Batten: Same material, finish, and color as exterior facings of roof panels.
 4. Clips: One piece; [0.064-inch- (1.63-mm-)] [0.097-inch- (2.50-mm-)] nominal thickness, [zinc-coated (galvanized)] [or] [aluminum-zinc alloy-coated] steel sheet.
 5. Panel Coverage: [36 inches (914 mm)] [39.6 inches (1000 mm)] <Insert dimension>.

6. Panel Thickness: [1.75 inches (44 mm)] [2.0 inches (51 mm)] [2.5 inches (64 mm)] [3.0 inches (76 mm)] [4.0 inches (102 mm)] [5.0 inches (127 mm)] [6.0 inches (152 mm)] <Insert dimension>.
7. Thermal-Resistance Value (R-Value): <Insert number> according to ASTM C 1363.

2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as exterior facings of metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Gutters: Formed from same material, finish, and color as exterior facings of panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- (2400-mm-) long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches (914 mm) o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match [metal roof panels] [roof fascia and rake trim].
- E. Downspouts: Formed from same material, finish, and color as exterior facings of roof panels. Fabricate in 10-foot- (3-m-) long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.

- F. Roof Curbs: Fabricated from same material, finish, and color as exterior facings of roof panels, **[0.048-inch (1.2-mm)]** <Insert dimension> nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb subframing of **0.060-inch-** (1.52-mm-) nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.
1. Insulate roof curb with **1-inch-** (25-mm-) thick, rigid insulation.
- G. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- H. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape **1/2 inch** (13 mm) wide and **1/8 inch** (3 mm) thick.
 2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.4 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Exterior Facings and Accessories:
 1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 2. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 3. Mica Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 4. Metallic Fluoropolymer: AAMA 621. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

5. FEVE Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish containing 100 percent fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
6. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.

D. Interior Facings:

1. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.
2. Acrylic or Polyester Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports

unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal roof panels as vapor seal; apply sealant to panel joint on exposed side of panels for weather seal.
 2. Shim or otherwise plumb substrates receiving metal panels.
 3. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 4. Install screw fasteners in predrilled holes.
 5. Locate and space fastenings in uniform vertical and horizontal alignment.
 6. Install flashing and trim as metal panel work proceeds.
 7. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 8. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 9. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
- C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.
- D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- E. Lap-Seam, Foamed-Insulation-Core Metal Roof Panels: Fasten insulated metal roof panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
1. Lap ribbed or fluted sheets one full-rib corrugation. Apply panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or applications not true to line.
 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of insulated metal roof panels.
 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 4. Provide sealant tape at lapped joints of insulated metal roof panels and between panels and protruding equipment, vents, and accessories.
 5. Apply a continuous ribbon of sealant tape to panel side laps and elsewhere as needed to weatherproof panels.
 6. Apply snap-on battens to seams of insulated metal roof panels to conceal fasteners.

- F. Standing-Seam, Foamed-Insulation-Core Metal Roof Panels: Fasten insulated metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
1. Install clips to supports with self-tapping fasteners.
 2. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so cleat, insulated metal roof panel, and factory-applied side-lap sealant are completely engaged.
- G. Batten-Seam, Foamed-Insulation-Core Metal Roof Panels: Fasten insulated metal roof panels to supports with concealed clips at each batten-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
1. Apply battens to insulated metal roof panel seams, fully engaged to provide weathertight joints.
- H. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, provide types recommended in writing by metal roof panel manufacturer.
- I. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of **10 feet (3 m)** with no joints allowed within **24 inches (610 mm)** of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than **1 inch (25 mm)** deep, filled with mastic sealant (concealed within joints).
- J. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than **36 inches (914 mm) o.c.** using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- K. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely **1 inch (25 mm)** away from walls; locate fasteners at top and bottom and at approximately **60 inches (1500 mm) o.c.** in between.

1. Provide elbows at base of downspouts to direct water away from building.
2. Connect downspouts to underground drainage system indicated.

L. Roof Curbs: Install flashing around bases where they meet metal roof panels.

M. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.4 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal panel units within installed tolerance of **1/4 inch in 20 feet** (6 mm in 6 m) on slope and location lines as indicated and within **1/8-inch** (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal panel installation, including accessories. Report results in writing.

B. Remove and replace applications where tests and inspections indicate that they do not comply with specified requirements.

C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 074113.23

SECTION 074213.13 - FORMED METAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Exposed-fastener, lap-seam metal wall panels.
2. Concealed-fastener, lap-seam metal wall panels.
3. Metal liner panels.

- B. Related Sections:

1. Section 074213.16 "Metal Plate Wall Panels" for solid metal plate wall panels.
2. Section 074213.19 "Insulated Metal Wall Panels" for foamed-in-place, laminated and honeycomb insulated metal wall panels.
3. Section 074213.23 "Metal Composite Material Wall Panels" for metal-faced composite wall panels.
4. Section 074213.53 "Metal Soffit Panels" for metal panels used in horizontal soffit applications.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.

1. Meet with DEN Project Manager, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.

4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal panel assembly during and after installation.
8. Review of procedures for repair of metal panels damaged after installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include product specifications, certified product test results, installation instructions and general recommendations, construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
2. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

C. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; large-scale details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish between factory and field assembly work.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than **1-1/2 inches per 12 inches (1:10)**.

D. Samples for Initial Selection: For each type of metal panel indicated with factory-applied finishes.

1. Include Samples of trim and accessories involving color selection.

E. Samples for Verification: For each type of exposed finish and color, prepared on Samples of size indicated below:

1. Metal Panels: Submit three (3) samples **12 inches (305 mm)** long by actual panel width. Include miscellaneous trim piece, anchors, insulation, sealants and compressible gasket, fasteners, closures, and other metal panel accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Certificate from installer evidencing minimum ten (10) years experience successfully installing this type of work on projects of this scale and proof of acceptance by manufacturer.
- C. Certificate from the manufacturer stating that all materials are per contract requirements and proof of minimum ten (10) years experience manufacturing products of this type on projects of this scale.
- D. Certificate from manufacturer that panel system is approved for use in Denver or has ICBO approval for Class 1 non-combustible construction.
- E. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- F. Structural Calculations: Signed and stamped by a Colorado licensed structural engineer.
- G. Field quality-control reports.
- H. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 MAINTENANCE SUBMITTALS

- A. Provide minimum four (4) gallons touch-up paint for each color used on Project. Store in area directed by DEN Project Manager.
 - 1. Instruct Owners personnel in appropriate paint touch-up procedures.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 - 1. A firm that has specialized in installation of types of products required for Project for not less than ten (10) years and which is acceptable to manufacturer(s) of primary materials.

B. Manufacturer's Qualifications:

1. A firm that has specialized in manufacture of products required for Project with a minimum of ten (10) years experience manufacturing products of this type on projects of this scale.

C. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

D. Performance Test Standards: Submit evidence that preformed panel system has been pretested by an independent laboratory and certified by manufacturer to provide specified resistance to air and water infiltration and structural deflection and failure when installed as indicated and when tested in accordance with AAMA Standard Test TM 1, "Specification for Method of Test for Metal Curtain Walls for Water Penetration Using Dynamic Pressure".

E. Fire Resistances:

1. Wall panels shall be rated and carry the following listings:
 - a. U.L. classification for "Surface Burning Characteristics", U.L. Standard 723 (ASTM-E84) File R6863.

	Finished Panel:	Core Only:
Flame Spread:	25 max.	25 max.
Fuel Contributed:	0	0
Smoke Developed:	450 max.	200 max.

- b. U.L. classification per "Insulated Wall Construction" U.L. Subject 1040 (corner test).
- c. Factory mutual approval as Class 1 panels.
- d. ICBO Research Report for Class 1 non-combustible construction and approval by the City and County of Denver.

F. Required Performances: Fabricate panels and other components of wall system for the following installed as indicated performances:

1. Wind Loading: Refer to Part 1 of this Section.
2. Water Penetration: No significant, uncontrolled leakage at 6.24 lbs. per sq. ft. per ASTM E 331.
3. Air Infiltration: 0.060 cfm per sq. ft. for wall areas, with 1.56 lbs. per sq. ft. differential pressure, as tested per ASTM E 283.
4. Sound Transmission: STC rating of 28.
5. Thermal Performance: Factory-assembled panel shall have a U-value of 0.072 btu/hr./SF when tested in accordance with ASTM C236.
6. Bond Strength: No metal primer interface corrosion or delamination shall occur after 500 hrs. at 120 deg F and 100% relative humidity.
7. Design to withstand thermal movements resulting from an ambient temperature

- range of minus 30 deg F (minus 35 deg C) to 120 deg F (67 deg C), which may cause preformed siding range of 180 deg F (100 deg. C), without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.
8. Pressure Equalization: Provide Rain Screen Test showing that with liner seal broken, there shall be no water rise in joint cavity under 10 psf in accordance with ASTM E331-70. A fully designed and tested gutter system meeting the same test requirements will be acceptable upon submittal of supporting documents.
 9. Galvanic Reaction: Provide galvanic protection between dissimilar metals.
- G. Provide complete structural calculations, including calculation for cold-formed metal framing and metal fabrications back-up, signed and stamped by an engineer registered in the state of Colorado. Calculations are to be based on the following:
1. Wind load exposure C, Importance factor I = 1.15.
 2. Minimum basic wind speed: 85 M.P.H., but not less than 50 p.s.f., positive and negative pressure.
 3. Wind Load Deflection: L/180, 3/4" max.
 4. Maximum Wind Load: 115 mph with gust factor of 1.3.
- H. Field Measurements: It is the intent of these specifications for Contractor to shop fabricate metal panels completely. Contractor to make all field measurements required to shop fabricate panel system accurately. Field cutting and trimming be held to an absolute minimum.
- I. Single Source Responsibility: The "Exterior Skin Installer" is to provide the structural calculations, coordination, fabrication, installation and warranty for all work associated with the exterior skin, which includes: Section 083213 "Sliding Aluminum Frame Glass Doors", Section 084413 "Glazed Aluminum Curtainwall", Section 089119 "Fixed Louvers", and Section 089516 "Wall Vents", and the following:
1. All cold formed metal framing or metal fabrications associated with the above. Cold formed metal framing to be of the size and spacing indicated on the drawings, except gauge shall be as needed as determined by the structural calculations required, but in no case less than 14 gauge. Metal fabrications shall be of the size indicated on the drawings, except thickness shall be as determined by the structural calculations required. Provide additional fabrications as needed.
 - a. All of this work to be in accordance with requirements of Section 054000 "Cold Formed Metal Framing" and Section 055000 "Metal Fabrications".
 2. All expansion joints in the exterior side of the above exterior wall, per Section 079500 "Expansion Control".
 3. All joint sealers installed within the above-described work including joints between adjacent work, per Section 079000, "Joint Sealants".
 4. All glazing installed within the above-described work per Section 088000, "Glazing".
 5. All painting, finishes, or coatings associated with the above described work.
 6. All firestopping associated with exterior skin intersection with rated roofs or floors per Section 078413 "Penetration Firestopping."

- J. Testing Agency: Contractor to employ an independent testing agency to make on-site inspections on at least a weekly basis during skin construction. Testing Agency to measure actual installed tolerances, and inspect all facets of construction with regard to compliance with contract requirements. Submit weekly report to DEN Project Manager. Immediately note any areas not in compliance. Independent Testing Agency shall verify existing installed tolerances prior to start of work and notify DEN Project Manager of any discrepancies to specified tolerances prior to start of prefabrication.
- K. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation. Coordinate installation of mock-up with work by other trades.
1. Build mockup of typical metal panel assembly [**as shown on Drawings**] <Insert **size**>, including [**corner,**] [**soffits,**] supports, attachments, and accessories.
 2. Demonstrate each type of detail condition to the greatest extent possible including; a minimum 100 square feet of masonry, an expansion joint, louver, curtainwall, glazing, preformed siding, sealants, painting, finishes, typical parapet and cap, typical cold formed metal framing, typical metal fabrications and a minimum 80 square feet of exterior soffit. This mockup may be constructed and approved in sections. Provide scaffolding to facilitate mockup review.
 3. Do not proceed with initial mockup prior to approval of initial submittals unless approved by the DEN Project Manager.
 4. Portions of the mockup that are not approved are to be reconstructed until approved. The approved mockup will serve as the standard of quality. Conduct field water test on approved initial mockup per AAMA 501.2-83
 5. Complete initial mockup a minimum of one (1) month prior to start of fabrication of panels, glazing, louvers, and curtainwall for the actual building.
 6. Remove initial mockup from the project site when directed by the DEN Project Manager, but not prior to Substantial Completion. Undamaged glass may be applied to overstock requirements. Salvage preformed siding, clean, protect, and store for Owner in area as directed by DEN Project Manager.
 7. Water-Spray Test: Conduct water-spray test of metal panel assembly mockup, testing for water penetration according to AAMA 501.2.
 8. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 9. Construct additional mockups on the permanent structure as may be required to demonstrate each type of condition not demonstrated in initial mock-up. Notify DEN Project Manager when ready for review. Do not proceed with subsequent work until mockup is approved.
 10. Cost of components of this section incorporated into mockups, including separate structure for the initial mockup shall be by this Contractor.
 11. Structural performance for mockup shall be designed to withstand wind loads specified herein, with deflections equal to those required for the final building. See structural drawings.
 12. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.
- E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.11 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Minimum **[two (2)]** <Insert number> years from date of Substantial Completion.
- B. Installer Warranty:
 - 1. Entire panel system, including weathertightness, material, finish, insulation,

seams, and fasteners for a period of minimum two (2) years from date of Substantial Completion.

- C. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: Minimum **[20] [10] <Insert number>** years from date of Substantial Completion.

1.13 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25] <Insert number>** percent.
- B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
1. Wind Loads: 115 mph with gust factor of 1.3.
 2. Other Design Loads: **[As indicated on Drawings] <Insert loads>**.
 3. Deflection Limits: For wind loads, no greater than **[1/180] [1/240] <Insert deflection>** of the span.
 4. Ambient Temperature Range: Minus 30 deg F (minus 35 deg C) to 120 deg F (49 deg C).
 5. **<Insert serviceability requirements>**.
- C. Air Infiltration: Air leakage of not more than **0.06 cfm/sq. ft. (0.3 L/s per sq. m)** when tested according to ASTM E 283 at the following test-pressure difference:
1. Test-Pressure Difference: **[1.57 lbf/sq. ft. (75 Pa)] [6.24 lbf/sq. ft. (300 Pa)]**.

- D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
1. Test-Pressure Difference: [**2.86 lbf/sq. ft. (137 Pa)**] [**6.24 lbf/sq. ft. (300 Pa)**].
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): [**120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces**] <Insert temperature range>.
- F. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 EXPOSED-FASTENER, LAP-SEAM METAL WALL PANELS

- A. General: Provide factory-formed metal panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.
- B. Corrugated-Profile, Exposed-Fastener Metal Wall Panels <Insert drawing **designation**>: Formed with alternating curved ribs spaced at **2.67 inches (68 mm)** o.c. across width of panel.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [AEP Span; a BlueScope Steel company.](#)
 - b. [Alcoa Inc.](#)
 - c. [ATAS International, Inc.](#)
 - d. [Berridge Manufacturing Company.](#)
 - e. [CENTRIA Architectural Systems.](#)
 - f. [Englert, Inc.](#)
 - g. [Fabral.](#)
 - h. [Firestone Metal Products, LLC.](#)
 - i. [Flexospan Steel Buildings, Inc.](#)
 - j. [Industrial Building Panels.](#)
 - k. [MBCI; a division of NCI Building Systems, L.P.](#)
 - l. [McElroy Metal, Inc.](#)
 - m. [Metal Sales Manufacturing Corporation.](#)
 - n. [Morin; a Kingspan Group company.](#)
 - o. <Insert manufacturer's name>.

- p. or approved equal.
2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, **Class AZ50 (Class AZM150)** coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: [**0.022 inch (0.56 mm)**] [**0.028 inch (0.71 mm)**] [**0.034 inch (0.86 mm)**] [**0.040 inch (1.02 mm)**] [**0.052 inch (1.32 mm)**].
 - b. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Siliconized polyester**] <Insert finish>.
 - c. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 3. Aluminum Sheet: Coil-coated sheet, **ASTM B 209 (ASTM B 209M)**, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: [**0.032 inch (0.81 mm)**] [**0.040 inch (1.02 mm)**].
 - b. Surface: [**Smooth, flat**] [**Embossed**] finish.
 - c. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Siliconized polyester**] [**Clear anodized**] [**Color anodized**] <Insert finish>.
 - d. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 4. Stainless-Steel Sheet: ASTM A 240/A 240M, [**Type 304**] [**Type 316**], fully annealed.
 - a. Nominal Thickness: [**0.019 inch (0.48 mm)**] [**0.025 inch (0.64 mm)**] [**0.031 inch (0.79 mm)**] [**0.38 inch (0.96 mm)**] [**0.50 inch (1.27 mm)**].
 - b. Exterior Finish: [**4**] [**2B**] <Insert finish>.
 5. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.
 - a. Thickness: [**16 oz./sq. ft. (0.55 mm thick)**] [**20 oz./sq. ft. (0.68 mm thick)**].
 - b. Exposed Finish: [**Mill**] [**Prepatinated**].
 - c. Prepatinated Color: [**Dark brown**] [**Verdigris**] <Insert color>.
 6. Rib Spacing: [**2.67 inches (68 mm)**] <Insert dimension> o.c.
 7. Panel Coverage: [**21.3 inches (541 mm)**] [**29.3 inches (744 mm)**] [**34.6 inches (881 mm)**] [**37.3 inches (947 mm)**] [**42.6 inches (1084 mm)**] [**45.3 inches (1151 mm)**] <Insert dimension>.
 8. Panel Height: [**0.5 inch (13 mm)**] [**0.875 inch (22 mm)**] <Insert dimension>.

- C. Tapered-Rib-Profile, Exposed-Fastener Metal Wall Panels <Insert drawing designation>: Formed with raised, trapezoidal major ribs and [intermediate stiffening ribs symmetrically spaced] [a flat pan] between major ribs.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Architectural Metal Systems; a Nucor company.](#)
 - b. [Berridge Manufacturing Company.](#)
 - c. [Butler Manufacturing Company; a BlueScope Steel company.](#)
 - d. [CENTRIA Architectural Systems.](#)
 - e. [Englert, Inc.](#)
 - f. [Fabral.](#)
 - g. [Firestone Metal Products, LLC.](#)
 - h. [Flexospan Steel Buildings, Inc.](#)
 - i. [MBCI; a division of NCI Building Systems, L.P.](#)
 - j. [McElroy Metal, Inc.](#)
 - k. [Metal Sales Manufacturing Corporation.](#)
 - l. [Morin; a Kingspan Group company.](#)
 - m. [Petersen Aluminum Corporation.](#)
 - n. [Union Corrugating Company.](#)
 - o. [United Steel Deck, Inc.; Subsidiary of Bouras Industries Inc.](#)
 - p. [VICWEST.](#)
 - q. <Insert manufacturer's name>.
 - r. or approved equal.
 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, [G90 \(Z275\)](#) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, [Class AZ50 \(Class AZM150\)](#) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: [[0.022 inch \(0.56 mm\)](#)] [[0.028 inch \(0.71 mm\)](#)] [[0.034 inch \(0.86 mm\)](#)] [[0.040 inch \(1.02 mm\)](#)] [[0.052 inch \(1.32 mm\)](#)].
 - b. Exterior Finish: [[Two-coat fluoropolymer](#)] [[Three-coat fluoropolymer](#)] [[Mica fluoropolymer](#)] [[Metallic fluoropolymer](#)] [[FEVE fluoropolymer](#)] [[Siliconized polyester](#)] <Insert finish>.
 - c. Color: [[As indicated by manufacturer's designations](#)] [[Match DEN Project Manager's samples](#)] [[As selected by DEN Project Manager from manufacturer's full range](#)] <Insert color>.
 3. Aluminum Sheet: Coil-coated sheet, [ASTM B 209 \(ASTM B 209M\)](#), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: [[0.032 inch \(0.81 mm\)](#)] [[0.040 inch \(1.02 mm\)](#)].
 - b. Surface: [[Smooth, flat](#)] [[Embossed](#)] finish.
 - c. Exterior Finish: [[Two-coat fluoropolymer](#)] [[Three-coat fluoropolymer](#)] [[Mica fluoropolymer](#)] [[Metallic fluoropolymer](#)] [[FEVE fluoropolymer](#)]

- [Siliconized polyester] [Clear anodized] [Color anodized] <Insert finish>.
- d. Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.
4. Stainless-Steel Sheet: ASTM A 240/A 240M, [Type 304] [Type 316], fully annealed.
- a. Nominal Thickness: [0.019 inch (0.48 mm)] [0.025 inch (0.64 mm)] [0.031 inch (0.79 mm)] [0.38 inch (0.96 mm)] [0.50 inch (1.27 mm)].
- b. Exterior Finish: [4] [2B] <Insert finish>.
5. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.
- a. Thickness: [16 oz./sq. ft. (0.55 mm thick)] [20 oz./sq. ft. (0.68 mm thick)].
- b. Exposed Finish: [Mill] [Prepatinated].
- c. Prepatinated Color: [Dark brown] [Verdigris] <Insert color>.
6. Major-Rib Spacing: [6 inches (152 mm)] [8 inches (203 mm)] [9 inches (229 mm)] [12 inches (305 mm)] <Insert dimension> o.c.
7. Panel Coverage: [24 inches (610 mm)] [36 inches (914 mm)] <Insert dimension>.
8. Panel Height: [0.625 inch (16 mm)] [0.75 inch (19 mm)] [1.0 inch (25 mm)] [1.25 inches (32 mm)] [1.5 inches (38 mm)] <Insert dimension>.
- D. Reverse-Rib-Profile, Exposed-Fastener Metal Wall Panels <Insert drawing designation>: Formed with recessed, trapezoidal major valleys and [intermediate stiffening valleys symmetrically spaced] [a flat pan] between major valleys.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. [Architectural Metal Systems; a Nucor company.](#)
- b. [Flexospan Steel Buildings, Inc.](#)
- c. [Union Corrugating Company.](#)
- d. [United Steel Deck, Inc.; Subsidiary of Bouras Industries Inc.](#)
- e. <Insert manufacturer's name>.
- f. or approved equal.
2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
- a. Nominal Thickness: [0.022 inch (0.56 mm)] [0.028 inch (0.71 mm)] [0.034 inch (0.86 mm)] [0.040 inch (1.02 mm)] [0.052 inch (1.32 mm)].

- b. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Siliconized polyester**] <Insert finish>.
 - c. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 3. Aluminum Sheet: Coil-coated sheet, **ASTM B 209** (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: [**0.032 inch (0.81 mm)**] [**0.040 inch (1.02 mm)**].
 - b. Surface: [**Smooth, flat**] [**Embossed**] finish.
 - c. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Siliconized polyester**] [**Clear anodized**] [**Color anodized**] <Insert finish>.
 - d. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 4. Stainless-Steel Sheet: ASTM A 240/A 240M, [**Type 304**] [**Type 316**], fully annealed.
 - a. Nominal Thickness: [**0.019 inch (0.48 mm)**] [**0.025 inch (0.64 mm)**] [**0.031 inch (0.79 mm)**] [**0.38 inch (0.96 mm)**] [**0.50 inch (1.27 mm)**].
 - b. Exterior Finish: [**4**] [**2B**] <Insert finish>.
 5. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.
 - a. Thickness: [**16 oz./sq. ft. (0.55 mm thick)**] [**20 oz./sq. ft. (0.68 mm thick)**].
 - b. Exposed Finish: [**Mill**] [**Prepatinated**].
 - c. Prepatinated Color: [**Dark brown**] [**Verdigris**] <Insert color>.
 6. Major-Rib Spacing: [**12 inches (305 mm)**] <Insert dimension> o.c.
 7. Panel Coverage: [**36 inches (914 mm)**] <Insert dimension>.
 8. Panel Height: [**1.25 inches (32 mm)**] <Insert dimension>.
- E. Vee-Rib-Profile, Exposed-Fastener Metal Wall Panels <Insert drawing designation>:
Formed with raised, V-shaped ribs and recesses that are approximately same size, evenly spaced across panel width, and with rib/recess sides angled at approximately 45 degrees.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [AEP Span; a BlueScope Steel company.](#)
 - b. [Alcoa Inc.](#)
 - c. [ATAS International, Inc.](#)
 - d. [CENTRIA Architectural Systems.](#)

- e. [Englert, Inc.](#)
 - f. [Fabral.](#)
 - g. [Firestone Metal Products, LLC.](#)
 - h. [Flexospan Steel Buildings, Inc.](#)
 - i. [Industrial Building Panels.](#)
 - j. [MBCI; a division of NCI Building Systems, L.P.](#)
 - k. [McElroy Metal, Inc.](#)
 - l. [Metal Sales Manufacturing Corporation.](#)
 - m. [Morin; a Kingspan Group company.](#)
 - n. [United Steel Deck, Inc.; Subsidiary of Bouras Industries Inc.](#)
 - o. **<Insert manufacturer's name>.**
 - p. or approved equal.
2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, **Class AZ50 (Class AZM150)** coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
- a. Nominal Thickness: **[0.022 inch (0.56 mm)] [0.028 inch (0.71 mm)] [0.034 inch (0.86 mm)] [0.040 inch (1.02 mm)] [0.052 inch (1.32 mm)].**
 - b. Exterior Finish: **[Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] <Insert finish>.**
 - c. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.**
3. Aluminum Sheet: Coil-coated sheet, **ASTM B 209 (ASTM B 209M)**, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
- a. Thickness: **[0.032 inch (0.81 mm)] [0.040 inch (1.02 mm)].**
 - b. Surface: **[Smooth, flat] [Embossed] finish.**
 - c. Exterior Finish: **[Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] [Clear anodized] [Color anodized] <Insert finish>.**
 - d. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.**
4. Stainless-Steel Sheet: ASTM A 240/A 240M, **[Type 304] [Type 316]**, fully annealed.
- a. Nominal Thickness: **[0.019 inch (0.48 mm)] [0.025 inch (0.64 mm)] [0.031 inch (0.79 mm)] [0.38 inch (0.96 mm)] [0.50 inch (1.27 mm)].**
 - b. Exterior Finish: **[4] [2B] <Insert finish>.**
5. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.

- a. Thickness: [**16 oz./sq. ft. (0.55 mm thick)**] [**20 oz./sq. ft. (0.68 mm thick)**].
 - b. Exposed Finish: [**Mill**] [**Prepatinated**].
 - c. Prepatinated Color: [**Dark brown**] [**Verdigris**] <Insert color>.
6. Rib Spacing: [**5.3 inches (135 mm)**] [**7.2 inches (183 mm)**] [**12 inches (305 mm)**] <Insert dimension> o.c.
 7. Panel Coverage: [**30 inches (762 mm)**] [**32 inches (813 mm)**] [**36 inches (914 mm)**] [**40 inches (1016 mm)**] <Insert dimension>.
 8. Panel Height: [**1.375 inches (35 mm)**] [**1.5 inches (38 mm)**] [**1.75 inches (44 mm)**] [**2.0 inches (51 mm)**] [**3.0 inches (76 mm)**] <Insert dimension>.
- F. Box-Rib-Profile, Exposed-Fastener Metal Wall Panels <Insert drawing designation>:
Formed with raised, box-shaped ribs, evenly spaced across panel width, and with rib/recess sides angled 60 degrees or more.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [AEP Span; a BlueScope Steel company.](#)
 - b. [Alcoa Inc.](#)
 - c. [Fabral.](#)
 - d. [Industrial Building Panels.](#)
 - e. [MBCI; a division of NCI Building Systems, L.P.](#)
 - f. [Metal Sales Manufacturing Corporation.](#)
 - g. [United Steel Deck, Inc.; Subsidiary of Bouras Industries Inc.](#)
 - h. [VICWEST.](#)
 - i. <Insert manufacturer's name>.
 - j. or approved equal.
 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, **Class AZ50 (Class AZM150)** coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: [**0.022 inch (0.56 mm)**] [**0.028 inch (0.71 mm)**] [**0.034 inch (0.86 mm)**] [**0.040 inch (1.02 mm)**] [**0.052 inch (1.32 mm)**].
 - b. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Siliconized polyester**] <Insert finish>.
 - c. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 3. Aluminum Sheet: Coil-coated sheet, **ASTM B 209 (ASTM B 209M)**, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: [**0.032 inch (0.81 mm)**] [**0.040 inch (1.02 mm)**].
 - b. Surface: [**Smooth, flat**] [**Embossed**] finish.

- c. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Siliconized polyester**] [**Clear anodized**] [**Color anodized**] <Insert finish>.
 - d. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 4. Stainless-Steel Sheet: ASTM A 240/A 240M, [**Type 304**] [**Type 316**], fully annealed.
 - a. Nominal Thickness: [**0.019 inch (0.48 mm)**] [**0.025 inch (0.64 mm)**] [**0.031 inch (0.79 mm)**] [**0.38 inch (0.96 mm)**] [**0.50 inch (1.27 mm)**].
 - b. Exterior Finish: [**4**] [**2B**] <Insert finish>.
 5. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.
 - a. Thickness: [**16 oz./sq. ft. (0.55 mm thick)**] [**20 oz./sq. ft. (0.68 mm thick)**].
 - b. Exposed Finish: [**Mill**] [**Prepatinated**].
 - c. Prepatinated Color: [**Dark brown**] [**Verdigris**] <Insert color>.
 6. Rib Spacing: [**2.67 inches (68 mm)**] [**4.0 inches (102 mm)**] [**5.3 inches (135 mm)**] [**6.0 inches (152 mm)**] <Insert dimension> o.c.
 7. Panel Coverage: [**24 inches (610 mm)**] [**28 inches (711 mm)**] [**30 inches (762 mm)**] [**32 inches (813 mm)**] [**36 inches (914 mm)**] <Insert dimension>.
 8. Panel Height: [**0.625 inch (16 mm)**] [**1.0 inch (25 mm)**] [**1.5 inches (38 mm)**] [**2.0 inches (51 mm)**] <Insert dimension>.
- G. Deep-Box-Rib-Profile, Exposed-Fastener Metal Wall Panels <Insert drawing **designation**>: Formed with raised, box-shaped ribs, evenly spaced across panel width, and with rib/recess sides angled more than 60 degrees.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [ATAS International, Inc.](#)
 - b. [CENTRIA Architectural Systems.](#)
 - c. [Fabral.](#)
 - d. [Metal Sales Manufacturing Corporation.](#)
 - e. [Morin; a Kingspan Group company.](#)
 - f. <Insert manufacturer's name>.
 - g. or approved equal.
 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, **Class AZ50 (Class AZM150)** coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

- a. Nominal Thickness: [0.022 inch (0.56 mm)] [0.028 inch (0.71 mm)] [0.034 inch (0.86 mm)] [0.040 inch (1.02 mm)] [0.052 inch (1.32 mm)].
 - b. Exterior Finish: [Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] <Insert finish>.
 - c. Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.
3. Aluminum Sheet: Coil-coated sheet, ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
- a. Thickness: [0.032 inch (0.81 mm)] [0.040 inch (1.02 mm)].
 - b. Surface: [Smooth, flat] [Embossed] finish.
 - c. Exterior Finish: [Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] [Clear anodized] [Color anodized] <Insert finish>.
 - d. Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.
4. Stainless-Steel Sheet: ASTM A 240/A 240M, [Type 304] [Type 316], fully annealed.
- a. Nominal Thickness: [0.019 inch (0.48 mm)] [0.025 inch (0.64 mm)] [0.031 inch (0.79 mm)] [0.38 inch (0.96 mm)] [0.50 inch (1.27 mm)].
 - b. Exterior Finish: [4] [2B] <Insert finish>.
5. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.
- a. Thickness: [16 oz./sq. ft. (0.55 mm thick)] [20 oz./sq. ft. (0.68 mm thick)].
 - b. Exposed Finish: [Mill] [Prepatinated].
 - c. Prepatinated Color: [Dark brown] [Verdigris] <Insert color>.
6. Rib Spacing: [12 inches (305 mm)] <Insert dimension> o.c.
7. Panel Coverage: [24 inches (610 mm)] <Insert dimension>.
8. Panel Height: [3.0 inches (76 mm)] [4.0 inches (102 mm)] <Insert dimension>.

2.3 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

- A. General: Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners[**and factory-applied sealant**] in side laps. Include accessories required for weathertight installation.

- B. Flush-Profile, Concealed-Fastener Metal Wall Panels <Insert drawing designation>:
Formed with vertical panel edges and [intermediate stiffening ribs symmetrically spaced] [a flat pan] between panel edges; with flush joint between panels.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [AEP Span; a BlueScope Steel company.](#)
 - b. [Alcoa Inc.](#)
 - c. [Architectural Building Components.](#)
 - d. [Architectural Metal Systems; a Nucor company.](#)
 - e. [ATAS International, Inc.](#)
 - f. [Berridge Manufacturing Company.](#)
 - g. [CENTRIA Architectural Systems.](#)
 - h. [Dimension Metals, Inc.](#)
 - i. [Fabral.](#)
 - j. [Flexospan Steel Buildings, Inc.](#)
 - k. [MBCI; a division of NCI Building Systems, L.P.](#)
 - l. [Metal-Fab Manufacturing, LLC](#)
 - m. [Morin; a Kingspan Group company.](#)
 - n. [Petersen Aluminum Corporation.](#)
 - o. [United Steel Deck, Inc.; Subsidiary of Bouras Industries Inc.](#)
 - p. [VICWEST.](#)
 - q. <Insert manufacturer's name>.
 - r. or approved equal.
 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, [G90 \(Z275\)](#) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, [Class AZ50 \(Class AZM150\)](#) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: [[0.022 inch \(0.56 mm\)](#)] [[0.028 inch \(0.71 mm\)](#)] [[0.034 inch \(0.86 mm\)](#)] [[0.040 inch \(1.02 mm\)](#)] [[0.052 inch \(1.32 mm\)](#)].
 - b. Exterior Finish: [[Two-coat fluoropolymer](#)] [[Three-coat fluoropolymer](#)] [[Mica fluoropolymer](#)] [[Metallic fluoropolymer](#)] [[FEVE fluoropolymer](#)] [[Siliconized polyester](#)] <Insert finish>.
 - c. Color: [[As indicated by manufacturer's designations](#)] [[Match DEN Project Manager's samples](#)] [[As selected by DEN Project Manager from manufacturer's full range](#)] <Insert color>.
 3. Aluminum Sheet: Coil-coated sheet, [ASTM B 209 \(ASTM B 209M\)](#), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: [[0.032 inch \(0.81 mm\)](#)] [[0.040 inch \(1.02 mm\)](#)].
 - b. Surface: [[Smooth, flat](#)] [[Embossed](#)] finish.
 - c. Exterior Finish: [[Two-coat fluoropolymer](#)] [[Three-coat fluoropolymer](#)] [[Mica fluoropolymer](#)] [[Metallic fluoropolymer](#)] [[FEVE fluoropolymer](#)]

- [Siliconized polyester] [Clear anodized] [Color anodized] <Insert finish>.
- d. Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.
4. Stainless-Steel Sheet: ASTM A 240/A 240M, [Type 304] [Type 316], fully annealed.
- a. Nominal Thickness: [0.019 inch (0.48 mm)] [0.025 inch (0.64 mm)] [0.031 inch (0.79 mm)] [0.38 inch (0.96 mm)] [0.50 inch (1.27 mm)].
- b. Exterior Finish: [4] [2B] <Insert finish>.
5. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.
- a. Thickness: [16 oz./sq. ft. (0.55 mm thick)] [20 oz./sq. ft. (0.68 mm thick)].
- b. Exposed Finish: [Mill] [Prepatinated].
- c. Prepatinated Color: [Dark brown] [Verdigris] <Insert color>.
6. Panel Coverage: [12 inches (305 mm)] <Insert dimension>.
7. Panel Height: [1.0 inch (25 mm)] [1.5 inches (38 mm)] <Insert dimension>.
- C. Reveal-Joint, Concealed-Fastener Metal Wall Panels <Insert drawing designation>:
Formed with vertical panel edges and [intermediate stiffening ribs symmetrically spaced] [a flat pan] between panel edges; with narrow reveal joint between panels.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. [ATAS International, Inc.](#)
- b. [CENTRIA Architectural Systems.](#)
- c. [Metal Sales Manufacturing Corporation.](#)
- d. [Morin; a Kingspan Group company.](#)
- e. [Petersen Aluminum Corporation.](#)
- f. <Insert manufacturer's name>.
- g. or approved equal.
2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
- a. Nominal Thickness: [0.022 inch (0.56 mm)] [0.028 inch (0.71 mm)] [0.034 inch (0.86 mm)] [0.040 inch (1.02 mm)] [0.052 inch (1.32 mm)].
- b. Exterior Finish: [Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] <Insert finish>.

- c. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 3. Aluminum Sheet: Coil-coated sheet, **ASTM B 209** (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: **[0.032 inch (0.81 mm)] [0.040 inch (1.02 mm)]**.
 - b. Surface: **[Smooth, flat] [Embossed]** finish.
 - c. Exterior Finish: **[Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] [Clear anodized] [Color anodized] <Insert finish>**.
 - d. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 4. Stainless-Steel Sheet: ASTM A 240/A 240M, **[Type 304] [Type 316]**, fully annealed.
 - a. Nominal Thickness: **[0.019 inch (0.48 mm)] [0.025 inch (0.64 mm)] [0.031 inch (0.79 mm)] [0.38 inch (0.96 mm)] [0.50 inch (1.27 mm)]**.
 - b. Exterior Finish: **[4] [2B] <Insert finish>**.
 5. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.
 - a. Thickness: **[16 oz./sq. ft. (0.55 mm thick)] [20 oz./sq. ft. (0.68 mm thick)]**.
 - b. Exposed Finish: **[Mill] [Prepatinated]**.
 - c. Prepatinated Color: **[Dark brown] [Verdigris] <Insert color>**.
 6. Panel Coverage: **[12 inches (305 mm)] <Insert dimension>**.
 7. Panel Height: **[1.0 inch (25 mm)] [1.5 inches (38 mm)] <Insert dimension>**.
- D. Wide-Reveal-Joint, Concealed-Fastener Metal Wall Panels **<Insert drawing designation>**: Formed with vertical panel edges and a stepped profile between panel edges, resulting in a wide reveal joint between panels.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Alcoa Inc.](#)
 - b. [Architectural Metal Systems; a Nucor company.](#)
 - c. [ATAS International, Inc.](#)
 - d. [CENTRIA Architectural Systems.](#)
 - e. [Englert, Inc.](#)
 - f. [Fabral.](#)
 - g. [Flexospan Steel Buildings, Inc.](#)
 - h. [Morin; a Kingspan Group company.](#)
 - i. [United Steel Deck, Inc.; Subsidiary of Bouras Industries Inc.](#)

- j. VICWEST.
 - k. <Insert manufacturer's name>.
 - l. or approved equal.
2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, **Class AZ50 (Class AZM150)** coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
- a. Nominal Thickness: [**0.022 inch (0.56 mm)**] [**0.028 inch (0.71 mm)**] [**0.034 inch (0.86 mm)**] [**0.040 inch (1.02 mm)**] [**0.052 inch (1.32 mm)**].
 - b. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Siliconized polyester**] <Insert finish>.
 - c. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
3. Aluminum Sheet: Coil-coated sheet, **ASTM B 209 (ASTM B 209M)**, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
- a. Thickness: [**0.032 inch (0.81 mm)**] [**0.040 inch (1.02 mm)**].
 - b. Surface: [**Smooth, flat**] [**Embossed**] finish.
 - c. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Siliconized polyester**] [**Clear anodized**] [**Color anodized**] <Insert finish>.
 - d. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
4. Stainless-Steel Sheet: ASTM A 240/A 240M, [**Type 304**] [**Type 316**], fully annealed.
- a. Nominal Thickness: [**0.019 inch (0.48 mm)**] [**0.025 inch (0.64 mm)**] [**0.031 inch (0.79 mm)**] [**0.38 inch (0.96 mm)**] [**0.50 inch (1.27 mm)**].
 - b. Exterior Finish: [**4**] [**2B**] <Insert finish>.
5. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.
- a. Thickness: [**16 oz./sq. ft. (0.55 mm thick)**] [**20 oz./sq. ft. (0.68 mm thick)**].
 - b. Exposed Finish: [**Mill**] [**Prepatinated**].
 - c. Prepatinated Color: [**Dark brown**] [**Verdigris**] <Insert color>.
6. Panel Coverage: [**12 inches (305 mm)**] <Insert dimension>.
7. Panel Height: [**1.5 inches (38 mm)**] <Insert dimension>.

- E. V-Groove-Profile, Concealed-Fastener Metal Wall Panels <Insert drawing designation>: Formed with vertical panel edges and [intermediate stiffening ribs symmetrically spaced] [a flat pan] between panel edges.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [ATAS International, Inc.](#)
 - b. <Insert manufacturer's name>.
 - c. or approved equal.
 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: [0.022 inch (0.56 mm)] [0.028 inch (0.71 mm)] [0.034 inch (0.86 mm)] [0.040 inch (1.02 mm)] [0.052 inch (1.32 mm)].
 - b. Exterior Finish: [Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] <Insert finish>.
 - c. Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.
 3. Aluminum Sheet: Coil-coated sheet, ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: [0.032 inch (0.81 mm)] [0.040 inch (1.02 mm)].
 - b. Surface: [Smooth, flat] [Embossed] finish.
 - c. Exterior Finish: [Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] [Clear anodized] [Color anodized] <Insert finish>.
 - d. Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.
 4. Stainless-Steel Sheet: ASTM A 240/A 240M, [Type 304] [Type 316], fully annealed.
 - a. Nominal Thickness: [0.019 inch (0.48 mm)] [0.025 inch (0.64 mm)] [0.031 inch (0.79 mm)] [0.38 inch (0.96 mm)] [0.50 inch (1.27 mm)].
 - b. Exterior Finish: [4] [2B] <Insert finish>.
 5. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.
 - a. Thickness: [16 oz./sq. ft. (0.55 mm thick)] [20 oz./sq. ft. (0.68 mm thick)].

- b. Exposed Finish: **[Mill]** **[Prepatinated]**.
 - c. Prepatinated Color: **[Dark brown]** **[Verdigris]** **<Insert color>**.
 6. Panel Coverage: **[6 inches (152 mm)]** **[8 inches (203 mm)]** **[12 inches (305 mm)]** **<Insert dimension>**.
 7. Panel Height: **[0.625 inch (16 mm)]** **[1.25 inches (32 mm)]** **<Insert dimension>**.
- F. Creased-Rib-Profile, Concealed-Fastener Metal Wall Panels **<Insert drawing designation>**: Formed with raised, center-creased, trapezoidal major ribs; with reveal joint between panels.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Alcoa Inc.](#)
 - b. [ATAS International, Inc.](#)
 - c. [Morin; a Kingspan Group company.](#)
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, **Class AZ50 (Class AZM150)** coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: **[0.022 inch (0.56 mm)]** **[0.028 inch (0.71 mm)]** **[0.034 inch (0.86 mm)]** **[0.040 inch (1.02 mm)]** **[0.052 inch (1.32 mm)]**.
 - b. Exterior Finish: **[Two-coat fluoropolymer]** **[Three-coat fluoropolymer]** **[Mica fluoropolymer]** **[Metallic fluoropolymer]** **[FEVE fluoropolymer]** **[Siliconized polyester]** **<Insert finish>**.
 - c. Color: **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's samples]** **[As selected by DEN Project Manager from manufacturer's full range]** **<Insert color>**.
 3. Aluminum Sheet: Coil-coated sheet, **ASTM B 209 (ASTM B 209M)**, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: **[0.032 inch (0.81 mm)]** **[0.040 inch (1.02 mm)]**.
 - b. Surface: **[Smooth, flat]** **[Embossed]** finish.
 - c. Exterior Finish: **[Two-coat fluoropolymer]** **[Three-coat fluoropolymer]** **[Mica fluoropolymer]** **[Metallic fluoropolymer]** **[FEVE fluoropolymer]** **[Siliconized polyester]** **[Clear anodized]** **[Color anodized]** **<Insert finish>**.
 - d. Color: **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's samples]** **[As selected by DEN Project Manager from manufacturer's full range]** **<Insert color>**.

4. Stainless-Steel Sheet: ASTM A 240/A 240M, [Type 304] [Type 316], fully annealed.
 - a. Nominal Thickness: [0.019 inch (0.48 mm)] [0.025 inch (0.64 mm)] [0.031 inch (0.79 mm)] [0.38 inch (0.96 mm)] [0.50 inch (1.27 mm)].
 - b. Exterior Finish: [4] [2B] <Insert finish>.
5. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.
 - a. Thickness: [16 oz./sq. ft. (0.55 mm thick)] [20 oz./sq. ft. (0.68 mm thick)].
 - b. Exposed Finish: [Mill] [Prepatinated].
 - c. Prepatinated Color: [Dark brown] [Verdigris] <Insert color>.
6. Panel Coverage: [12 inches (305 mm)] <Insert dimension>.
7. Panel Height: [0.875 inch (22 mm)] [1.5 inches (38 mm)] <Insert dimension>.

2.4 METAL LINER PANELS

- A. General: Provide factory-formed metal liner panels designed for interior side walls and field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for a complete installation.
- B. Metal Liner Panels <Insert drawing designation>: [Solid] [Perforated] panels formed with [intermediate stiffening ribs symmetrically spaced] [a flat pan] between panel edges; with a flush joint between panels.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Alcoa Inc.](#)
 - b. [Architectural Metal Systems; a Nucor company.](#)
 - c. [Berridge Manufacturing Company.](#)
 - d. [CENTRIA Architectural Systems.](#)
 - e. [Englert, Inc.](#)
 - f. [Fabral.](#)
 - g. [Flexospan Steel Buildings, Inc.](#)
 - h. [MBCI; a division of NCI Building Systems, L.P.](#)
 - i. [Metal Sales Manufacturing Corporation.](#)
 - j. [Morin; a Kingspan Group company.](#)
 - k. [United Steel Deck, Inc.; Subsidiary of Bouras Industries Inc.](#)
 - l. <Insert manufacturer's name>.
 - m. or approved equal.
 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

- a. Nominal Thickness: [0.022 inch (0.56 mm)] [0.028 inch (0.71 mm)] [0.034 inch (0.86 mm)] [0.040 inch (1.02 mm)] [0.052 inch (1.32 mm)].
 - b. Exterior Finish: [Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] <Insert finish>.
 - c. Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.
3. Aluminum Sheet: Coil-coated sheet, ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
- a. Thickness: [0.032 inch (0.81 mm)] [0.040 inch (1.02 mm)].
 - b. Surface: [Smooth, flat] [Embossed] finish.
 - c. Exterior Finish: [Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] [Clear anodized] [Color anodized] <Insert finish>.
 - d. Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.
4. Stainless-Steel Sheet: ASTM A 240/A 240M, [Type 304] [Type 316], fully annealed.
- a. Nominal Thickness: [0.019 inch (0.48 mm)] [0.025 inch (0.64 mm)] [0.031 inch (0.79 mm)] [0.38 inch (0.96 mm)] [0.50 inch (1.27 mm)].
 - b. Exterior Finish: [4] [2B] <Insert finish>.
5. Panel Coverage: [12 inches (305 mm)] [16 inches (406 mm)] [24 inches (610 mm)] [36 inches (914 mm)] <Insert dimension>.
6. Seam Profile: [Flush] [Tapered] [Striated].
7. Seam Height: [1.5 inches (38 mm)] [2.0 inches (51 mm)] [3.0 inches (76 mm)] <Insert dimension>.
8. Acoustical Performance: Where sound-absorption requirement is indicated, fabricate interior liner panels with 1/8-inch- (3-mm-) diameter holes uniformly spaced approximately 1000 holes/sq. ft. (10 750 holes/sq. m).
- a. NRC of not less than [0.65] [0.85] [1.00] <Insert rating> when tested according to ASTM C 423.

2.5 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
 2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.6 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to

factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.7 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:
 - 1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply

- coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 3. Mica Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 4. Metallic Fluoropolymer: AAMA 621. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 5. FEVE Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish containing 100 percent fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 6. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than **0.2 mil (0.005 mm)** for primer and **0.8 mil (0.02 mm)** for topcoat.
 7. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of **0.5 mil (0.013 mm)**.

D. Aluminum Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Three-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
3. Mica Fluoropolymer: AAMA 620. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
4. Metallic Fluoropolymer: AAMA 620. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
5. FEVE Fluoropolymer: AAMA 620. Two-coat fluoropolymer finish containing 100 percent fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

6. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than **0.2 mil (0.005 mm)** for primer and **0.8 mil (0.02 mm)** for topcoat.
 7. Exposed Anodized Finish:
 - a. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
 - b. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.
- E. Stainless-Steel Panels and Accessories:
1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - c. Directional Satin Finish: No. 4.
 3. Bright, Cold-Rolled, Unpolished Finish: No. 2B.
- F. Copper Panels and Accessories:
1. Prepatination: Factory prepatinate according to ASTM B 882 to convert the copper surface to an inorganic crystalline structure with the appearance and durability of naturally formed patina.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Install panels with concealed fasteners. Concealed self-tapping screws or nut and bolt are acceptable. Installation shall include no exposed wet sealant or tape except where noted on Drawings.
 - 2. All panels shall be removable from the exterior side without need for panel cutting or removal of curtainwall mullions or louvers.
 - 3. Shim or otherwise plumb substrates receiving metal panels.
 - 4. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 - 5. Install screw fasteners in predrilled holes.
 - 6. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 7. Install flashing and trim as metal panel work proceeds.
 - 8. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 - 9. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 - 10. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
 - 1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
 - 2. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
 - 3. Copper Panels: Use copper, stainless-steel, or hardware-bronze fasteners.
 - 4. Stainless-Steel Panels: Use stainless-steel fasteners.

- C. Installation Tolerances: Shim and align panel units within installed tolerance of 1/4" in 20' 0" on level/plumb/slope and location/line as indicated, and within 1/16" offset at flush conditions of adjoining faces and alignment of matching profiles. Maximum 3/8" deviation of any material at any given theoretical point.
- D. Wall Panel Support Framing System: To be supplied and installed by metal wall Contractor. Final alignment to be the responsibility of this Contractor.
- E. Shop Drawings: Do not proceed with installation until approved shop drawings have been received.
- F. Inspection:
1. Examine alignment of structural steel prior to installation.
 2. Inspect all material including spandrel panels.
- G. Installation and Erection: Install the metal wall panels, fasteners, trim and related items in accordance with approved shop/erection drawings and manufacturer's specifications. Panels shall be installed by the manufacturer and/or approved erectors who have been trained and have experience in the installation of the particular type of wall panel and/or curtain wall systems specified.
1. The factory assembled wall panels shall be attached to the structural steel from the exterior of the building using self-tapping fasteners and clips spaced at each girt. Flashings and accessories shall be fastened 12" on center.
 2. Erection of the wall panels shall be started per manufacturer's recommendation and the panels held true to line. Horizontal lines are to be straight and level and vertical lines plumb.
- H. Joint Sealants: Install joint fillers gaskets and sealants where indicated and where required for weatherproof performance of panel systems.
1. Refer to Section 079000 "Joint Sealants" of these specifications for product and installation requirements applicable to indicated joint sealants.
- I. Joint Sealants, Post-Installation: Refer to Section 079000 "Joint Sealants" of these specifications for post installation requirements on joint sealers.
- J. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- K. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.

3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
 5. Flash and seal panels with weather closures at perimeter of all openings.
- L. Watertight Installation:
1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
 2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 3. At panel splices, nest panels with minimum **6-inch (152-mm)** end lap, sealed with sealant and fastened together by interlocking clamping plates.
- M. Metal Liner Panels: Install panels on [**exterior side of girts, with girts exposed to the interior**] [**interior side of girts with flush appearance on the inside**].
- N. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- O. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of **10 feet (3 m)** with no joints allowed within **24 inches (610 mm)** of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than **1 inch (25 mm)** deep, filled with mastic sealant (concealed within joints).

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: **[Owner will engage] [Engage]** a qualified testing agency to perform tests and inspections.
- B. Water-Spray Test: After installation, test area of assembly **[shown on Drawings] [as directed by DEN Project Manager]** <Insert area> for water penetration according to AAMA 501.2.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.
- D. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.
- E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- F. Prepare test and inspection reports.

3.5 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Damaged Material: Repair or replace all damaged material to the satisfaction of the DEN Project Manager if damage has been caused by the manufacturer or wall panel erector/contractor. The General Contractor shall be responsible for the protection of completed or installed walls from damage by other trades. Installed areas or portions of the work shall be inspected by the Owner for approval following the completion of such areas.
- D. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 074213.13

SECTION 074213.19 - INSULATED METAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Foamed-insulation-core metal wall panels.
 - 2. Laminated-insulation-core metal wall panels.
 - 3. Honeycomb-core metal wall panels.
- B. Related Requirements:
 - 1. Section 074213.53 "Metal Soffit Panels" for metal panels used in horizontal soffit applications.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.
 - 1. Meet with Owner, DEN Project Manager, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
 - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
 - 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.

7. Review temporary protection requirements for metal panel assembly during and after installation.
8. Review procedures for repair of metal panels damaged after installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include product specifications, certified product test results, installation instructions and general recommendations, construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
 - a. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

C. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; large scale details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish between factory and field assembly work.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than **1-1/2 inches per 12 inches (1:10)**.

D. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

E. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below.

1. Metal Panels: Submit three (3) samples **12 inches (305 mm)** long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Certificate from installer evidencing minimum ten (10) years experience successfully

installing this type of work on projects of this scale and proof of acceptance by manufacturer.

- C. Certificate from the manufacturer stating that all materials are per contract requirements and proof of minimum ten (10) years experience manufacturing products of this type on projects of this scale.
- D. Certificate from manufacturer that panel system is approved for use in Denver or has ICBO approval for Class 1 non-combustible construction.
- E. Product Test Reports: For each product, tests performed by a qualified testing agency.
- F. Structural Calculations: Signed and stamped by a Colorado licensed structural engineer.
- G. Field quality-control reports.
- H. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 MAINTENANCE SUBMITTALS

- A. Provide minimum four (4) gallons touch-up paint for each color used on Project. Store in area directed by DEN Project Manager.
 - 1. Instruct Owners personnel in appropriate paint touch-up procedures.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 - 1. A firm that has specialized in installation of types of products required for Project for not less than ten (10) years and which is acceptable to manufacturer(s) of primary materials.
- B. Manufacturer's Qualifications:
 - 1. A firm that has specialized in manufacture of products required for Project with a minimum of ten (10) years experience manufacturing products of this type on projects of this scale.

C. Performance Test Standards: Submit evidence that preformed panel system has been pretested by an independent laboratory and certified by manufacturer to provide specified resistance to air and water infiltration and structural deflection and failure when installed as indicated and when tested in accordance with AAMA Standard Test TM 1, "Specification for Method of Test for Metal Curtain Walls for Water Penetration Using Dynamic Pressure".

D. Fire Resistances:

1. Wall panels shall be rated and carry the following listings:

a. U.L. classification for "Surface Burning Characteristics", U.L. Standard 723 (ASTM-E84) File R6863.

	Finished Panel:	Core Only:
Flame Spread	25 max.	25 max.
Fuel Contributed	0	0
Smoke Developed	450 max.	200 max.

b. U.L. classification per "Insulated Wall Construction" U.L. Subject 1040 (corner test).

c. Factory mutual approval as Class 1 panels.

d. ICBO Research Report for Class 1 non-combustible construction and approval by the City and County of Denver.

E. Required Performances: Fabricate panels and other components of wall system for the following installed as indicated performances:

1. Wind Loading: Refer to Part 1 of this Section.
2. Water Penetration: No significant, uncontrolled leakage at 6.24 lbs. per sq. ft. per ASTM E 331.
3. Air Infiltration: 0.060 cfm per sq. ft. for wall areas, with 1.56 lbs. per sq. ft. differential pressure, as tested per ASTM E 283.
4. Sound Transmission: STC rating of 28.
5. Thermal Performance: Factory-assembled panel shall have a U-value of 0.072 btu/hr./SF when tested in accordance with ASTM C236.
6. Bond Strength: No metal primer interface corrosion or delamination shall occur after 500 hrs. at 120 deg F and 100% relative humidity.
7. Design to withstand thermal movements resulting from an ambient temperature range of minus 30 deg F (minus 35 deg C) to 120 deg F (67 deg C), which may cause preformed siding range of 180 deg F (100 deg C), without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.
8. Pressure Equalization: Provide Rain Screen Test showing that with liner seal broken, there shall be no water rise in joint cavity under 10 psf in accordance with ASTM E331-70. A fully designed and tested gutter system meeting the same test requirements will be acceptable upon submittal of supporting documents.
9. Galvanic Reaction: Provide galvanic protection between dissimilar metals.

F. Provide complete structural calculations, including calculation for cold-formed metal

framing and metal fabrications back-up, signed and stamped by an engineer registered in the state of Colorado. Calculations are to be based on the following:

1. Wind load exposure C, Importance factor I = 1.15.
 2. Minimum basic wind speed: 85 M.P.H., but not less than 50 p.s.f., positive and negative pressure.
 3. Wind Load Deflection: L/180, 3/4" max.
 4. Maximum Wind Load: 115 mph with gust factor of 1.3.
- G. Field Measurements: It is the intent of these specifications for Contractor to shop fabricate metal panels completely. Contractor to make all field measurements required to shop fabricate panel system accurately. Field cutting and trimming be held to an absolute minimum.
- H. Single Source Responsibility: The "Exterior Skin Installer" is to provide the structural calculations, coordination, fabrication, installation and warranty for all work associated with the exterior skin, which includes: Section 083213 "Sliding Aluminum Frame Glass Doors", Section 084413 "Glazed Aluminum Curtainwall", Section 089119 "Fixed Louvers", and Section 089516 "Wall Vents", and the following:
1. All cold formed metal framing or metal fabrications associated with the above. Cold formed metal framing to be of the size and spacing indicated on the drawings, except gauge shall be as needed as determined by the structural calculations required, but in no case less than 14 gauge. Metal fabrications shall be of the size indicated on the drawings, except thickness shall be as determined by the structural calculations required. Provide additional fabrications as needed.
 - a. All of this work to be in accordance with requirements of Section 054000 "Cold Formed Metal Framing" and Section 055000 "Metal Fabrications".
 2. All expansion joints in the exterior side of the above exterior wall, per Section 079500 "Expansion Control".
 3. All joint sealers installed within the above described work including joints between adjacent work, per Section 079000, "Joint Sealants".
 4. All glazing installed within the above described work per Section 088000, "Glazing".
 5. All painting, finishes or coatings associated with the above described work.
 6. All firestopping associated with exterior skin intersection with rated roofs or floors per Section 078413 "Penetration Firestopping."
- I. Testing Agency: Contractor to employ an independent testing agency to make on-site inspections on at least a weekly basis during skin construction. Testing Agency to measure actual installed tolerances, and inspect all facets of construction with regard to compliance with contract requirements. Submit weekly report to DEN Project Manager. Immediately note any areas not in compliance. Independent Testing Agency shall verify existing installed tolerances prior to start of work and notify DEN Project Manager of any discrepancies to specified tolerances prior to start of prefabrication.
- J. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

Coordinate installation of mock-up with work by other trades.

1. Build mockup of typical metal panel assembly [**as shown on Drawings**] <Insert **size**>, including [**corner,**] [**soffits,**] supports, attachments, and accessories.
2. Demonstrate each type of detail condition to the greatest extent possible including; a minimum 100 square feet of masonry, an expansion joint, louver, curtainwall, glazing, preformed siding, sealants, painting, finishes, typical parapet and cap, typical cold formed metal framing, typical metal fabrications and a minimum 80 square feet of exterior soffit. This mockup may be constructed and approved in sections. Provide scaffolding to facilitate mockup review.
3. Do not proceed with initial mockup prior to approval of initial submittals unless approved by the DEN Project Manager.
4. Portions of the mockup that are not approved are to be reconstructed until approved. The approved mockup will serve as the standard of quality. Conduct field water test on approved initial mockup per AAMA 501.2-83
5. Complete initial mockup a minimum of one (1) month prior to start of fabrication of panels, glazing, louvers, and curtainwall for the actual building.
6. Remove initial mockup from the project site when directed by the DEN Project Manager, but not prior to Substantial Completion. Undamaged glass may be applied to overstock requirements. Salvage preformed siding, clean, protect, and store for Owner in area as directed by DEN Project Manager.
7. Water-Spray Test: Conduct water-spray test of metal panel assembly mockup, testing for water penetration according to AAMA 501.2.
8. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
9. Construct additional mockups on the permanent structure as may be required to demonstrate each type of condition not demonstrated in initial mock-up. Notify DEN Project Manager when ready for review. Do not proceed with subsequent work until mockup is approved.
10. Cost of components of this section incorporated into mockups, including separate structure for the initial mockup, shall be by this Contractor.
11. Structural performance for mockup shall be designed to withstand wind loads specified herein, with deflections equal to those required for the final building. See structural drawings.
12. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with

positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

- D. Retain strippable protective covering on metal panels during installation.

1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.11 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Structural failures including rupturing, cracking, or puncturing.
- b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Minimum **[Two]** <Insert number> years from date of Substantial Completion.

- B. Installer Warranty:

1. Entire panel system, including weathertightness, material, finish, insulation, seams, and fasteners for a period of minimum two (2) years from date of Substantial Completion.

- C. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

- a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
- b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
- c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: Minimum **[20]** **[10]** **<Insert number>** years from date of Substantial Completion.

1.13 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25]** **<Insert number>** percent.
- B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 72:
 1. Wind Loads: 115 mph with gust factor of 1.3.
 2. Other Design Loads: **[As indicated on Drawings]** **<Insert loads>**.
 3. Deflection Limits: For wind loads, no greater than **[1/180]** **[1/240]** **<Insert deflection>** of the span.
 4. Ambient Temperature Range: Minus 30 deg F (minus 35 deg C) to 120 deg F (49 deg C).
 5. **<Insert serviceability requirements>**.
- C. Air Infiltration: Air leakage of not more than **0.06 cfm/sq. ft. (0.3 L/s per sq. m)** when tested according to ASTM E 283 at the following test-pressure difference:
 1. Test-Pressure Difference: **[1.57 lbf/sq. ft. (75 Pa)]** **[6.24 lbf/sq. ft. (300 Pa)]**.
- D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 1. Test-Pressure Difference: **[2.86 lbf/sq. ft. (137 Pa)]** **[6.24 lbf/sq. ft. (300 Pa)]**.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 1. Temperature Change (Range): **[120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces]** **<Insert temperature range>**.
- F. Fire-Test-Response Characteristics: Provide metal wall panels and system components with the following fire-test-response characteristics, as determined by

testing identical panels and system components per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Characteristics: Provide materials and construction tested for fire resistance per ASTM E 119.
2. Intermediate-Scale Multistory Fire Test: Tested mockup, representative of completed multistory wall assembly of which wall panel is a part, complies with NFPA 285 for test method and required fire-test-response characteristics of exterior non-load-bearing wall panel assemblies.
3. Radiant Heat Exposure: No ignition when tested according to NFPA 268.
4. Potential Heat: Acceptable level when tested according to NFPA 259.
5. Surface-Burning Characteristics: Provide wall panels with a flame-spread index of 25 or less and a smoke-developed index of 450 or less, per ASTM E 84.

2.2 FOAMED-INSULATION-CORE METAL WALL PANELS

A. General: Provide factory-formed and -assembled metal wall panels fabricated from two metal facing sheets and insulation core foamed in place during fabrication, and with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.

1. Panel Performance:
 - a. Flatwise Tensile Strength: 30 psi (207 kPa) when tested according to ASTM C 297/C 297M.
 - b. Humid Aging: Volume increase not greater than 6.0 percent and no delamination or metal corrosion when tested for seven days at 140 deg F (60 deg C) and 100 percent relative humidity according to ASTM D 2126.
 - c. Heat Aging: Volume increase not greater than 2.0 percent and no delamination, surface blistering, or permanent bowing when tested for seven days at 200 deg F (93 deg C) according to ASTM D 2126.
 - d. Cold Aging: Volume decrease not more than 1.0 percent and no delamination, surface blistering, or permanent bowing when tested for seven days at minus 20 deg F (29 deg C) according to ASTM D 2126.
 - e. Fatigue: No evidence of delamination, core cracking, or permanent bowing when tested to a 20-lbf/sq. ft. (958-kPa) positive and negative wind load and with deflection of L/180 for 2 million cycles.
 - f. Autoclave: No delamination when exposed to 2-psi (13.8-kPa) pressure at a temperature of 212 deg F (100 deg C) for 2-1/2 hours.
2. Insulation Core: Modified isocyanurate or polyurethane foam using a non-CFC blowing agent, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.
 - a. Closed-Cell Content: 90 percent when tested according to ASTM D 6226.
 - b. Density: 2.0 to 2.6 lb/cu. ft. (32 to 42 kg/cu. m) when tested according to ASTM D 1622.

- c. Compressive Strength: Minimum **20 psi** (140 kPa) when tested according to ASTM D 1621.
 - d. Shear Strength: **26 psi** (179 kPa) when tested according to ASTM C 273/C 273M.
- B. Exposed-Fastener, Foamed-Insulation-Core Metal Wall Panels **<Insert drawing designation>**: Formed with a raised, trapezoidal major rib at panel edge and two intermediate stiffening ribs symmetrically spaced between major rib and panel edge; designed for lapping side edges of adjacent panels and mechanically attaching to supports using exposed fasteners in side laps.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **IPS - Insulated Panel Systems, an NCI Company; RWP Wall Panel.**
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
 2. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, **Class AZ50 (Class AZM150)** coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: [**0.022 inch (0.56 mm)**] [**0.028 inch (0.71 mm)**] [**0.034 inch (0.86 mm)**].
 - b. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Siliconized polyester**] **<Insert finish>**.
 - 1) Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] **<Insert color>**.
 - c. Interior Finish: [**Siliconized polyester**] **<Insert finish>**.
 - 1) Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] **<Insert color>**.
 3. Backer Board: On back side of exterior facing.
 4. Snap-on Batten: Same material, finish, and color as exterior facings of wall panels.
 5. Panel Coverage: [**36 inches (914 mm)**] **<Insert dimension>** nominal.
 6. Panel Thickness: [**3.0 inches (76 mm)**] [**4.0 inches (102 mm)**] [**5.0 inches (127 mm)**] **<Insert dimension>**.
 7. Thermal-Resistance Value (R-Value): **<Insert R-value>** according to ASTM C 1363.
- C. Concealed-Fastener, Foamed-Insulation-Core Metal Wall Panels **<Insert drawing designation>**: Formed with tongue-and-groove panel edges; designed for sequential

installation by interlocking panel edges and mechanically attaching panels to supports using concealed clips or fasteners.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. [CENTRIA Architectural Systems](#); [Formawall 1000] [Versapanel] [Versawall].
 - b. [IPS - Insulated Panel Systems, an NCI company](#); [ESP] [EWP] [RWP] Wall Panel.
 - c. [Kingspan](#); [AW-200] [AWS-300] [AWS-300] [AWS-400] Series Wall Panel.
 - d. [MBCI, a division of NCI Building Systems, L.P.](#); TW-100 Wall Panel.
 - e. [Metl-Span LLC](#); [7.2 Insul-Rib] [CF Architectural] [CF Fluted] [CFI Fluted] [CF Mesa] [CFI Mesa] [CFI Metl-Plank] [CF Striated] [CFI Striated] [CFI-V-Rib] Insulated Metal Wall Panel.
 - f. <Insert manufacturer's name; product name or designation>.
2. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, [G90 \(Z275\)](#) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, [Class AZ50 \(Class AZM150\)](#) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: [[0.022 inch \(0.56 mm\)](#)] [[0.028 inch \(0.71 mm\)](#)] [[0.034 inch \(0.86 mm\)](#)].
 - b. Exterior Finish: [Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] <Insert finish>.
 - 1) Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.
 - c. Interior Finish: [Siliconized polyester] <Insert finish>.
 - 1) Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.
3. Backer Board: On back side of exterior facing.
4. Snap-on Batten: Same material, finish, and color as exterior facings of wall panels.
5. Panel Coverage: [[36 inches \(914 mm\)](#)] [[40 inches \(1016 mm\)](#)] <Insert dimension> nominal.
6. Panel Thickness: [[1.0 inch \(25 mm\)](#)] [[1.5 inches \(38 mm\)](#)] [[2.0 inches \(51 mm\)](#)] [[2.5 inches \(64 mm\)](#)] [[3.0 inches \(76 mm\)](#)] [[4.0 inches \(102 mm\)](#)] [[5.0 inches \(127 mm\)](#)] <Insert dimension>.
7. Thermal-Resistance Value (R-Value): <Insert R-value> according to ASTM C 1363.

2.3 LAMINATED-INSULATION-CORE METAL WALL PANELS

- A. General: Provide factory-formed and -assembled metal wall panels fabricated from two metal facing sheets and core material laminated or otherwise securely bonded to facing sheets during fabrication without use of contact adhesives, and with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.

1. Panel Performance:

- a. Flatwise Tensile Strength: **27 psi (186 kPa)** when tested according to ASTM C 297/C 297M.
- b. Humid Aging: Volume increase not greater than 6.0 percent and no delamination or metal corrosion when tested for seven days at **140 deg F (60 deg C)** and 100 percent relative humidity according to ASTM D 2126.
- c. Heat Aging: Volume increase not greater than 2.0 percent and no delamination, surface blistering, or permanent bowing when tested for seven days at **200 deg F (93 deg C)** according to ASTM D 2126.
- d. Cold Aging: Volume decrease not more than 1.0 percent and no delamination, surface blistering, or permanent bowing when tested for seven days at **minus 20 deg F (29 deg C)** according to ASTM D 2126.
- e. Fatigue: No evidence of delamination, core cracking, or permanent bowing when tested to a **20-lbf/sq. ft. (958-kPa)** positive and negative wind load and with deflection of L/180 for 2 million cycles.
- f. Autoclave: No delamination when exposed to **2-psi (13.8-kPa)** pressure at a temperature of **212 deg F (100 deg C)** for 2-1/2 hours.

- B. **Wrapped-Edge, Laminated-Insulation-Core Metal Wall Panels <Insert drawing designation>**: Formed with flush exterior panel facing wrapped over panel edges; designed for independent installation by mechanically attaching [**panels to supports using staggered, concealed side clips engaging panel edges**] [**through extended panel edges to supports using concealed fasteners**]; with [**sealant**] [**gasketed**] joints.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. [Architectural Specialty Products, Inc.](#); Series 500.
- b. [Kingspan](#); Designwall 1000.
- c. [Protean Construction Products, Inc.](#); FM-100 Panel.
- d. **<Insert manufacturer's name; product name or designation>**.
- e. or approved equal.

2. **Metallic-Coated Steel Sheet**: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, **Class AZ50 (Class AZM150)** coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

- a. Nominal Thickness: [**0.028 inch (0.71 mm)**] [**0.034 inch (0.86 mm)**] [**0.040 inch (1.02 mm)**] [**0.052 inch (1.32 mm)**].

- b. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Siliconized polyester**] <Insert finish>.
 - 1) Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
- c. Interior Finish: [**Siliconized polyester**] <Insert finish>.
 - 1) Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
3. Aluminum Sheet: Fabricate panel with exterior and interior facings of same material and thickness. Provide facings of aluminum coil-coated sheet, [ASTM B 209](#) (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: [**0.032 inch (0.81 mm)**] [**0.040 inch (1.02 mm)**] [**0.050 inch (1.27 mm)**] [**0.063 inch (1.60 mm)**] [**0.080 inch (2.03 mm)**].
 - b. Surface: [**Smooth, flat**] [**Embossed**] finish.
 - c. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Siliconized polyester**] [**Clear anodized**] [**Color anodized**] <Insert finish>.
 - 1) Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 - d. Interior Finish: [**Siliconized polyester**] <Insert finish>.
 - 1) Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
4. Core Material: [**Manufacturers' standard.**][**Board insulation of the following type:**]
 - a. Polyisocyanurate Insulation: Closed cell, modified polyisocyanurate foam using a non-CFC blowing agent, board type, with a maximum flame-spread index of 25 and a smoke-developed index of 450.
 - 1) Closed-Cell Content: 90 percent when tested according to ASTM D 6226.
 - b. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, [1.60-lb/cu. ft.](#) ([26-kg/cu. m](#)) minimum density, unless otherwise indicated; with a maximum flame-spread index of 25 and a smoke-developed index of 450.

- c. Molded-Polystyrene Board Insulation: ASTM C 578, [**Type I, 0.9 lb/cu. ft.** (14 kg/cu. m)] [**Type II, 1.35 lb/cu. ft.** (22 kg/cu. m)], **Class 2 or 3, Grade 3**, with a maximum flame-spread index of 25 and a smoke-developed index of 450.
 5. Backer Board: [**0.125-inch- (3-mm-)**] [**0.250-inch- (6-mm-)**] thick hardboard behind exterior facing for increased impact resistance.
 6. Clips: Manufacturer's standard one piece, formed from [**zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet**] [**stainless steel**].
 7. Gaskets: Extruded, dry seal silicone.
 8. Sealant: Manufacturer's standard silicone.
 9. Panel Thickness: [**1.0 inch (25 mm)**] [**2.0 inches (51 mm)**] [**3.0 inches (76 mm)**] [**4.0 inches (102 mm)**] [**5.0 inches (127 mm)**] [**6.0 inches (152 mm)**] <Insert dimension>.
 10. Thermal-Resistance Value (R-Value): <Insert R-value> according to ASTM C 1363.
- C. Shiplap-Edge, Laminated-Insulation-Core Metal Wall Panels <Insert drawing designation>: Formed with flush exterior panel facing and with shiplap edges; designed for sequential installation by mechanically attaching panels to supports using concealed clips and fasteners; with factory-applied [**sealant**] [**gaskets**] in side laps.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. [Alply LLC](#); Classic Wall.
 - b. [Architectural Specialty Products, Inc.](#); Series [**HF Vertical**] [**SCR-DR Horizontal**] Preinsulated Metal Siding.
 - c. [Industrial Building Panels, Inc.](#); 900 Series Thermaply Panels.
 - d. [Kingspan](#); Designwall [**2000**] [**4000**].
 - e. [Protean Construction Products, Inc.](#); FM-200 Panel.
 - f. <Insert manufacturer's name; product name or designation>.
 - g. or approved equal.
 2. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, **Class AZ50 (Class AZM150)** coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: [**0.028 inch (0.71 mm)**] [**0.034 inch (0.86 mm)**] [**0.040 inch (1.02 mm)**].
 - b. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Siliconized polyester**] <Insert finish>.
 - 1) Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 - c. Interior Finish: [**Siliconized polyester**] <Insert finish>.

- 1) Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.**
3. Aluminum Sheet: Fabricate panel with exterior and interior facings of same material and thickness. Provide facings of aluminum coil-coated sheet, **ASTM B 209** (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: **[0.032 inch (0.81 mm)] [0.040 inch (1.02 mm)] [0.050 inch (1.27 mm)] [0.063 inch (1.60 mm)].**
 - b. Surface: **[Smooth, flat] [Embossed]** finish.
 - c. Exterior Finish: **[Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] [Clear anodized] [Color anodized] <Insert finish>.**
 - 1) Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.**
 - d. Interior Finish: **[Siliconized polyester] <Insert finish>.**
 - 1) Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.**
4. Core Material: **[Manufacturers' standard.][Board insulation of the following type:]**
 - a. Polyisocyanurate Insulation: Closed cell, modified polyisocyanurate foam using a non-CFC blowing agent, board type, with a maximum flame-spread index of 25 and a smoke-developed index of 450.
 - 1) Closed-Cell Content: 90 percent when tested according to ASTM D 6226.
 - b. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, **1.60-lb/cu. ft. (26-kg/cu. m)** minimum density unless otherwise indicated; with a maximum flame-spread index of 25 and a smoke-developed index of 450.
 - c. Molded-Polystyrene Board Insulation: ASTM C 578, **[Type I, 0.9 lb/cu. ft. (14 kg/cu. m)] [Type II, 1.35 lb/cu. ft. (22 kg/cu. m), Class 2 or 3, Grade 3]**, with a maximum flame-spread index of 25 and a smoke-developed index of 450.
5. Backer Board: **[0.125-inch- (3-mm-)] [0.250-inch- (6-mm-)]** thick hardboard behind exterior facing for increased impact resistance.
6. Clips: Manufacturer's standard one piece, formed from **[zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet] [stainless steel].**
7. Gaskets: Extruded, dry seal silicone.

8. Sealant: Manufacturer's standard silicone.
 9. Panel Thickness: [1.0 inch (25 mm)] [2.0 inches (51 mm)] [3.0 inches (76 mm)] [4.0 inches (102 mm)] [5.0 inches (127 mm)] [6.0 inches (152 mm)] <Insert dimension>.
 10. Thermal-Resistance Value (R-Value): <Insert R-value> according to ASTM C 1363.
- D. Framed-Edge, Laminated-Insulation-Core Metal Wall Panels <Insert drawing designation>: Formed with flush exterior panel facing and integral, extruded edge members; designed for independent installation by mechanically attaching panels to supports through edge framing using concealed fasteners; with gasketed joints.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. [Alply LLC](#); Snug-Seam.
 - b. [Architectural Specialty Products, Inc.](#); Series MLW.
 - c. [Protean Construction Products, Inc.](#); FM-210 Panel.
 - d. <Insert manufacturer's name; product name or designation>.
 - e. or approved equal.
 2. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: [0.028 inch (0.71 mm)] [0.034 inch (0.86 mm)] [0.040 inch (1.02 mm)].
 - b. Exterior Finish: [Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] <Insert finish>.
 - 1) Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.
 - c. Interior Finish: [Siliconized polyester] <Insert finish>.
 - 1) Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.
 3. Aluminum Sheet: Fabricate panel with exterior and interior facings of same material and thickness. Provide facings of aluminum coil-coated sheet, ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: [0.032 inch (0.81 mm)] [0.040 inch (1.02 mm)] [0.050 inch (1.27 mm)] [0.063 inch (1.60 mm)] [0.080 inch (2.03 mm)].
 - b. Surface: [Smooth, flat] [Embossed] finish.

- c. Exterior Finish: **[Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] [Clear anodized] [Color anodized] <Insert finish>**.
 - 1) Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 - d. Interior Finish: **[Siliconized polyester] <Insert finish>**.
 - 1) Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
4. Core Material: **[Manufacturers' standard.] [Board insulation of the following type:]**
- a. Polyisocyanurate Insulation: Closed cell, modified polyisocyanurate foam using a non-CFC blowing agent, board type, with a maximum flame-spread index of 25 and a smoke-developed index of 450.
 - 1) Closed-Cell Content: 90 percent when tested according to ASTM D 6226.
 - b. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, **1.60-lb/cu. ft. (26-kg/cu. m)** minimum density unless otherwise indicated; with a maximum flame-spread index of 25 and a smoke-developed index of 450.
 - c. Molded-Polystyrene Board Insulation: ASTM C 578, **[Type I, 0.9 lb/cu. ft. (14 kg/cu. m)] [Type II, 1.35 lb/cu. ft. (22 kg/cu. m), Class 2 or 3, Grade 3]**, with maximum flame-spread index of 25 and smoke-developed index of 450.
5. Backer Board: **[0.125-inch- (3-mm-)] [0.250-inch- (6-mm-)]** thick hardboard behind exterior facing for increased impact resistance.
6. Edge Members: Extruded aluminum, not less than **0.063-inch (1.60-mm)** wall thickness.
7. Gaskets: Extruded, dry seal silicone.
8. Panel Thickness: **[1.0 inch (25 mm)] [2.0 inches (51 mm)] [3.0 inches (76 mm)] [4.0 inches (102 mm)] [5.0 inches (127 mm)] [6.0 inches (152 mm)] <Insert dimension>**.
9. Thermal-Resistance Value (R-Value): **<Insert R-value>** according to ASTM C 1363.

2.4 HONEYCOMB-CORE METAL WALL PANELS

- A. General: Provide factory-formed and -assembled metal wall panels fabricated from two metal facing sheets and honeycomb-core material laminated or otherwise securely bonded to facing sheets during fabrication without use of contact adhesives or pinch

rollers, and with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.

1. Panel Performance:

- a. Fatigue: No evidence of delamination, core cracking, or permanent bowing when tested to a **20-lbf/sq. ft. (958-kPa)** positive and negative wind load and with deflection of L/180 for 2 million cycles.
- b. Autoclave: No delamination when exposed to **2-psi (13.8-kPa)** pressure at a temperature of **212 deg F (100 deg C)** for 2-1/2 hours.

B. **Wrapped-Edge, Honeycomb-Core Metal Wall Panels <Insert drawing designation>**: Formed with flush exterior panel facing wrapped over panel edges; designed for independent installation by mechanically attaching **[panels to supports using staggered, concealed side clips engaging panel edges]** **[through extended panel edges to supports using concealed fasteners]**; with **[sealant]** **[gasketed]** joints.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. [Architectural Specialty Products, Inc.](#); Series 500.
- b. [Firestone Metal Products, LLC](#); UNA-CORE Series **[10 Calked Joint System]** **[30 Glazing Panel]** **[45 Spandrel Panel]**.
- c. [Industrial Building Panels, Inc.](#); Honeycomb 1000 Series.
- d. [Protean Construction Products, Inc.](#); HC-100 Panel.
- e. **<Insert manufacturer's name; product name or designation>**.
- f. or approved equal.

2. **Metallic-Coated Steel Sheet**: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, **Class AZ50 (Class AZM150)** coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

- a. Nominal Thickness: **[0.028 inch (0.71 mm)]** **[0.034 inch (0.86 mm)]** **[0.040 inch (1.02 mm)]**.
- b. Exterior Finish: **[Two-coat fluoropolymer]** **[Three-coat fluoropolymer]** **[Mica fluoropolymer]** **[Metallic fluoropolymer]** **[FEVE fluoropolymer]** **[Siliconized polyester]** **<Insert finish>**.

1) Color: **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's samples]** **[As selected by DEN Project Manager from manufacturer's full range]** **<Insert color>**.

c. Interior Finish: **[Siliconized polyester]** **<Insert finish>**.

1) Color: **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's samples]** **[As selected by DEN Project Manager from manufacturer's full range]** **<Insert color>**.

3. Aluminum Sheet: Fabricate panel with exterior and interior facings of same material and thickness. Provide facings of aluminum coil-coated sheet, **ASTM B 209** (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: **[0.032 inch (0.81 mm)] [0.040 inch (1.02 mm)] [0.050 inch (1.27 mm)] [0.063 inch (1.60 mm)]**.
 - b. Surface: **[Smooth, flat] [Embossed]** finish.
 - c. Exterior Finish: **[Two-coat fluoropolymer] [Three-coat fluoropolymer] [Mica fluoropolymer] [Metallic fluoropolymer] [FEVE fluoropolymer] [Siliconized polyester] [Clear anodized] [Color anodized] <Insert finish>**.
 - 1) Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 - d. Interior Finish: **[Siliconized polyester] <Insert finish>**.
 - 1) Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 4. Kraft-Paper Honeycomb Core: Manufacturer's standard phenolic-resin impregnated paper, with not less than 15 percent resin content by weight and chemically treated for fire resistance; with maximum **1/2-inch (13-mm)** cell size.
 5. Aluminum Honeycomb Core: Manufacturer's standard **0.003-inch-** (0.08-mm-) thick, commercial-grade aluminum with maximum **3/4-inch (19-mm)** cell size.
 6. Clips: Manufacturer's standard one piece, formed from **[zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet] [stainless steel]**.
 7. Gaskets: Extruded, dry seal silicone.
 8. Sealant: Manufacturer's standard silicone.
 9. Panel Thickness: **[0.25 inch (6 mm)] [1.0 inch (25 mm)] [2.0 inches (51 mm)] [3.0 inches (76 mm)] [4.0 inches (102 mm)] <Insert dimension>**.
- C. Shiplap-Edge, Honeycomb-Core Metal Wall Panels **<Insert drawing designation>**: Formed with flush exterior panel facing and with shiplap edges; designed for sequential installation by mechanically attaching panels to supports using concealed clips and fasteners; with factory-applied **[sealant] [gaskets]** in side laps.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. [Architectural Specialty Products, Inc.](#); Series 5000.
 - b. [Kingspan](#); Designwall 3000.
 - c. [Protean Construction Products, Inc.](#); HC-200 Panel.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
 2. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation, or

aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, **Class AZ50** (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

- a. Nominal Thickness: [**0.028 inch (0.71 mm)**] [**0.034 inch (0.86 mm)**] [**0.040 inch (1.02 mm)**].
 - b. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Siliconized polyester**] <Insert finish>.
 - 1) Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 - c. Interior Finish: [**Siliconized polyester**] <Insert finish>.
 - 1) Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
3. Aluminum Sheet: Fabricate panel with exterior and interior facings of same material and thickness. Provide facings of aluminum coil-coated sheet, **ASTM B 209** (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
- a. Thickness: [**0.032 inch (0.81 mm)**] [**0.040 inch (1.02 mm)**] [**0.050 inch (1.27 mm)**] [**0.063 inch (1.60 mm)**].
 - b. Surface: [**Smooth, flat**] [**Embossed**] finish.
 - c. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Siliconized polyester**] [**Clear anodized**] [**Color anodized**] <Insert finish>.
 - 1) Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 - d. Interior Finish: [**Siliconized polyester**] <Insert finish>.
 - 1) Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
4. Kraft-Paper Honeycomb Core: Manufacturer's standard phenolic-resin-impregnated paper, with not less than 15 percent resin content by weight and chemically treated for fire resistance; with maximum **1/2-inch (13-mm)** cell size.
5. Aluminum Honeycomb Core: Manufacturer's standard **0.003-inch-** (0.08-mm-) thick, commercial-grade aluminum with maximum **3/4-inch (19-mm)** cell size.

6. Clips: Manufacturer's standard one piece, formed from [**zinc-coated (galvanized) steel or aluminum-zinc alloy-coated steel**] [**stainless steel**].
 7. Gaskets: Extruded, dry seal silicone.
 8. Sealant: Manufacturer's standard silicone.
 9. Panel Thickness: [**1.0 inch (25 mm)**] [**1.25 inches (32 mm)**] [**2.0 inches (51 mm)**] **<Insert dimension>**.
- D. Framed-Edge, Honeycomb-Core Metal Wall Panels **<Insert drawing designation>**: Formed with flush exterior panel facing and integral, extruded edge members; designed for independent installation by mechanically attaching panels to supports through edge framing using concealed fasteners; with gasketed joints.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. [Architectural Specialty Products, Inc.](#); Series MLW.
 - b. [Firestone Metal Products, LLC](#); UNA-CLAD Series 2000 Vertical Oriented Dry-Set System.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
 2. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, **Class AZ50 (Class AZM150)** coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: **0.028 inch (0.71 mm)**.
 - b. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Siliconized polyester**] **<Insert finish>**.
 - 1) Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] **<Insert color>**.
 - c. Interior Finish: [**Siliconized polyester**] **<Insert finish>**.
 - 1) Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] **<Insert color>**.
 3. Aluminum Sheet: Fabricate panel with exterior and interior facings of same material and thickness. Provide facings of aluminum coil-coated sheet, **ASTM B 209 (ASTM B 209M)**, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: [**0.040 inch (1.02 mm)**] [**0.063 inch (1.60 mm)**].
 - b. Surface: [**Smooth, flat**] [**Embossed**] finish.
 - c. Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**]

[Siliconized polyester] [Clear anodized] [Color anodized] <Insert finish>.

1) Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.**

d. Interior Finish: **[Siliconized polyester] <Insert finish>.**

1) Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.**

4. Kraft-Paper Honeycomb Core: Manufacturer's standard phenolic-resin-impregnated paper, with not less than 15 percent resin content by weight and chemically treated for fire resistance; with maximum **1/2-inch (13-mm)** cell size.
5. Aluminum Honeycomb Core: Manufacturer's standard **0.003-inch- (0.08-mm-)** thick, commercial-grade aluminum with maximum **3/4-inch (19-mm)** cell size.
6. Edge Members: Extruded aluminum, not less than **0.063-inch (1.6-mm)** wall thickness.
7. Gaskets: Extruded, dry seal silicone.
8. Panel Thickness: **[1.0 inch (25 mm)] [2.0 inches (51 mm)] [3.0 inches (76 mm)] <Insert dimension>.**

2.5 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, **G90 (Z275 hot-dip galvanized)** coating designation or ASTM A 792/A 792M, **Class AZ50 (Class AZM150)** aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum **1-inch- (25-mm-)** thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

- C. Backer Board: Hardboard complying with ANSI A135.4, Class 1 tempered, [**1/8 inch (3 mm)**] [**1/4 inch (6 mm)**] thick unless otherwise indicated.
- D. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- E. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- F. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape **1/2 inch (13 mm)** wide and **1/8 inch (3 mm)** thick.
 - 2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.6 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- D. Honeycomb-Core Metal Wall Panels: Fabricate panels using manufacturer's standard thermosetting structural adhesive in a lamination process that bonds panel under minimum **10-psi (69-kPa)** pressure. Use of contact adhesives with pinch-roll process is unacceptable.
 - 1. Panel Bow Tolerance: Not more than 0.5 percent of panel width or length.

- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.7 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:
1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 2. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 3. Mica Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

4. Metallic Fluoropolymer: AAMA 621. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
5. FEVE Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish containing 100 percent fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
6. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than **0.2 mil (0.005 mm)** for primer and **0.8 mil (0.02 mm)** for topcoat.
7. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of **0.5 mil (0.013 mm)**.

D. Aluminum Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Three-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
3. Mica Fluoropolymer: AAMA 620. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
4. Metallic Fluoropolymer: AAMA 620. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
5. FEVE Fluoropolymer: AAMA 620. Two-coat fluoropolymer finish containing 100 percent fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
6. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than **0.2 mil (0.005 mm)** for primer and **0.8 mil (0.02 mm)** for topcoat.
7. Exposed Anodized Finish:
 - a. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
 - b. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
 - 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Install panels with concealed fasteners. Concealed self-tapping screws or nut and bolt are acceptable. Installation shall include no exposed wet sealant or tape except where noted on Drawings.
 - 2. All panels shall be removable from the exterior side without need for panel cutting or removal of curtainwall mullions or louvers.
 - 3. Shim or otherwise plumb substrates receiving metal panels.
 - 4. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 - 5. Install screw fasteners in predrilled holes.
 - 6. Locate and space fastenings in uniform vertical and horizontal alignment.

7. Install flashing and trim as metal panel work proceeds.
 8. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 9. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 10. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
 2. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- C. Installation Tolerances: Shim and align panel units within installed tolerance of 1/4" in 20' 0" on level/plumb/slope and location/line as indicated, and within 1/16" offset at flush conditions of adjoining faces and alignment of matching profiles. Maximum 3/8" deviation of any material at any given theoretical point.
- D. Wall Panel Support Framing System: To be supplied and installed by metal wall Contractor. Final alignment to be the responsibility of this Contractor.
- E. Shop Drawings: Do not proceed with installation until approved shop drawings have been received.
- F. Inspection:
1. Examine alignment of structural steel prior to installation.
 2. Inspect all material including spandrel panels.
- G. Installation and Erection: Install the metal wall panels, fasteners, trim and related items in accordance with approved shop/erection drawings and manufacturer's specifications. Panels shall be installed by the manufacturer and/or approved erectors who have been trained and have experience in the installation of the particular type of wall panel and/or curtain wall systems specified.
1. The factory assembled wall panels shall be attached to the structural steel from the exterior of the building using self-tapping fasteners and clips spaced at each girt. Flashings and accessories shall be fastened 12" on center.
 2. Erection of the wall panels shall be started per manufacturer's recommendation and the panels held true to line. Horizontal lines are to be straight and level and vertical lines plumb.
- H. Joint Sealants: Install joint fillers gaskets and sealants where indicated and where required for weatherproof performance of panel systems.
1. Refer to Section 079000 "Joint Sealants" of these specifications for product and installation requirements applicable to indicated joint sealants.

- I. Joint Sealants, Post-Installation: Refer to Section 079000 "Joint Sealants" of these specifications for post installation requirements on joint sealers.
- J. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- K. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal wall panel manufacturer.
 - 1. Seal metal wall panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer.
 - 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.4 INSULATED METAL WALL PANEL INSTALLATION

- A. General: Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal wall panels as vapor seal; apply sealant to panel joint on exposed side of panels for weather seal.
 - 1. Fasten foamed-insulation-core metal wall panels to supports with fasteners at each lapped joint at location and spacing and with fasteners recommended by manufacturer.
 - 2. Apply panels and associated items true to line for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
 - 3. Provide metal-backed washers under heads of exposed fasteners on weather side of insulated metal wall panels.
 - 4. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 - 5. Provide sealant tape at lapped joints of insulated metal wall panels and between panels and protruding equipment, vents, and accessories.
 - 6. Apply a continuous ribbon of sealant tape to panel side laps and elsewhere as needed to make panels weathertight.
 - 7. Apply snap-on battens to exposed-fastener, insulated-core metal wall panel seams to conceal fasteners.
- B. Foamed-Insulation-Core Metal Wall Panels: Fasten metal wall panels to supports with concealed clips at each joint at location and spacing and with fasteners recommended by manufacturer. Fully engage tongue and groove of adjacent panels.
 - 1. Install clips to supports with self-tapping fasteners.
- C. Laminated-Insulation-Core Metal Wall Panels:

1. Wrapped-Edge Panels: Mechanically attach wall panels to supports using staggered, concealed side clips engaging wrapped panel edges. Install clips to supports with self-tapping fasteners. Seal joints with **[backer rod and sealant] [manufacturer's standard gaskets]**.
 2. Wrapped-Edge Panels: Mechanically attach wall panels through extended edge of panels to supports using self-tapping fasteners. Seal joints with **[backer rod and sealant] [manufacturer's standard gaskets]**.
 3. Shiplap-Edge Panels: Mechanically attach wall panels to supports using staggered, concealed side clips engaging tongue-and-groove panel edges. Install clips to supports with self-tapping fasteners.
 - a. Horizontal Joints: **[Maintain reveal joint of consistent width] [Seal joints with backer rod and sealant] [Seal joints with manufacturer's standard gaskets]**.
 - b. Vertical Joints: **[Maintain reveal joint of consistent width] [Seal joints with backer rod and sealant] [Seal joints with manufacturer's standard gaskets]**.
 4. Framed-Edge Panels: Mechanically attach wall panels through integral, extruded edge members to supports using self-tapping fasteners. Seal joints with manufacturer's standard gaskets.
- D. Honeycomb-Core Metal Wall Panels:
1. Wrapped-Edge Panels: Mechanically attach wall panels to supports using staggered, concealed side clips engaging wrapped panel edges. Install clips to supports with self-tapping fasteners. Seal joints with **[backer rod and sealant] [manufacturer's standard gaskets]**.
 2. Wrapped-Edge Panels: Mechanically attach wall panels through extended edge of panels to supports using self-tapping fasteners. Seal joints with **[backer rod and sealant] [manufacturer's standard gaskets]**.
 3. Shiplap-Edge Panels: Mechanically attach wall panels to supports using staggered, concealed side clips engaging tongue-and-groove panel edges. Install clips to supports with self-tapping fasteners.
 - a. Horizontal Joints: **[Maintain reveal joint of consistent width] [Seal joints with backer rod and sealant] [Seal joints with manufacturer's standard gaskets]**.
 - b. Vertical Joints: **[Maintain reveal joint of consistent width] [Seal joints with backer rod and sealant] [Seal joints with manufacturer's standard gaskets]**.
 4. Framed-Edge Panels: Mechanically attach wall panels through integral, extruded edge members to supports using self-tapping fasteners. Seal joints with manufacturer's standard gaskets.
- E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- F. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that are permanently watertight.
1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of **10 feet (3 m)** with no joints allowed within **24 inches (610 mm)** of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than **1 inch (25 mm)** deep, filled with mastic sealant (concealed within joints).

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: **[Owner will engage] [Engage]** a qualified testing agency to perform tests and inspections.
- B. Water-Spray Test: After installation, test area of assembly **[shown on Drawings] [as directed by DEN Project Manager]** <Insert area> for water penetration according to AAMA 501.2.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.
- D. Metal wall panels will be considered defective if they do not pass test and inspections.
- E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- F. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Damaged Material: Repair or replace all damaged material to the satisfaction of the DEN Project Manager if damage has been caused by the manufacturer or wall panel erector/contractor. The General Contractor shall be responsible for the protection of completed or installed walls from damage by other trades. Installed areas or portions of the work shall be inspected by the Owner for approval following the completion of such areas.
- D. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 074213.19

SECTION 074213.23 - METAL COMPOSITE MATERIAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes metal composite material wall panels.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>**.
 1. Meet with DEN Project Manager, Owner's insurer if applicable, metal composite material panel Installer, structural-support Installer, and installers whose work interfaces with or affects metal composite material panels, including installers of doors, windows, and louvers.
 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 3. Review methods and procedures related to metal composite material panel installation, including manufacturer's written instructions.
 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal composite material panels.
 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
 7. Review temporary protection requirements for metal composite material panel assembly during and after installation.
 8. Review procedures for repair of panels damaged after installation.
 9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include product specifications, certified product test results, installation instructions and general recommendations, construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
 2. Include data substantiating that materials comply with requirements.
- B. Shop Drawings:
1. Include fabrication and installation layouts of metal composite material panels; large-scale details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details. Distinguish between factory and field assembly work.
 2. Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1-1/2 inches per 12 inches (1:10).
- C. Samples for Initial Selection: For each type of metal composite material panel indicated with factory-applied color finishes.
1. Include similar Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish and color required, prepared on Samples of size indicated below.
1. Metal Composite Material Panels: Submit three (3) samples 12 inches (305 mm) long by actual panel width. Include miscellaneous trim piece, anchors, insulation, sealants and compressible gasket, fasteners, closures, and other metal composite material panel accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Certificate from installer evidencing minimum ten (10) years experience successfully installing this type of work on projects of this scale and proof of acceptance by manufacturer.
- C. Certificate from the manufacturer stating that all materials are per contract requirements and proof of minimum ten (10) years experience manufacturing products of this type on projects of this scale.
- D. Certificate from manufacturer that panel system is approved for use in Denver or has ICBO approval for Class 1 non-combustible construction.
- E. Product Test Reports: For each product, tests performed by a qualified testing agency.

- F. Structural Calculations: Signed and stamped by a Colorado licensed structural engineer.
- G. Field quality-control reports.
- H. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal composite material panels to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 MAINTENANCE SUBMITTALS

- A. Provide minimum four (4) gallons touch-up paint for each color used on Project. Store in area directed by DEN Project Manager.
 - 1. Instruct Owners personnel in appropriate paint touch-up procedures.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 - 1. A firm that has specialized in installation of types of products required for Project for not less than ten (10) years and which is acceptable to manufacturer(s) of primary materials.
- B. Manufacturer's Qualifications:
 - 1. A firm that has specialized in manufacture of products required for Project with a minimum of ten (10) years experience manufacturing products of this type on projects of this scale.
- C. Performance Test Standards: Submit evidence that preformed panel system has been pretested by an independent laboratory and certified by manufacturer to provide specified resistance to air and water infiltration and structural deflection and failure when installed as indicated and when tested in accordance with AAMA Standard Test TM 1, "Specification for Method of Test for Metal Curtain Walls for Water Penetration Using Dynamic Pressure".
- D. Fire Resistances:
 - 1. Wall panels shall be rated and carry the following listings:

- a. U.L. classification for "Surface Burning Characteristics", U.L. Standard 723 (ASTM-E84) File R6863.

	Finished Panel:	Core Only:
Flame Spread	25 max.	25 max.
Fuel Contributed	0	0
Smoke Developed	450 max.	200 max.

- b. U.L. classification per "Insulated Wall Construction" U.L. Subject 1040 (corner test).
c. Factory mutual approval as Class 1 panels.
d. ICBO Research Report for Class 1 non-combustible construction and approval by the City and County of Denver.

- E. Required Performances: Fabricate panels and other components of wall system for the following installed as indicated performances:

1. Wind Loading: Refer to Part 1 of this Section.
2. Water Penetration: No significant, uncontrolled leakage at 6.24 lbs. per sq. ft. per ASTM E 331.
3. Air Infiltration: 0.060 cfm per sq. ft. for wall areas, with 1.56 lbs. per sq. ft. differential pressure, as tested per ASTM E 283.
4. Sound Transmission: STC rating of 28.
5. Thermal Performance: Factory-assembled panel shall have a U-value of 0.072 btu/hr./SF when tested in accordance with ASTM C236.
6. Bond Strength: No metal primer interface corrosion or delamination shall occur after 500 hrs. at 120 deg F and 100% relative humidity.
7. Design to withstand thermal movements resulting from an ambient temperature range of minus 30 deg F (minus 35 deg C) to 120 deg F (67 deg C), which may cause preformed siding range of 180 deg.F (100 deg C), without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.
8. Pressure Equalization: Provide Rain Screen Test showing that with liner seal broken, there shall be no water rise in joint cavity under 10 psf in accordance with ASTM E331-70. A fully designed and tested gutter system meeting the same test requirements will be acceptable upon submittal of supporting documents.
9. Galvanic Reaction: Provide galvanic protection between dissimilar metals.

- F. Provide complete structural calculations, including calculation for cold-formed metal framing and metal fabrications back-up, signed and stamped by an engineer registered in the state of Colorado. Calculations are to be based on the following:

1. Wind load exposure C, Importance factor I = 1.15.
2. Minimum basic wind speed: 85 M.P.H., but not less than 50 p.s.f., positive and negative pressure.
3. Wind Load Deflection: L/180, 3/4" max.
4. Maximum Wind Load: 115 mph with gust factor of 1.3.

- G. Field Measurements: It is the intent of these specifications for Contractor to shop fabricate metal panels completely. Contractor to make all field measurements required

to shop fabricate panel system accurately. Field cutting and trimming be held to an absolute minimum.

- H. Single Source Responsibility: The "Exterior Skin Installer" is to provide the structural calculations, coordination, fabrication, installation and warranty for all work associated with the exterior skin, which includes: Section 083213 "Sliding Aluminum Frame Glass Doors", Section 084413 "Glazed Aluminum Curtainwall", Section 089119 "Fixed Louvers", and Section 089516 "Wall Vents", and the following:
1. All cold formed metal framing or metal fabrications associated with the above. Cold formed metal framing to be of the size and spacing indicated on the drawings, except gauge shall be as needed as determined by the structural calculations required, but in no case less than 14 gauge. Metal fabrications shall be of the size indicated on the drawings, except thickness shall be as determined by the structural calculations required. Provide additional fabrications as needed.
 - a. All of this work to be in accordance with requirements of Section 054000 "Cold Formed Metal Framing" and Section 055000 "Metal Fabrications".
 2. All expansion joints in the exterior side of the above exterior wall, per Section 079500 "Expansion Control".
 3. All joint sealers installed within the above described work including joints between adjacent work, per Section 079000, "Joint Sealants".
 4. All glazing installed within the above described work per Section 088000, "Glazing".
 5. All painting, finishes, or coatings associated with the above described work.
 6. All firestopping associated with exterior skin intersection with rated roofs or floors per Section 078413 "Penetration Firestopping."
- I. Testing Agency: Contractor to employ an independent testing agency to make on-site inspections on at least a weekly basis during skin construction. Testing Agency to measure actual installed tolerances, and inspect all facets of construction with regard to compliance with contract requirements. Submit weekly report to DEN Project Manager. Immediately note any areas not in compliance. Independent Testing Agency shall verify existing installed tolerances prior to start of work and notify DEN Project Manager of any discrepancies to specified tolerances prior to start of prefabrication.
- J. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation. Coordinate installation of mock-up with work by other trades.
1. Build mockup of typical metal composite material panel assembly [**as shown on Drawings**] <Insert size>, including [**corner,**] [**soffits,**] supports, attachments, and accessories.
 2. Demonstrate each type of detail condition to the greatest extent possible including; a minimum 100 square feet of masonry, an expansion joint, louver, curtainwall, glazing, preformed siding, sealants, painting, finishes, typical parapet and cap, typical cold formed metal framing, typical metal fabrications and a minimum 80 square feet of exterior soffit. This mockup may be constructed and approved in sections. Provide scaffolding to facilitate mockup review.

3. Do not proceed with initial mockup prior to approval of initial submittals unless approved by the DEN Project Manager.
4. Portions of the mockup that are not approved are to be reconstructed until approved. The approved mockup will serve as the standard of quality. Conduct field water test on approved initial mockup per AAMA 501.2-83
5. Complete initial mockup a minimum of one (1) month prior to start of fabrication of panels, glazing, louvers, and curtainwall for the actual building.
6. Remove initial mockup from the project site when directed by the DEN Project Manager, but not prior to Substantial Completion. Undamaged glass may be applied to overstock requirements. Salvage preformed siding, clean, protect, and store for Owner in area as directed by DEN Project Manager.
7. Water-Spray Test: Conduct water-spray test of mockup of metal composite material panel assembly, testing for water penetration according to AAMA 501.2.
8. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
9. Construct additional mockups on the permanent structure as may be required to demonstrate each type of condition not demonstrated in initial mock-up. Notify DEN Project Manager when ready for review. Do not proceed with subsequent work until mockup is approved.
10. Cost of components of this section incorporated into mockups, including separate structure for the initial mockup, shall be by this Contractor.
11. Structural performance for mockup shall be designed to withstand wind loads specified herein, with deflections equal to those required for the final building. See structural drawings.
12. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal composite material panels, and other manufactured items so as not to be damaged or deformed. Package metal composite material panels for protection during transportation and handling.
- B. Unload, store, and erect metal composite material panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal composite material panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal composite material panels to ensure dryness, with positive slope for drainage of water. Do not store metal composite material panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal composite material panels during installation.
- E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal composite material panels to be performed according to manufacturers' written instructions and warranty requirements.

1.11 COORDINATION

- A. Coordinate metal composite material panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal composite material panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
2. Warranty Period: Minimum [**two (2)**] <Insert number> years from date of Substantial Completion.

- B. Installer Warranty:

1. Entire panel system, including weathertightness, material, finish, insulation, seams, and fasteners for a period of minimum two (2) years from date of Substantial Completion.

- C. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal composite material panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: Minimum [**20**] [**10**] <Insert number> years from date of Substantial Completion.

1.13 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal composite material panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 330:
1. Wind Loads: 115 mph with gust factor of 1.3.
 2. Other Design Loads: [**As indicated on Drawings**] <Insert loads>.
 3. Deflection Limits: For wind loads, no greater than [**1/180**] [**1/240**] <Insert deflection> of the span.
 4. Ambient Temperature Range: Minus 30 deg F (minus 35 deg C) to 120 deg F (49 deg C).
 5. <Insert serviceability requirements>.
- B. Air Infiltration: Air leakage of not more than **0.06 cfm/sq. ft.** (0.3 L/s per sq. m) when tested according to ASTM E 283 at the following test-pressure difference:
1. Test-Pressure Difference: [**1.57 lbf/sq. ft. (75 Pa)**] [**6.24 lbf/sq. ft. (300 Pa)**].
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
1. Test-Pressure Difference: [**2.86 lbf/sq. ft. (137 Pa)**] [**6.24 lbf/sq. ft. (300 Pa)**].
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): [**120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces**] <Insert temperature range>.
- E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 METAL COMPOSITE MATERIAL WALL PANELS <Insert drawing designation>

- A. Metal Composite Material Wall Panel Systems: Provide factory-formed and -assembled, metal composite material wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment assembly components[, **panel stiffeners**], and accessories required for weathertight system.
- Products: Subject to compliance with requirements, provide one of the following:
 - [3A Composites USA, Inc.](#); [**Alucobond**] [**Alucobond Plus**].
 - [Alcoa Inc.](#); Reynobond [**FR**] [**PE**].
 - [CENTRIA Architectural Systems](#); Formabond Wall System.
 - [Citadel Architectural Products, Inc.](#); Envelope 2000 [**RR**] [**RS**].
 - [Firestone Metal Products, LLC](#); UNA-FAB [**Series 1000**] [**Series 1500**].
 - [Protean Construction Products, Inc.](#); ACM 100.
 - <Insert manufacturer's name; product name or designation>.
 - or approved equal.
- B. Aluminum-Faced Composite Wall Panels <Insert drawing designation>: Formed with **0.020-inch-** (0.50-mm-) thick, [**coil-coated**] [**anodized**] aluminum sheet facings.
- Panel Thickness: [**0.118 inch (3 mm)**] [**0.157 inch (4 mm)**] [**0.197 inch (5 mm)**] [**0.236 inch (6 mm)**] [**As indicated on Drawings**].
 - Core: [**Standard**] [**Fire retardant**].
 - Exterior Finish: [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Mica fluoropolymer**] [**Metallic fluoropolymer**] [**FEVE fluoropolymer**] [**Clear anodized**] [**Color anodized**] <Insert finish>.
 - Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
- C. Copper-Faced Composite Wall Panels <Insert drawing designation>: Formed with [**12-oz./sq. ft. (0.41-mm-thick)**] [**14-oz./sq. ft. (0.48-mm-thick)**] copper sheet facings.
- Panel Thickness: [**0.157 inch (4 mm)**] [**0.236 inch (6 mm)**] [**As indicated on Drawings**].
 - Core: [**Standard**] [**Fire retardant**].
 - Exterior Finish: [**Mill**] [**Prepatinated**].
- D. Attachment Assembly Components: Formed from [**extruded aluminum**] [**material compatible with panel facing**].
- E. Attachment Assembly: [**Manufacturer's standard**] [**Clip**] [**Subgirt and spline**] [**Track support**] [**Rainscreen principle system**] <Insert method>.

2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal composite material panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal composite material panels unless otherwise indicated.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal composite material panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal composite material panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal composite material panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal composite material panels and remain weathertight; and as recommended in writing by metal composite material panel manufacturer.

2.4 FABRICATION

- A. General: Fabricate and finish metal composite material panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate metal composite material panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Aluminum Panels and Accessories:
 1. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 2. Three-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 3. Mica Fluoropolymer: AAMA 620. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 4. Metallic Fluoropolymer: AAMA 620. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

5. 5. FEVE Fluoropolymer: AAMA 620. **[Two-coat fluoropolymer] [Three-coat fluoropolymer] [Two-coat fluoropolymer with suspended mica flakes] [Three-coat fluoropolymer with suspended metallic flakes]** finish containing 100 percent fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 6. Exposed Anodized Finish:
 - a. Clear Anodic Finish: AAMA 611, **[AA-M12C22A41, Class I, 0.018 mm] [AA-M12C22A31, Class II, 0.010 mm]** or thicker.
 - b. Color Anodic Finish: AAMA 611, **[AA-M12C22A42/A44, Class I, 0.018 mm] [AA-M12C22A32/A34, Class II, 0.010 mm]** or thicker.
- D. Copper Panels and Accessories:
1. Prepatination: Factory prepatinate according to ASTM B 882 to convert the copper surface to an inorganic crystalline structure with the appearance and durability of naturally formed patina.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal composite material panel supports, and other conditions affecting performance of the Work.
 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal composite material wall panel manufacturer.
 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal composite material wall panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and assemblies penetrating metal composite material panels to verify actual locations of penetrations relative to seam locations of metal composite material panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal composite material panel manufacturer's written recommendations.

3.3 METAL COMPOSITE MATERIAL PANEL INSTALLATION

- A. General: Install metal composite material panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor metal composite material panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Install panels with concealed fasteners. Concealed self-tapping screws or nut and bolt are acceptable. Installation shall include no exposed wet sealant or tape except where noted on Drawings.
 2. All panels shall be removable from the exterior side without need for panel cutting or removal of curtainwall mullions or louvers.
 3. Shim or otherwise plumb substrates receiving metal composite material panels.
 4. Flash and seal metal composite material panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal composite material panels are installed.
 5. Install screw fasteners in predrilled holes.
 6. Locate and space fastenings in uniform vertical and horizontal alignment.
 7. Install flashing and trim as metal composite material panel work proceeds.
 8. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 9. Align bottoms of metal composite material panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 10. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
 2. Copper Panels: Use copper, stainless-steel or hardware-bronze fasteners.
- C. Installation Tolerances: Shim and align panel units within installed tolerance of 1/4" in 20' 0" on level/plumb/slope and location/line as indicated, and within 1/16" offset at flush conditions of adjoining faces and alignment of matching profiles. Maximum 3/8" deviation of any material at any given theoretical point.
- D. Wall Panel Support Framing System: To be supplied and installed by metal wall Contractor. Final alignment to be the responsibility of this Contractor.

- E. Shop Drawings: Do not proceed with installation until approved shop drawings have been received.
- F. Inspection:
 - 1. Examine alignment of structural steel prior to installation.
 - 2. Inspect all material including spandrel panels.
- G. Installation and Erection: Install the metal wall panels, fasteners, trim and related items in accordance with approved shop/erection drawings and manufacturer's specifications. Panels shall be installed by the manufacturer and/or approved erectors who have been trained and have experience in the installation of the particular type of wall panel and/or curtain wall systems specified.
 - 1. The factory assembled wall panels shall be attached to the structural steel from the exterior of the building using self-tapping fasteners and clips spaced at each girt. Flashings and accessories shall be fastened 12" on center.
 - 2. Erection of the wall panels shall be started per manufacturer's recommendation and the panels held true to line. Horizontal lines are to be straight and level and vertical lines plumb.
- H. Joint Sealants: Install joint fillers gaskets and sealants where indicated and where required for weatherproof performance of panel systems.
 - 1. Refer to Section 079000 "Joint Sealants" of these specifications for product and installation requirements applicable to indicated joint sealants.
- I. Joint Sealants, Post-Installation: Refer to Section 079000 "Joint Sealants" of these specifications for post installation requirements on joint sealers.
- J. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal composite material panel manufacturer.
- K. Attachment Assembly, General: Install attachment assembly required to support metal composite material wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
 - 1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
- L. Installation: Attach metal composite material wall panels to supports at locations, spacings, and with fasteners recommended by manufacturer to achieve performance requirements specified.
 - 1. Wet Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 079200 "Joint Sealants."

2. composite material
 3. Rainscreen Systems: Do not apply sealants to joints unless otherwise indicated.
- M. Clip Installation: Attach panel clips to supports at locations, spacings, and with fasteners recommended by manufacturer. Attach routed-and-returned flanges of wall panels to panel clips with manufacturer's standard fasteners.
1. Seal horizontal and vertical joints between adjacent panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 079200 "Joint Sealants."
 2. Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gaskets.
- N. Subgirt-and-Spline Installation: Install support assembly at locations, spacings, and with fasteners recommended by manufacturer. Use manufacturer's standard subgirts and splines that provide support and complete secondary drainage assembly, draining to the exterior at horizontal joints. Attach metal composite material wall panels by interlocking perimeter extrusions attached to panels with subgirts and splines. Fully engage integral subgirt-and-spline gaskets and leave horizontal and vertical joints with open reveal. Terminate edge of panels flush with perimeter extrusions.
1. Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
 2. Do not apply sealants to joints unless otherwise indicated.
- O. Track-Support Installation: Install support assembly at locations, spacings, and with fasteners recommended by manufacturer. Use manufacturer's standard horizontal tracks and vertical **[tracks] [drain channels]** that provide support and secondary drainage assembly, draining to the exterior at horizontal joints through drain tube. Attach metal composite material wall panels to tracks by interlocking panel edges with manufacturer's standard "T" clips.
1. Attach routed-and-returned flanges of wall panels to perimeter extrusions with manufacturer's standard fasteners.
 2. Attach flush wall panels to perimeter extrusions by engaging panel edges and by attaching with manufacturer's standard structural silicone adhesive.
 3. Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
 4. Do not apply sealants to joints unless otherwise indicated.
- P. Rainscreen-Principle Installation: Install using manufacturer's standard assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach metal composite material wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.
1. Install wall panels to allow individual panels to be installed and removed without disturbing adjacent panels.

2. Do not apply sealants to joints unless otherwise indicated.

Q. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal composite material panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal composite material panel manufacturer; or, if not indicated, provide types recommended in writing by metal composite material panel manufacturer.

R. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.

2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of **10 feet (3 m)** with no joints allowed within **24 inches (605 mm)** of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than **1 inch (25 mm)** deep, filled with mastic sealant (concealed within joints).

3.4 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal composite material wall panel units within installed tolerance of **1/4 inch in 20 feet (6 mm in 6 m)**, non-accumulative, on level, plumb, and location lines as indicated, and within **1/8-inch (3-mm)** offset of adjoining faces and of alignment of matching profiles.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: **[Owner will engage] [Engage]** a qualified independent testing agency to perform field tests and inspections.

B. Water-Spray Test: After installation, test area of assembly **[shown on Drawings] [as directed by DEN Project Manager]** **<Insert area>** for water penetration according to AAMA 501.2.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal composite material wall panel installation, including accessories.

- D. Metal composite material wall panels will be considered defective if they do not pass test and inspections.
- E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- F. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal composite material panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal composite material panel installation, clean finished surfaces as recommended by metal composite material panel manufacturer. Maintain in a clean condition during construction.
- B. After metal composite material panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Damaged Material: Repair or replace all damaged material to the satisfaction of the DEN Project Manager if damage has been caused by the manufacturer or wall panel erector/contractor. The General Contractor shall be responsible for the protection of completed or installed walls from damage by other trades. Installed areas or portions of the work shall be inspected by the Owner for approval following the completion of such areas.
- D. Replace metal composite material panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 074213.23

SECTION 075323 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Adhered EPDM membrane roofing system.
2. Mechanically fastened EPDM membrane roofing system.
3. Loosely laid and ballasted EPDM membrane roofing system.
4. Auxiliary roofing materials.
5. Substrate boards.
6. Vapor retarder.
7. Roof insulation.
8. Accessories.
9. Walkways.

- B. Section includes the installation of acoustical roof deck rib insulation strips furnished under Section 053100 "Steel Decking."

C. Related Sections:

1. Section 053100 "Steel Decking" for furnishing acoustical deck rib insulation.
2. **[Section 061000 "Rough Carpentry"] [Section 061053 "Miscellaneous Rough Carpentry"]** for wood nailers, curbs, and blocking[; **and for wood-based, structural-use roof deck panels**].
3. Section 070150.19 "Preparation for Re-Roofing" for recover board beneath new membrane roofing.
4. Section 072100 "Thermal Insulation" for insulation beneath the roof deck.
5. Section 076200 "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counterflashings.
6. Section 077129 "Manufactured Roof Expansion Joints" for proprietary manufactured roof expansion-joint assemblies.
7. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
8. Section 221423 "Storm Drainage Piping Specialties" for roof drains.

- D. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 DEFINITIONS

- A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.
- B. Thermal Resistivity: Where thermal resistivity properties of insulating materials are designated by R-values, they represent the rate of heat flow through a homogenous material exactly 1" thick, measured by test method included in referenced material standard or otherwise indicated. They are expressed by the temperature difference in degrees F between the two exposed faces required to cause one BTU to flow through one square foot per hour at mean temperatures indicated.
- C. Thermal Resistance: Where thermal resistance properties of insulating materials are designated by R values they represent the rate of heat flow through a material of thickness indicated, measured by test method included in referenced material standard or otherwise indicated. They are expressed by the temperature difference in degrees F between the two exposed faces required to cause one BTU to flow through one square foot per hour at mean temperatures indicated.
- D. Combustibility Characteristics: ASTM E 136.
- E. Maximum Allowable Asbestos Content of Inorganic Insulations: Provide insulations which contain less than 0.25 percent by weight of asbestos of any type or mixture of types occurring naturally as impurities, as determined by polarized light microscopy test per Appendix A of 40 CFR 763.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
- C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.
 - 1. Corner Uplift Pressure: <Insert lbf/sq. ft. (kPa/sq. m)>.
 - 2. Perimeter Uplift Pressure: <Insert lbf/sq. ft. (kPa/sq. m)>.
 - 3. Field-of-Roof Uplift Pressure: <Insert lbf/sq. ft. (kPa/sq. m)>.
- D. FM Approvals Listing: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system, and that are listed in FM Approvals'

"RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals' markings.

1. Fire/Windstorm Classification: [**Class 1A-90**] [**Class 1A-105**] [**Class 1A-120**] <Insert class>.
2. Hail Resistance: [**MH**] [**SH**].

- E. Solar Reflectance Index: Not less than [**78**] [**29**] when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.
- F. Energy Performance: Provide roofing system that is listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for [**low**] [**steep**]-slope roof products.
- G. Energy Performance: Provide roofing system with initial solar reflectance not less than [**0.70**] <Insert value> and emissivity not less than [**0.75**] <Insert value> when tested according to CRRC-1.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
1. Include data substantiating that materials comply with requirements.
 2. Submit product data, specifications, installation instructions, and general recommendations from manufacturers of flexible sheet roofing system materials, for types of roofing required.
- B. LEED Submittals:
1. Product Test Reports for Credit SS 7.2: For roof materials, documentation indicating that roof materials comply with Solar Reflectance Index requirement.
 2. Product Data for Credit IEQ 4.1: For adhesives and sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
 3. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants used inside the weatherproofing system, documentation indicating that they comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
1. Base flashings and membrane terminations.
 2. Tapered insulation, including slopes.
 3. Roof plan showing orientation of steel roof deck and orientation of membrane roofing and fastening spacings and patterns for mechanically fastened membrane roofing.
 4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

5. Sheet layout, seam locations, colors (as applicable), details, and special conditions.

D. Samples for Verification: For the following products, in manufacturer's standard sizes:

1. Submit 12" square samples of sheet roofing, of color specified, including T-shaped side and end lap seam.
2. Submit 12" square samples of roof insulation.
3. **10 lb (4.5 kg)** of aggregate ballast in gradation[**and color**] indicated.
4. Roof paver[, **full sized,**] in each color and texture required.
5. Walkway pads or rolls.
6. Termination bars.
7. Battens.
8. Six insulation fasteners of each type, length, and finish.
9. Six roof cover fasteners of each type, length, and finish.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and manufacturer.

B. Installer to submit certificate that he has not less than five (5) years of successful experience installing roof systems similar to those required by this project.

C. Manufacturer Certificate: Signed by roofing manufacturer certifying that membrane roofing system complies with requirements specified in "Performance Requirements" Article.

1. Submit evidence of complying with performance requirements.
2. Manufacturer to submit certificate that he has not less than ten (10) years experience in manufacturing of the types of products specified.
3. Manufacturer shall submit evidence describing in detail, to what extent is the insulation product to be supplied for this project an ozone depleting product, as relates to its manufacturing process, or other.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.

E. Research/Evaluation Reports: For components of membrane roofing system, from [**the ICC-ES**] <Insert applicable model code organization>.

F. Field quality-control reports.

G. Warranties: Sample of special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For membrane roofing system to include in maintenance manuals.

- B. Provide minimum 2% extra roof pavers. Store in area directed by DEN Project Manager.

1.8 QUALITY ASSURANCE

- A. **Manufacturer Qualifications:** A qualified manufacturer that is **[UL listed] [FM Approvals approved]** for membrane roofing system identical to that used for this Project.
 - 1. Obtain primary flexible sheet roofing from a single manufacturer. Provide secondary materials as recommended and approved in writing by manufacturer of primary materials. Manufacturer shall not have less than ten (10) years experience in manufacturing of the types of products specified.
- B. **Installer Qualifications:** A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.
 - 1. A firm with not less than five (5) years of successful experience installing of roofing systems similar to those required for this project and which is acceptable to or licensed by manufacturer of primary roofing materials.
 - 2. Work associated with flexible sheet roofing, including (but not limited to) insulation, flashing and counterflashing, expansion joints, and flexible sheet joint sealers, is to be performed by Installer of flexible sheet roofing.
- C. **Source Limitations:** Obtain components including **[roof insulation] [fasteners] <Insert products>** for membrane roofing system **[from same manufacturer as membrane roofing] [or] [approved by membrane roofing manufacturer]**.
- D. **Exterior Fire-Test Exposure:** ASTM E 108, **[Class A] [Class B] [Class C]**; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.
- E. **Fire-Resistance Ratings:** Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. **UL Listing:** Provide labeled materials that have been tested and listed by UL in "Building Materials Directory" for application indicated, with "Class A" rated materials/system for roof slopes shown.
- F. **Flood Test:** Conduct and pass two inch (2") minimum depth flood testing at roof high point for 24 hours on all horizontal installations. Conduct flood test after roof drains are installed and after all construction activities are completed that require access to roof or penetration of roof systems.
- G. **Insurance Certification:** Assist Owner in preparation and submittal of roof installation

acceptance certification necessary in connection with fire and extended coverage insurance on roofing and associated work.

- H. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>**.
1. Meet with DEN Project Manager, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Review requirements for deck substrate conditions and finishes, including flatness and fastening.
 5. Review structural loading limitations of roof deck during and after roofing.
 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
 7. Review governing regulations and requirements for insurance and certificates if applicable.
 8. Review temporary protection requirements for roofing system during and after installation.
 9. Review roof observation and repair procedures after roofing installation.
 10. Record discussions and agreements and furnish copy to each participant. Provide at least 72 hours advance notice to participants prior to convening preliminary roofing conference.
- I. Preinstallation Roofing Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>**.
1. Meet with DEN Project Manager, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 5. Review structural loading limitations of roof deck during and after roofing.
 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.

7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.
10. Record discussions and agreements and furnish copy to each participant. Provide at least 72 hours advance notice to participants prior to convening preinstallation roofing conference.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.10 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

- A. Special Project Warranty: Manufacturer's standard or customized form, without monetary limitation, signed by Manufacturer of primary roofing materials and his authorized Installer, in which manufacturer and installer agree to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
 1. Special Project Warranty includes membrane roofing, base flashings, **[roof insulation,] [fasteners,] [cover boards,] [substrate board,] [roofing**

- accessories,] [roof pavers,]** and other components of membrane roofing system. Warranty shall include all components specified by this section.
2. Warranty Period: Minimum **[10] [15] [20] <Insert number>** years from date of Substantial Completion.
 3. Provide system tested and approved for FM I-90, secured per FM Data Sheets I-28 and I-29S.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Performance: Provide roofing materials recognized to be of generic type indicated and tested to show compliance with indicated performances, or provide other similar materials certified in writing by manufacturer to be equal or better than specified in every significant respect, and acceptable to DEN Project Manager.
- B. Compatibility: Provide products that are recommended by manufacturers to be fully compatible with indicated substrates, or provide separation materials as required to eliminate contact between incompatible materials.
- C. Slip Sheet: Between insulation and EPDM membrane provide manufacturers standard fiberglass slip sheet, meeting requirements for type of roof specified.

2.2 EPDM MEMBRANE ROOFING

- A. EPDM: ASTM D 4637, **[Type I, non-reinforced,] [Type II, scrim or fabric internally reinforced,]** uniform, flexible EPDM sheet.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle SynTec Incorporated.
 - b. ERSystems.
 - c. Firestone Building Products.
 - d. GAF Materials Corporation.
 - e. GenFlex Roofing Systems.
 - f. International Diamond Systems.
 - g. Johns Manville.
 - h. Mule-Hide Products Co., Inc.
 - i. Protective Coatings, Inc.
 - j. Roofing Products International, Inc.
 - k. StaFast Building Products.
 - l. Versico Incorporated.
 - m. **<Insert manufacturer's name>**.
 - n. or approved equal.
 2. Thickness: **[45 mils (1.1 mm)] [60 mils (1.5 mm)] [75 mils (1.9 mm)] [90 mils (2.2**

- mm)] <Insert thickness>, nominal.
3. Exposed Face Color: [**Black**] [**White on black**] <Insert color>.
- B. Fabric-Backed EPDM: ASTM D 4637, Type III, non-reinforced, uniform, flexible EPDM sheet, laminated to a nonwoven polyester fabric backing except at selvages.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle SynTec Incorporated.
 - b. Versico Incorporated.
 - c. <Insert manufacturer's name>.
 - d. or approved equal.
 2. Composite Thickness: [**90 mils** (2.3 mm)] [**100 mils** (2.5 mm)] [**105 mils** (2.7 mm)] [**115 mils** (2.9 mm)], nominal.
 3. Exposed Face Color: [**White on black**] <Insert color>.

2.3 AUXILIARY MEMBRANE ROOFING MATERIALS

- A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
 2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Plastic Foam Adhesives: 50 g/L.
 - b. Gypsum Board and Panel Adhesives: 50 g/L.
 - c. Multipurpose Construction Adhesives: 70 g/L.
 - d. Fiberglass Adhesives: 80 g/L.
 - e. Single-Ply Roof Membrane Adhesives: 250 g/L.
 - f. Single-Ply Roof Membrane Sealants: 450 g/L.
 - g. Nonmembrane Roof Sealants: 300 g/L.
 - h. Sealant Primers for Nonporous Substrates: 250 g/L.
 - i. Sealant Primers for Porous Substrates: 775 g/L.
 - j. Other Adhesives and Sealants: 250 g/L.
 3. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Sheet Flashing: **60-mil-** (1.5-mm-) thick EPDM, partially cured or cured, according to application.

- C. Protection Sheet: Epichlorohydrin or neoprene non-reinforced flexible sheet, **55- to 60-mil-** (1.4- to 1.5-mm-) thick, recommended by EPDM manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil.
- D. Bonding Adhesive: Manufacturer's standard[, **water based**].
- E. Modified Asphaltic Fabric-Backed Membrane Adhesive: Roofing system manufacturer's standard modified asphalt, asbestos-free, cold-applied adhesive formulated for compatibility and use with fabric-backed membrane roofing.
- F. Water-Based, Fabric-Backed Membrane Adhesive: Roofing system manufacturer's standard water-based, cold-applied adhesive formulated for compatibility and use with fabric-backed membrane roofing.
- G. Low-Rise, Urethane, Fabric-Backed Membrane Adhesive: Roof system manufacturer's standard spray-applied, low-rise, two-component urethane adhesive formulated for compatibility and use with fabric-backed membrane roofing.
- H. Seaming Material: [**Single-component, butyl splicing adhesive and splice cleaner**] [**Manufacturer's standard, synthetic-rubber polymer primer and 3-inch-** (75-mm-) **wide minimum, butyl splice tape with release film**].
- I. Lap Sealant: Manufacturer's standard, single-component sealant[, **colored to match membrane roofing**].
- J. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.
- K. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately **1 by 1/8 inch** (25 by 3 mm) thick; with anchors.
- L. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately **1 inch wide by 0.05 inch thick** (25 mm wide by 1.3 mm thick), prepunched.
- M. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to roofing system manufacturer.
- N. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.
- O. Liquid coating, specifically formulated for coating EPDM membrane roofing, as follows:
 - 1. Type: [**Acrylic emulsion**] [**Hypalon**].
 - 2. Color: [**White**] [**Gray**] [**Tan**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.

2.4 SUBSTRATE BOARDS

- A. Substrate Board: ASTM C 1396/C 1396M, Type X gypsum board, **5/8 inch** (16 mm) thick.
- B. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, [**1/4 inch** (6 mm)] [**1/2 inch** (13 mm)] [**Type X, 5/8 inch** (16 mm)] thick.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Georgia-Pacific Corporation; Dens Deck.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
- C. Substrate Board: ASTM C 1278/C 1278M, cellulosic-fiber-reinforced, water-resistant gypsum substrate, [**1/4 inch** (6 mm)] [**3/8 inch** (10 mm)] [**1/2 inch** (13 mm)] [**5/8 inch** (16 mm)] thick.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. USG Corporation; Secureck.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
- D. Substrate Board: ASTM C 728, perlite board, [**3/4 inch** (19 mm)] [**1 inch** (25 mm)] thick, seal coated.
- E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate panel to roof deck.

2.5 VAPOR RETARDER

- A. Polyethylene Film: ASTM D 4397, **6 mils** (0.15 mm) thick, minimum, with maximum permeance rating of **0.13 perm** (7.5 ng/Pa x s x sq. m).
1. Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
 2. Adhesive: Manufacturer's standard lap adhesive, FM Approvals approved for vapor-retarder application.

2.6 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured[**or approved**] by EPDM membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated[**and that produce FM Approvals-approved roof insulation**].

- B. Extruded-Polystyrene Board Insulation: ASTM C 578, [**Type IV, 1.6-lb/cu. ft.** (26-kg/cu. m)] [**Type X, 1.3-lb/cu. ft.** (21-kg/cu. m)] minimum density, square edged.
- C. Molded-Polystyrene Board Insulation: ASTM C 578, [**Type II, 1.35-lb/cu. ft.** (22-kg/cu. m)] [**Type VIII, 1.15-lb/cu. ft.** (18-kg/cu. m)] [**Type IX, 1.8-lb/cu. ft.** (29-kg/cu. m)] minimum density.
- D. Composite Molded-Polystyrene Board Insulation: ASTM C 578, [**Type II, 1.35-lb/cu. ft.** (22-kg/cu. m)] [**Type VIII, 1.15-lb/cu. ft.** (18-kg/cu. m)] [**Type IX, 1.8-lb/cu. ft.** (29-kg/cu. m)] minimum density, with factory-applied facings, as follows:
1. Facer: ASTM C 208, Type II, Grade 2, cellulosic-fiber insulation board, asphalt coated, **1/2 inch** (13 mm) thick.
 2. Facer: DOC PS 2, Exposure 1, OSB, **7/16 inch** (11 mm) thick.
- E. Polyisocyanurate Board Insulation: ASTM C 1289, [**Type II, Class 1, Grade 2**] [**Type II, Class I, Grade 3**], felt or glass-fiber mat facer on both major surfaces.
- F. Composite Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2 with factory-applied facing board on one major surface, as indicated below by type, and felt or glass-fiber mat facer on the other.
1. Type IV, cellulosic-fiber-insulation-board facer, Grade 2, **1/2 inch** (13 mm) thick.
 2. Type V, OSB facer, **7/16 inch** (11 mm) thick.
 3. Type VII, glass mat faced gypsum board facer, **1/4 inch** (6 mm) thick.
- G. Perlite Board Insulation: ASTM C 728, rigid, mineral-aggregate thermal insulation board composed of expanded perlite, cellulosic fibers, binders, and waterproofing agents with top surface seal coated.
- H. Cellulosic-Fiber Board Insulation: ASTM C 208, Type II, Grade 2, fibrous-felted, rigid insulation boards of wood fiber or other cellulosic-fiber and water-resistant binders, asphalt impregnated, chemically treated for deterioration.
- I. Cellular-Glass Board Insulation: ASTM C 552, Type IV, rigid, cellular-glass thermal board insulation faced with manufacturer's standard kraft-paper sheets.
- J. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of [**1/4 inch per 12 inches (1:48)**] <Insert slope> unless otherwise indicated.
- K. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.7 INSULATION ACCESSORIES

- A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.

- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation[**and cover boards**] to substrate, and acceptable to roofing system manufacturer.
- C. Modified Asphaltic Insulation Adhesive: Insulation manufacturer's recommended modified asphalt, asbestos-free, cold-applied adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- D. Bead-Applied Insulation Adhesive: Insulation manufacturer's recommended bead-applied, low-rise, one- or multicomponent urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- E. Full-Spread Applied Insulation Adhesive: Insulation manufacturer's recommended spray-applied, low-rise, two-component urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- F. Cover Board: ASTM C 208, Type II, Grade 2, cellulosic-fiber insulation board, **1/2 inch** (13 mm) thick.
- G. Cover Board: DOC PS 2, Exposure 1, OSB, **7/16 inch** (11 mm) thick.
- H. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, [**1/4 inch** (6 mm)] [**1/2 inch** (13 mm)] [**5/8 inch** (16 mm)] thick[, **factory primed**].
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Georgia-Pacific Corporation; [**Dens Deck**] [**Dens Deck Prime**] [**Dens Deck DuraGuard**].
 - b. <**Insert manufacturer's name; product name or designation**>.
 - c. or approved equal.
- I. Cover Board: ASTM C 1278/C 1278M, cellulosic-fiber reinforced, water-resistant gypsum substrate, [**1/4 inch** (6 mm)] [**3/8 inch** (10 mm)] [**1/2 inch** (13 mm)] [**5/8 inch** (16 mm)] thick.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. USG Corporation; Securock.
 - b. <**Insert manufacturer's name; product name or designation**>.
 - c. or approved equal.
- J. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by roofing system manufacturer for application.

2.8 ASPHALT MATERIALS

- A. Roofing Asphalt: [**ASTM D 312, Type III or Type IV**] [**ASTM D 6152, SEBS modified**].

- B. Asphalt Primer: ASTM D 41.

2.9 AGGREGATE BALLAST

- A. Aggregate Ballast: Provide aggregate ballast that will withstand weather exposure without significant deterioration and will not contribute to membrane degradation, of the following type and size:

1. Aggregate Type: **[Smooth, washed, riverbed gravel or other acceptable smooth-faced stone] [Crushed gravel or crushed stone]**.
2. Size: ASTM D 448, Size 4, ranging in size from **3/4 to 1-1/2 inches** (19 to 38 mm).
3. Size: ASTM D 448, Size 2, ranging in size from **1-1/2 to 2-1/2 inches** (38 to 63 mm).
4. Size: ASTM D 448, Size 3, ranging in size from **1 to 2 inches** (25 to 50 mm).

2.10 ROOF PAVERS

- A. Lightweight Roof Pavers: Interlocking, lightweight concrete units, specially factory cast for use as roof ballast; grooved back, with four-way drainage capability; beveled, doweled, or otherwise profiled; and as follows:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hanover Architectural Products.
 - b. Rapid Building Systems.
 - c. Roofblok Limited.
 - d. Westile Roofing Products.
 - e. **<Insert manufacturer's name>**.
 - f. or approved equal.
2. Size: **<Insert actual size(s) of pavers>**.
3. Weight: **<Insert weight or weight range>**.
4. Compressive Strength: **[2500 psi (17 MPa)] [5000 psi (34 MPa)] <Insert strength>**, minimum.
5. Colors and Textures: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range]**.

- B. Rubber Roof Pavers: Interlocking, lightweight rubber units, **24 by 24 by 2-1/4 inches** (600 by 600 by 57 mm), **6 lb/sq. ft.** (30 kg/sq. m) specially manufactured for use as roof ballast; with grooved back for four-way drainage, beveled and doweled; and as follows:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle SynTec Incorporated; Interlocking Rubber Paver.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.

2. Perimeter Securement Strip: Manufacturer's standard [**coated steel sheet channel**] [**aluminum sheet channel**] [**mill-finish aluminum sheet hold down**] [**coated aluminum sheet hold down, color as selected by DEN Project Manager,**] and fasteners.
 3. Color: [**Black**] [**Gray**] [**Terra cotta**] <Insert color>.
- C. Heavyweight Roof Pavers: Heavyweight, hydraulically pressed, concrete units, [**square edged**] [**with top edges beveled 3/16 inch (5 mm)**], factory cast for use as roof pavers; absorption not greater than 5 percent, ASTM C 140; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C 67; and as follows:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hanover Architectural Products.
 - b. Rapid Building Systems.
 - c. Roofblok Limited.
 - d. Sunny Brook Pressed Concrete.
 - e. Wausau Tile, Inc.; Terra-Paving Division.
 - f. Westile Roofing Products.
 - g. <Insert manufacturer's name>.
 - h. or approved equal.
 2. Size: [**24 by 24 inches (600 by 600 mm)**] <Insert dimensions>. Manufacture pavers to dimensional tolerances of plus or minus **1/16 inch (1.6 mm)** in length, height, and thickness.
 3. Weight: [**18 lb/sq. ft. (90 kg/sq. m)**] [**22 lb/sq. ft. (110 kg/sq. m)**] <Insert weight>.
 4. Compressive Strength: [**7500 psi (52 MPa)**] [**6500 psi (45 MPa)**] <Insert strength>, minimum.
 5. Colors and Textures: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**].

2.11 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway [**pads**] [**or**] [**rolls**], approximately **3/16 inch (5 mm)** thick, and acceptable to membrane roofing system manufacturer.
- B. Walkway Roof Pavers: Heavyweight, hydraulically pressed, concrete units, [**square edged**] [**with top edges beveled 3/16 inch (5 mm)**], factory cast for use as roof pavers; absorption not greater than 5 percent, ASTM C 140; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C 67; and as follows:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hanover Architectural Products.

- b. Rapid Building Systems.
 - c. Roofblok Limited.
 - d. Sunny Brook Pressed Concrete.
 - e. Wausau Tile, Inc.; Terra-Paving Division.
 - f. Westile Roofing Products.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
2. Size: **[24 by 24 inches (600 by 600 mm)] <Insert dimensions>**. Manufacture pavers to dimensional tolerances of plus or minus **1/16 inch (1.6 mm)** in length, height, and thickness.
 3. Weight: **[18 lb/sq. ft. (90 kg/sq. m)] [22 lb/sq. ft. (110 kg/sq. m)] <Insert weight>**.
 4. Compressive Strength: **[7500 psi (52 MPa)] [6500 psi (45 MPa)] <Insert strength>**, minimum.
 5. Colors and Textures: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range]**.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."
 4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
 5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 6. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

- B. Comply with manufacturers' instructions for preparation of substrate to receive EPDM system.
- C. Install cant strips, flashings, and accessory items as shown, and as recommended by manufacturer even if products are not shown on Drawings.
- D. Prime substrate where recommended by manufacturer of materials being installed.
- E. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- F. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- G. Install acoustical roof deck rib insulation strips, specified in Section 053100 "Steel Decking," according to acoustical roof deck manufacturer's written instructions, immediately before installation of overlying construction and to remain dry.

3.3 SUBSTRATE BOARD

- A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
 - 1. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
 - 2. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to membrane roofing system manufacturers' written instructions.

3.4 VAPOR-RETARDER INSTALLATION

- A. Polyethylene Film: Loosely lay polyethylene-film vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of **2 inches** (50 mm) and **6 inches** (150 mm), respectively.
 - 1. Continuously seal side and end laps with **[tape] [adhesive]**.
- B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.

3.5 INSULATION INSTALLATION

- A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is **2.7 inches** (68 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of **6 inches** (150 mm) in each direction.
 - 1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
- E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding **1/4 inch** (6 mm) with insulation.
 - 1. Cut and fit insulation within **1/4 inch** (6 mm) of nailers, projections, and penetrations.
- G. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:
 - 1. Prime surface of concrete deck with asphalt primer at rate of **3/4 gal./100 sq. ft.** (0.3 L/sq. m) and allow primer to dry.
 - 2. Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus **25 deg F** (14 deg C) of equiviscous temperature.
 - 3. Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
 - 4. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
- H. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
 - 1. Fasten insulation according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.
 - 2. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.
- I. Mechanically Fastened and Adhered Insulation: Install first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified

board-type roof insulation to deck type.

1. Fasten first layer of insulation according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.
2. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
3. Set each subsequent layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
4. Set each subsequent layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
5. Set each subsequent layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

J. Loosely Laid Insulation: Loosely lay insulation units over substrate.

K. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction. Loosely butt cover boards together[**and fasten to roof deck**].

1. Fasten cover boards according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.
2. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.

3.6 ADHERED MEMBRANE ROOFING INSTALLATION

- A. Adhere [**fabric-backed**] membrane roofing over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll membrane roofing and allow to relax before installing.
- B. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.
- C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.
- E. Hot Roofing Asphalt: Apply a solid mopping of hot roofing asphalt to substrate at temperature and rate required by manufacturer and install fabric-backed membrane roofing. Do not apply to splice area of membrane roofing.
- F. Fabric-Backed Membrane Adhesive: Apply to substrate at rate required by manufacturer and install fabric-backed membrane roofing.

- G. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeters.
- H. Apply membrane roofing with side laps shingled with slope of roof deck where possible.
- I. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.
 - 1. Apply a continuous bead of in-seam sealant before closing splice if required by membrane roofing system manufacturer.
- J. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.
- K. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.
- L. Spread sealant or mastic bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.
- M. Install membrane roofing and auxiliary materials to tie in to existing membrane roofing to maintain weather-tightness of transition [**and to not void warranty for existing membrane roofing system**].
- N. Adhere protection sheet over membrane roofing at locations indicated.

3.7 MECHANICALLY FASTENED MEMBRANE ROOFING INSTALLATION

- A. Mechanically fasten membrane roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll membrane roofing and allow to relax before installing.
 - 1. For in-splice attachment, install membrane roofing with long dimension perpendicular to steel roof deck flutes.
- B. Start installation of membrane roofing in presence of roofing system manufacturer's technical personnel.
- C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Mechanically fasten or adhere membrane roofing securely at terminations, penetrations, and perimeter of roofing.

- E. Apply membrane roofing with side laps shingled with slope of roof deck where possible.
- F. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.
 - 1. Apply a continuous bead of in-seam sealant before closing splice if required by membrane roofing system manufacturer.
- G. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.
- H. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.
- I. Spread sealant or mastic bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.
- J. In-Splice Attachment: Secure one edge of membrane roofing using fastening plates or metal battens centered within membrane splice and mechanically fasten membrane roofing to roof deck. Field splice seam.
- K. Through-Membrane Attachment: Secure membrane roofing using fastening plates or metal battens and mechanically fasten membrane roofing to roof deck. Cover battens and fasteners with a continuous cover strip.
- L. Install membrane roofing and auxiliary materials to tie in to existing roofing to maintain weather-tightness of transition [**and to not void warranty for existing membrane roofing system**].
- M. Adhere protection sheet over membrane roofing at locations indicated.

3.8 LOOSELY LAID AND BALLASTED MEMBRANE ROOFING INSTALLATION

- A. Loosely lay membrane roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll membrane roofing and allow to relax before installing.
 - 1. Comply with requirements in SPRI RP-4 for [**System 1**] [**System 2**] [**System 3**].
- B. Start installation of membrane roofing in presence of roofing system manufacturer's technical personnel.
- C. Accurately align membrane roofing, without stretching, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

- D. Mechanically fasten or adhere perimeter of membrane roofing according to requirements in SPRI RP-4.
- E. **[Mechanically fasten] [or] [adhere]** membrane roofing at corners, perimeters, and transitions according to requirements in SPRI RP-4.
 - 1. At corners and perimeters, omit aggregate ballast leaving membrane roofing exposed.
 - 2. At corners and perimeters, adhere a second layer of membrane roofing
- F. Apply membrane roofing with side laps shingled with slope of deck where possible.
- G. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.
 - 1. Apply a continuous bead of in-seam sealant before closing splice if required by membrane roofing system manufacturer.
- H. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.
- I. Leave seams uncovered until inspected by **[membrane roofing system manufacturer] [testing agency]**.
- J. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.
- K. Spread sealant or mastic bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.
- L. Install membrane roofing and auxiliary materials to tie in to existing roofing to maintain weather-tightness of transition **[and to not void warranty for existing membrane roofing system]**.
- M. Adhere protection sheet over membrane roofing at locations indicated.
- N. Install protection mat over membrane roofing, overlapping a minimum of **6 inches** (150 mm). Install an additional protection mat layer at projections, pipes, vents, and drains, overlapping a minimum of **12 inches** (300 mm).
- O. Aggregate Ballast: Apply uniformly over membrane roofing at the rate required by membrane roofing system manufacturer, but not less than the following, spreading with care to minimize possibility of damage to membrane roofing system. Lay ballast as membrane roofing is installed, leaving membrane roofing ballasted at the end of the workday.

1. Ballast Weight: Size 4 aggregate, **10 lb/sq. ft.** (50 kg/sq. m).
2. Ballast Weight: Size 2 aggregate, **13 lb/sq. ft.** (65 kg/sq. m), at corners and perimeter; Size 4 aggregate, **10 lb/sq. ft.** (50 kg/sq. m), elsewhere.
3. Ballast Weight: Size 2 aggregate, **13 lb/sq. ft.** (65 kg/sq. m).
4. Ballast Weight: Size 3 aggregate, **<Insert weight>**, at corners, **<Insert weight>** at perimeter, and **<Insert weight>**, elsewhere.

P. Roof-Paver Ballast: Install [**lightweight**] [**heavyweight**] roof-paver ballast according to manufacturer's written instructions.

Q. Roof-Paver Ballast: Install rubber roof-paver ballast according to manufacturer's written instructions, in locations indicated.

1. Install perimeter paver edge securement.

R. Roof-Paver and Aggregate Ballast: Install heavyweight roof pavers according to manufacturer's written instructions on roof corners and perimeter.

1. Install Size 4 aggregate ballast elsewhere on roofing at a minimum rate of **10 lb/sq. ft.** (50 kg/sq. m).
2. Install Size 2 aggregate ballast elsewhere on roofing at a minimum rate of **13 lb/sq. ft.** (65 kg/sq. m).

3.9 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- E. Terminate and seal top of sheet flashings[**and mechanically anchor to substrate through termination bars**].

3.10 COATING INSTALLATION

- A. Apply coatings to [**membrane roofing**] [**base flashings**] according to manufacturer's written recommendations, by spray, roller, or other suitable application method.

3.11 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.
- B. Roof-Paver Walkways: Install walkway roof pavers according to manufacturer's written instructions in locations indicated, to form walkways. Leave **3 inches** (75 mm) of space between adjacent roof pavers.

3.12 FIELD QUALITY CONTROL

- A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified independent testing agency to perform inspections.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- C. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.
- D. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.13 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to DEN Project Manager.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.14 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS **<Insert name>** of **<Insert address>**, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
 - 1. Owner: **<Insert name of Owner.>**
 - 2. Address: **<Insert address.>**
 - 3. Building Name/Type: **<Insert information.>**

4. Address: **<Insert address.>**
 5. Area of Work: **<Insert information.>**
 6. Acceptance Date: **<Insert date.>**
 7. Warranty Period: **<Insert time.>**
 8. Expiration Date: **<Insert date.>**
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
 - a. Lightning;
 - b. Peak gust wind speed exceeding **<Insert wind speed>** mph (m/sec);
 - c. Fire;
 - d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
 - e. Faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
 - f. Vapor condensation on bottom of roofing; and
 - g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
 2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
 3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
 4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely

- damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
 6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
 7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this **<Insert day>** day of **<Insert month>**, **<Insert year>**.

1. Authorized Signature: **<Insert signature>**.
2. Name: **<Insert name>**.
3. Title: **<Insert title>**.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 075323

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Manufactured through-wall flashing[**with snaplock receiver**] [**with counterflashing**].
2. Manufactured reglets[**with counterflashing**].
3. Formed roof-drainage sheet metal fabrications.
4. Formed low-slope roof sheet metal fabrications.
5. Formed steep-slope roof sheet metal fabrications.
6. Formed wall sheet metal fabrications.
7. Formed equipment support flashing.
8. Formed overhead-piping safety pans.

B. Related Requirements:

1. **[Section 061000 "Rough Carpentry"] [Section 061053 "Miscellaneous Rough Carpentry"]** for wood nailers, curbs, and blocking.
2. Section <Insert Section number> "<Insert Section title>" for [materials and]installation of sheet metal flashing and trim integral with roofing.
3. Section <Insert Section number> "<Insert Section title>" for sheet metal flashing and trim integral with metal wall panels.
4. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
5. Section 079500 "Expansion Control" for manufactured sheet metal expansion-joint covers.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.
 1. Meet with DEN Project Manager, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
 2. Review methods and procedures related to sheet metal flashing and trim.
 3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
 4. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 5. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
 6. Review requirements for insurance and certificates if applicable.
 7. Review sheet metal flashing observation and repair procedures after flashing installation.
 8. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
 2. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
- C. Shop Drawings: For sheet metal flashing and trim.
 1. Include plans, elevations, sections, and attachment details at 1/4" = 1'-0" scale.
 2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.

3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
10. Include details of special conditions.
11. Include details of connections to adjoining work.
12. Detail formed flashing and trim at scale of not less than **[3 inches per 12 inches (1:5)] <Insert scale>**.

D. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

E. Samples for Verification: For each type of exposed finish.

1. Sheet Metal Flashing: **12 inches (300 mm)** long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: **12 inches (300 mm)** long and in required profile. Include fasteners and other exposed accessories.
3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.
4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Submit certificate showing that manufacturer has not less than five (5) years' experience in the manufacturing of the types of products specified.

C. Product Certificates: For each type of coping and roof edge flashing that is **[SPRI ES-1 tested] [and] [FM Approvals approved]**.

D. Product Test Reports: For each product, for tests performed by a qualified testing agency.

E. Submit certificate showing that installation contractor has not less than three (3) years of successful experience in the installation of similar types of flashing and trim specified.

F. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Coordinate work of this section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of work and protection of materials and finishes.
- B. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
- C. Manufacturer shall have not less than five (5) years' experience in the manufacturing of the types of products specified.
 - 1. For copings and roof edge flashings that are **[SPRI ES-1 tested] [and] [FM Approvals approved]**, shop shall be listed as able to fabricate required details as tested and approved.
- D. Installation contractor shall have not less than three (3) years of successful experience in the installation of similar types of flashing and trim specified.
- E. Coordinate with other systems to assure watertight assemblies.
- F. Workmanship performed at the job site to be equal to that performed in the shop.
- G. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Build mockup of typical roof **[edge] [eave]**, including **[built-in gutter] [fascia] [fascia trim] [apron flashing]** <Insert item>, approximately **[10 feet (3.0 m)]** <Insert dimension> long, including supporting construction cleats, seams, attachments[, **underlayment,**] and accessories.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.
- B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.
- C. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- D. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.
- E. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.10 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Warranty: Shall be required for a period of **[two (2)] <Insert number>** years by installer. Reference roof system warranty in other Division 07 Sections.
 - 2. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 3. Finish Warranty Period: Minimum **[20] [10] <Insert number>** years from date of Substantial Completion.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with **[NRCA's "The NRCA Roofing Manual"] [and] [SMACNA's "Architectural Sheet Metal Manual"]** requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- D. FM Approvals Listing: Manufacture and install **[copings] [roof edge flashings]** that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, **[Class 1-60] [Class 1-75] [Class 1-90] [Class 1-105] [Class 1-120] <Insert class>**. Identify materials with name of fabricator and design approved by FM Approvals.
- E. SPRI Wind Design Standard: Manufacture and install **[copings] [roof edge flashings]** tested according to SPRI ES-1 and capable of resisting the following design pressure:
1. Design Pressure: **[As indicated on Drawings] <Insert design pressure>**.
- F. Recycled Content of Copper-Sheet Flashing and Trim: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[40] <Insert number>** percent.
- G. Recycled Content of Steel-Sheet Flashing and Trim: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25] <Insert number>** percent.
- H. Recycled Content of Zinc-Sheet Flashing and Trim: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[15] <Insert number>** percent.
- I. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change: **[120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces] <Insert temperature change>**.

J. Finishes:

1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
2. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
3. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or in-stalled to minimize contrast.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 or H01 temper.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hussey Copper Ltd.
 - b. Revere Copper Products, Inc.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.
2. Nonpatinated Exposed Finish: Mill.
3. Nonpatinated, Exposed, Lacquered Finish: Finish designations for copper alloys comply with system defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products."
 - a. Brushed Satin (Lacquered): M32-06x (Mechanical Finish: directionally textured, medium satin; with clear organic coating); coating of "Incralac," **[waterborne,] [solvent-borne,]** methyl methacrylate copolymer lacquer with UV inhibitor, applied by air spray in two coats per manufacturer's written instructions to total thickness of **1 mil** (0.025 mm).
 - b. Mirror Polished (Lacquered): M22-06x (Mechanical Finish: buffed, specular; with clear organic coating); coating of "Incralac," **[waterborne,] [solvent-borne,]** air-drying, methyl methacrylate copolymer lacquer with UV inhibitor, applied by air spray in two coats per manufacturer's written instructions to total thickness of **1 mil** (0.025 mm).
4. Prepatinated Copper-Sheet Finish: **[Dark brown] [Verdigris] <Insert color>**, prepatinated according to ASTM B 882.

C. Aluminum Sheet: **ASTM B 209** (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with **[smooth, flat] [embossed]** surface.

1. As-Milled Finish: **[Mill]** **[One-side bright mill]** **[Standard one-side bright]** **[Standard two-side bright]**.
2. Alclad Finish: Metallurgically bonded surfacing alloy on both sides, forming aluminum sheet with reflective luster.
3. Factory Prime Coating: Where painting after installation is required, pretreat metal with white or light-colored, factory-applied, baked-on epoxy primer coat; minimum dry film thickness of **0.2 mil** (0.005 mm).
4. Clear Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
5. Color Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - a. Color: **[Champagne]** **[Light bronze]** **[Medium bronze]** **[Dark bronze]** **[Black]** **<Insert color>**.
 - b. Color: **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from full range of industry colors and color densities]**.
 - c. Color Range: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
6. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - b. Three-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - c. Mica Fluoropolymer: AAMA 620. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - d. Metallic Fluoropolymer: AAMA 620. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - e. FEVE Fluoropolymer: AAMA 620. Two-coat fluoropolymer finish containing 100 percent fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - f. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with dry film thickness of not less than **0.2 mil** (0.005 mm) for primer and **0.8 mil** (0.02 mm) for topcoat.

7. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 8. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of **0.5 mil** (0.013 mm).
- D. Stainless-Steel Sheet: ASTM A 240/A 240M[**or ASTM A 666**], [**Type 304**] [**Type 316**], dead soft, fully annealed; with [**smooth, flat**] [**embossed**] surface.
1. Finish: [**2D (dull, cold rolled)**] [**2B (bright, cold rolled)**] [**3 (coarse, polished directional satin)**] [**4 (polished directional satin)**] <Insert finish>.
- E. Zinc-Tin Alloy-Coated Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, dead-soft, fully annealed, stainless-steel sheet of minimum uncoated thickness indicated; coated on both sides with zinc-tin alloy (50 percent zinc, 50 percent tin), with factory-applied gray preweathering.
1. **Products**: Subject to compliance with requirements, provide one of the following:
 - a. **Follansbee Steel**; [**TCS II**] [**TCS Satin**].
 - b. <Insert manufacturer's name; product name or designation>.
 - c. or approved equal.
- F. Zinc-Tin Alloy-Coated Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper, of minimum uncoated weight (thickness) indicated; coated on both sides with zinc-tin alloy (50 percent zinc, 50 percent tin).
1. **Products**: Subject to compliance with requirements, provide one of the following:
 - a. **Revere Copper Products, Inc.**; FreedomGray.
 - b. <Insert manufacturer's name; product name or designation>.
 - c. or approved equal.
- G. Metallic-Coated Steel Sheet: Provide [**zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 (Z275) coating designation**] [or] [**aluminum-zinc alloy-coated steel sheet according to ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation, Grade 40 (Grade 275)**]; prepainted by coil-coating process to comply with ASTM A 755/A 755M.
1. Surface: [**Smooth, flat**] [**Embossed**] [**and mill phosphatized for field painting**] [**and with manufacturer's standard clear acrylic coating on both sides**].
 2. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - b. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear

- topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- c. Mica Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - d. Metallic Fluoropolymer: AAMA 621. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - e. FEVE Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish containing 100 percent fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - f. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with dry film thickness of not less than **0.2 mil** (0.005 mm) for primer and **0.8 mil** (0.02 mm) for topcoat.
3. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of **0.5 mil** (0.013 mm).
- H. **Zinc Sheet**: [99.995 percent electrolytic high-grade zinc with alloy additives of copper (0.08 to 0.20 percent), titanium (0.07 to 0.12 percent), and aluminum (0.015 percent)] [Zinc, 99 percent pure, alloyed with 0.08 to 1.00 percent copper, 0.06 to 0.20 percent titanium, and up to 0.015 percent aluminum]; with manufacturer's standard factory-applied, flexible, protective back coating.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. [Contrarian Metal Resources](#); Alloy 710 Zinc.
 - b. [Jarden Zinc Products](#); Solid Zinc Strip.
 - c. [Rheinzink America Inc.](#); RHEINZINK.
 - d. [Umicore Building Products USA, Inc.](#); VM ZINC series.
 - e. <Insert manufacturer's name; product name or designation>.
 - f. or approved equal.
 2. Finish: [**Bright rolled**] [**Prewathered gray**] [**Prewathered black**] <Insert finish>.
- I. Copper-Clad Stainless-Steel Sheet: ASTM B 506, annealed Temper O61.
1. **Products**: Subject to compliance with requirements, provide one of the following:

- a. [Engineering Materials Solutions, a member of the Wickeder Group](#); CopperPlus.
 - b. [SEMCO Southeastern Metals, a Gibraltar Industries company](#); CopperXT.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
2. Nonpatinated Exposed Finish: Mill.
3. Nonpatinated, Exposed, Lacquered Finish: Finish designations for copper alloys comply with system defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products."
- a. Brushed Satin (Lacquered): M32-06x (Mechanical Finish: directionally textured, medium satin; with clear organic coating); coating of "Incralac," **[waterborne,] [solvent-borne,]** methyl methacrylate copolymer lacquer with UV inhibitor, applied by air spray in two coats per manufacturer's written instructions to total thickness of **1 mil (0.025 mm)**.
 - b. Mirror Polished (Lacquered): M22-06x (Mechanical Finish: buffed, specular; with clear organic coating); coating of "Incralac," **[waterborne,] [solvent-borne,]** air-drying, methyl methacrylate copolymer lacquer with UV inhibitor, applied by air spray in two coats per manufacturer's written instructions to total thickness of **1 mil (0.025 mm)**.

2.3 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
- B. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over **220 deg F (111 deg C)**; and complying with physical requirements of ASTM D 226/D 226M for Type I and Type II felts.
1. **Products**: Subject to compliance with requirements, provide one of the following:
 - a. [Atlas Roofing Corporation](#); Summit.
 - b. [Engineered Coated Products](#); Nova-Seal II.
 - c. [Kirsch Building Products, LLC](#); **[Sharkskin Comp] [Sharkskin Ultra]**.
 - d. [SDP Advanced Polymer Products Inc](#); Palisade.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
- C. Self-Adhering, High-Temperature Sheet: Minimum **30 mils (0.76 mm)** thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
1. **Products**: Subject to compliance with requirements, provide one of the following:

- a. [Carlisle Residential, a division of Carlisle Construction Materials](#); WIP 300HT.
 - b. [Grace Construction Products, a unit of W. R. Grace & Co.-Conn.](#); [**Grace Ice and Water Shield HT**] [**Ultra**].
 - c. [Henry Company](#); Blueskin PE200 HT.
 - d. [Kirsch Building Products, LLC](#); Sharkskin Ultra SA.
 - e. [Metal-Fab Manufacturing, LLC](#); MetShield.
 - f. [Owens Corning](#); WeatherLock Specialty Tile & Metal Underlayment.
 - g. [Polyguard Products, Inc.](#); Deck Guard HT.
 - h. [Protecto Wrap Company](#); Protecto Jiffy Seal Ice & Water Guard HT.
 - i. [SDP Advanced Polymer Products Inc](#); Palisade SA-HT.
 - j. <Insert manufacturer's name; product name or designation>.
 - k. or approved equal.
2. Thermal Stability: ASTM D 1970; stable after testing at **240 deg F** (116 deg C) or higher.
 3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus **20 deg F** (29 deg C) or lower.
- D. Slip Sheet: Rosin-sized building paper, **3 lb/100 sq. ft.** (0.16 kg/sq. m) minimum.

2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners[, **solder**], protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal[**or manufactured item**] unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal[**or manufactured item**].
1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 2. Fasteners for [**Copper**] [**Zinc-Tin Alloy-Coated Copper**] [**Copper-Clad Stainless-Steel**] Sheet: Copper, hardware bronze or passivated Series 300 stainless steel.
 3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.

5. Fasteners for Zinc-Tin Alloy-Coated Stainless-Steel Sheet: Series 300 stainless steel.
 6. Fasteners for [**Zinc-Coated (Galvanized)**] [**Aluminum-Zinc Alloy-Coated**] Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
 7. Fasteners for Zinc Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
- C. Solder:
1. For [**Copper**] [**Copper-Clad Stainless Steel**]: ASTM B 32, [**Grade Sn50, 50 percent tin and 50 percent lead**] [**with maximum lead content of 0.2 percent**].
 2. For Stainless Steel: ASTM B 32, [**Grade Sn60**] [**Grade Sn96**], with acid flux of type recommended by stainless-steel sheet manufacturer.
 3. For Zinc-Tin Alloy-Coated [**Stainless Steel**] [**Copper**]: ASTM B 32, 100 percent tin, with maximum lead content of 0.2 percent, as recommended by sheet metal manufacturer.
 4. For Zinc-Coated (Galvanized) Steel: ASTM B 32, [**Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead**] [**with maximum lead content of 0.2 percent**].
 5. For Zinc: ASTM B 32, [**40 percent tin and 60 percent lead with low antimony,**] [**with maximum lead content of 0.2 percent,**] as recommended by zinc manufacturer.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape **1/2 inch (13 mm)** wide and **1/8 inch (3 mm)** thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric [**polyurethane**] [**polysulfide**] [**silicone**] polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- H. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
- I. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

- A. Through-Wall, Ribbed, Sheet Metal Flashing: Manufacture through-wall sheet metal flashing for embedment in masonry, with ribs at **3-inch (75-mm)** intervals along length of flashing to provide integral mortar bond. Manufacture through-wall flashing [**with snaplock receiver on exterior face to receive counterflashing**] [**with interlocking counterflashing on exterior face, of same metal as flashing**].
1. Copper: [**10-oz. (0.34-mm-thick)**] <Insert weight (thickness)> minimum for fully concealed flashing; [**16 oz. (0.55 mm thick)**] <Insert weight (thickness)> elsewhere.
 - a. **Products:** Subject to compliance with requirements, provide one of the following:
 - 1) [Cheney Flashing Company](#); Cheney Flashing [**Dovetail**] [**Sawtooth**].
 - 2) [Hohmann & Barnard, Inc.](#); STF Sawtooth Flashing.
 - 3) [Keystone Flashing Company, Inc.](#); Keystone Three-Way Interlocking Thruwall Flashing.
 - 4) [Sandell Manufacturing](#); Pre-Formed Metal Flashing.
 - 5) <Insert manufacturer's name; product name or designation>.
 - 6) or approved equal.
 2. Stainless Steel: [**0.016 inch (0.40 mm)**] <Insert dimension> thick.
 - a. **Products:** Subject to compliance with requirements, provide one of the following:
 - 1) [Cheney Flashing Company](#); Cheney Flashing [**Dovetail**] [**Sawtooth**].
 - 2) [Hohmann & Barnard, Inc.](#); STF Sawtooth Flashing.
 - 3) [Keystone Flashing Company, Inc.](#); Keystone Three-Way Interlocking Thruwall Flashing.
 - 4) [Sandell Manufacturing](#); Pre-Formed Metal Flashing.
 - 5) <Insert manufacturer's name; product name or designation>.
 - 6) or approved equal.

B. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated [**with factory-mitered and -welded corners and junctions**] [**and**] [**with interlocking counterflashing on exterior face, of same metal as reglet**].

 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Cheney Flashing Company](#).
 - b. [Fry Reglet Corporation](#).
 - c. [Heckmann Building Products, Inc.](#)
 - d. [Hickman, W. P. Company](#).
 - e. [Hohmann & Barnard, Inc.](#)
 - f. [Keystone Flashing Company, Inc.](#)

- g. [National Sheet Metal Systems, Inc.](#)
 - h. [Sandell Manufacturing.](#)
 - i. <Insert manufacturer's name>.
 - j. or approved equal.
2. Material: [**Stainless steel, 0.019 inch (0.48 mm) thick**] [**Copper, 16 oz./sq. ft. (0.55 mm thick)**] [**Aluminum, 0.024 inch (0.61 mm) thick**] [**Galvanized steel, 0.022 inch (0.56 mm) thick**].
 3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
 4. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
 5. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
 6. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
 7. Accessories:
 - a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
 - b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.
 8. Finish: [**Mill**] [**With manufacturer's standard color coating**] <Insert finish>.

2.6 FABRICATION, GENERAL

- A. General Metal Fabrication: Shop fabricate work to greatest extent possible. Comply with details shown, and with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices.
 1. Fabricate for waterproof and weather resistant performance; with expansion provisions for running work, sufficient to permanently prevent leakage, damage, or deterioration of the work.
 2. Form work to fit substrates. Comply with material manufacturer instructions and recommendations for forming material.
 3. Form exposed sheet metal work without excessive oil canning, buckling and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.
- B. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 2. Obtain field measurements for accurate fit before shop fabrication.
 3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of **1/4 inch in 20 feet** (6 mm in 6 m) on slope and location lines indicated on Drawings and within **1/8-inch** (3-mm) offset of adjoining faces and of alignment of matching profiles.
- D. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."
- E. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
1. Form expansion joints of intermeshing hooked flanges, not less than **1 inch** (25 mm) deep, filled with butyl sealant concealed within joints.
 2. Use lapped expansion joints only where indicated on Drawings.
- F. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- H. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard[**and by FM Global Property Loss Prevention Data Sheet 1-49**] for application, but not less than thickness of metal being secured.
- I. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- J. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. [**Rivet joints where necessary for strength.**]
- K. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. [**Rivet joints where necessary for strength.**]
- L. Separations: Provide for separation of metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.

- M. Do not use graphite pencils to mark metal surfaces.

2.7 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters: Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum **96-inch-** (2400-mm-) long sections. Furnish flat-stock gutter brackets and **[flat-stock] [twisted]** gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than **[twice the gutter thickness] [dimension indicated on Drawings] <Insert dimension>**. Fabricate expansion joints, expansion-joint covers, **[gutter bead reinforcing bars,]** and gutter accessories from same metal as gutters. **[Shop fabricate interior and exterior corners.]**

1. Gutter Profile: **[Style A] [Style B] [Style C] [Style D] [Style E] [Style F] [Style G] [Style H] [Style I] [Style J] [Style K] [Style L]** according to cited sheet metal standard.
2. Expansion Joints: **[Lap type] [Butt type] [Butt type with cover plate] [Built in]**.
3. Accessories: **[Continuous, removable leaf screen with sheet metal frame and hardware cloth screen] [Wire-ball downspout strainer] [Valley baffles]**.
4. Gutters with Girth up to **15 Inches** (380 mm): Fabricate from the following materials:
 - a. Copper: **[16 oz./sq. ft. (0.55 mm thick)] <Insert weight (thickness)>**.
 - b. Aluminum: **[0.032 inch (0.81 mm)] <Insert dimension> thick**.
 - c. Stainless Steel: **[0.016 inch (0.40 mm)] <Insert dimension> thick**.
 - d. Zinc-Tin Alloy-Coated Stainless Steel: **[0.015 inch (0.38 mm)] <Insert dimension> thick**.
 - e. Zinc-Tin Alloy-Coated Copper: **[16 oz./sq. ft. (0.55 mm thick)] <Insert weight (thickness)>**.
 - f. Galvanized Steel: **[0.022 inch (0.56 mm)] <Insert dimension> thick**.
 - g. Aluminum-Zinc Alloy-Coated Steel: **[0.022 inch (0.56 mm)] <Insert dimension> thick**.
 - h. Zinc: **[0.032 inch (0.80 mm)] [0.039 inch (1.00 mm)] <Insert dimension> thick**.
 - i. Copper-Clad Stainless Steel: **[0.016 inch (0.40 mm)] <Insert dimension> thick**.
5. Gutters with Girth **16 to 20 Inches** (410 to 510 mm): Fabricate from the following materials:
 - a. Copper: **[16 oz./sq. ft. (0.55 mm thick)] <Insert weight (thickness)>**.
 - b. Aluminum: **[0.040 inch (1.02 mm)] <Insert dimension> thick**.
 - c. Stainless Steel: **[0.019 inch (0.48 mm)] <Insert dimension> thick**.
 - d. Zinc-Tin Alloy-Coated Stainless Steel: **[0.018 inch (0.46 mm)] <Insert dimension> thick**.
 - e. Zinc-Tin Alloy-Coated Copper: **[16 oz./sq. ft. (0.55 mm thick)] <Insert weight (thickness)>**.
 - f. Galvanized Steel: **[0.028 inch (0.71 mm)] <Insert dimension> thick**.

- g. Aluminum-Zinc Alloy-Coated Steel: [**0.028 inch (0.71 mm)**] <Insert dimension> thick.
 - h. Zinc: [**0.039 inch (1.00 mm)**] [**0.048 inch (1.25 mm)**] <Insert dimension> thick.
 - i. Copper-Clad Stainless-Steel: [**0.018 inch (0.46 mm)**] <Insert dimension> thick.
6. Gutters with Girth 21 to 25 Inches (530 to 640 mm): Fabricate from the following materials:
- a. Copper: [**20 oz./sq. ft. (0.68 mm thick)**] <Insert weight (thickness)>.
 - b. Aluminum: [**0.050 inch (1.27 mm)**] <Insert dimension> thick.
 - c. Stainless Steel: [**0.025 inch (0.64 mm)**] <Insert dimension> thick.
 - d. Zinc-Tin Alloy-Coated Stainless Steel: [**0.024 inch (0.61 mm)**] <Insert dimension> thick.
 - e. Zinc-Tin Alloy-Coated Copper: [**20 oz./sq. ft. (0.68 mm thick)**] <Insert weight (thickness)>.
 - f. Galvanized Steel: [**0.034 inch (0.86 mm)**] <Insert dimension> thick.
 - g. Aluminum-Zinc Alloy-Coated Steel: [**0.034 inch (0.86 mm)**] <Insert dimension> thick.
 - h. Zinc: [**0.048 inch (1.25 mm)**] [**0.059 inch (1.50 mm)**] <Insert dimension> thick.
 - i. Copper-Clad Stainless Steel: [**0.027 inch (0.69 mm)**] <Insert dimension> thick.
7. Gutters with Girth 26 to 30 Inches (660 to 760 mm): Fabricate from the following materials:
- a. Copper: [**24 oz./sq. ft. (0.82 mm thick)**] <Insert weight (thickness)>.
 - b. Aluminum: [**0.063 inch (1.60 mm)**] <Insert dimension> thick.
 - c. Stainless Steel: [**0.031 inch (0.79 mm)**] <Insert dimension> thick.
 - d. Zinc-Tin Alloy-Coated Copper: [**24 oz./sq. ft. (0.82 mm thick)**] <Insert weight (thickness)>.
 - e. Galvanized Steel: [**0.040 inch (1.02 mm)**] <Insert dimension> thick.
 - f. Aluminum-Zinc Alloy-Coated Steel: [**0.040 inch (1.02 mm)**] <Insert dimension> thick.
8. Gutters with Girth 31 to 35 Inches (790 to 890 mm): Fabricate from the following materials:
- a. Copper: [**24 oz./sq. ft. (0.82 mm thick)**] <Insert weight (thickness)>.
 - b. Stainless Steel: [**0.038 inch (0.95 mm)**] <Insert dimension> thick.
 - c. Zinc-Tin Alloy-Coated Copper: [**25 oz./sq. ft. (0.87 mm thick)**] <Insert weight (thickness)>.
 - d. Galvanized Steel: [**0.052 inch (1.32 mm)**] <Insert dimension> thick.
 - e. Aluminum-Zinc Alloy-Coated Steel: [**0.052 inch (1.32 mm)**] <Insert dimension> thick.
- B. Built-in Gutters: Fabricate to cross section required, with riveted and soldered joints, complete with end pieces, outlet tubes, and other special accessories as required.

Fabricate in minimum **96-inch-** (2400-mm-) long sections. Fabricate expansion joints and accessories from same metal as gutters unless otherwise indicated.

1. Fabricate gutters with built-in expansion joints[**and gutter-end expansion joints at walls**].
 2. Accessories: [**Continuous, removable leaf screen with sheet metal frame and hardware cloth screen**] [**Bronze wire-ball downspout strainer**] [**Wire-ball downspout strainer**].
 3. Fabricate from the Following Materials:
 - a. Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
 - b. Stainless Steel: [**0.016 inch (0.40 mm)**] <Insert dimension> thick.
 - c. Zinc-Tin Alloy-Coated Stainless Steel: [**0.015 inch (0.38 mm)**] <Insert dimension> thick.
 - d. Zinc-Tin Alloy-Coated Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
 - e. Zinc: [**0.032 inch (0.80 mm)**] [**0.039 inch (1.00 mm)**] <Insert dimension> thick.
 - f. Copper-Clad Stainless Steel: [**0.016 inch (0.40 mm)**] <Insert dimension> thick.
- C. Downspouts: Fabricate [**round**] [**rectangular**] [**open-face**] downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from [**same material as downspouts and anchors**] <Insert material>.[**Shop fabricate elbows.**]
1. Fabricated Hanger Style: [**Fig 1-35A**] [**Fig 1-35B**] [**Fig 1-35C**] [**Fig 1-35D**] [**Fig 1-35E**] [**Fig 1-35F**] [**Fig 1-35G**] [**Fig 1-35H**] [**Fig 1-35I**] [**Fig 1-35J**] according to SMACNA's "Architectural Sheet Metal Manual."
 2. Manufactured Hanger Style: [**Fig 1-34A**] [**Fig 1-34B**] [**Fig 1-34C**] [**Fig 1-34D**] [**Fig 1-34E**] according to SMACNA's "Architectural Sheet Metal Manual."
 3. Hanger Style: <Insert description>.
 4. Fabricate from the following materials:
 - a. Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
 - b. Aluminum: [**0.024 inch (0.61 mm)**] <Insert dimension> thick.
 - c. Stainless Steel: [**0.016 inch (0.40 mm)**] <Insert dimension> thick.
 - d. Zinc-Tin Alloy-Coated Stainless Steel: [**0.015 inch (0.38 mm)**] <Insert dimension> thick.
 - e. Zinc-Tin Alloy-Coated Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
 - f. Galvanized Steel: [**0.022 inch (0.56 mm)**] <Insert dimension> thick.
 - g. Aluminum-Zinc Alloy-Coated Steel: [**0.022 inch (0.56 mm)**] <Insert dimension> thick.
 - h. Zinc: [**0.032 inch (0.80 mm)**] [**0.039 inch (1.00 mm)**] <Insert dimension> thick.
 - i. Copper-Clad Stainless Steel: [**0.016 inch (0.40 mm)**] <Insert dimension> thick.
- D. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, **4-inch-** (100-mm-) wide wall flanges to interior, and base extending **4 inches**

(100 mm) beyond cant or tapered strip into field of roof.[**Fasten gravel guard angles to base of scupper.**] Fabricate from the following materials:

1. Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
2. Aluminum: [**0.032 inch (0.81 mm)**] <Insert dimension> thick.
3. Stainless Steel: [**0.019 inch (0.48 mm)**] <Insert dimension> thick.
4. Zinc-Tin Alloy-Coated Stainless Steel: [**0.018 inch (0.46 mm)**] <Insert dimension> thick.
5. Zinc-Tin Alloy-Coated Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
6. Galvanized Steel: [**0.028 inch (0.71 mm)**] <Insert dimension> thick.
7. Aluminum-Zinc Alloy-Coated Steel: [**0.028 inch (0.71 mm)**] <Insert dimension> thick.
8. Zinc: [**0.032 inch (0.80 mm)**] [**0.039 inch (1.00 mm)**] <Insert dimension> thick.
9. Copper-Clad Stainless Steel: [**0.018 inch (0.46 mm)**] <Insert dimension> thick.

E. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes[, **exterior flange trim,**] [**and**] [**built-in overflows**]. Fabricate from the following materials:

1. Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
2. Aluminum: [**0.032 inch (0.81 mm)**] <Insert dimension> thick.
3. Stainless Steel: [**0.016 inch (0.40 mm)**] <Insert dimension> thick.
4. Zinc-Tin Alloy-Coated Stainless Steel: [**0.015 inch (0.38 mm)**] <Insert dimension> thick.
5. Zinc-Tin Alloy-Coated Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
6. Galvanized Steel: [**0.028 inch (0.71 mm)**] <Insert dimension> thick.
7. Aluminum-Zinc Alloy-Coated Steel: [**0.028 inch (0.71 mm)**] <Insert dimension> thick.
8. Zinc: [**0.032 inch (0.80 mm)**] [**0.039 inch (1.00 mm)**] <Insert dimension> thick.
9. Copper-Clad Stainless Steel: [**0.016 inch (0.40 mm)**] <Insert dimension> thick.

F. Splash Pans: Fabricate to dimensions and shape required and from the following materials:

1. Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
2. Aluminum: [**0.040 inch (1.02 mm)**] <Insert dimension> thick.
3. Stainless Steel: [**0.019 inch (0.48 mm)**] <Insert dimension> thick.
4. Zinc-Tin Alloy-Coated Stainless Steel: [**0.018 inch (0.46 mm)**] <Insert dimension> thick.
5. Zinc-Tin Alloy-Coated Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
6. Zinc: [**0.032 inch (0.80 mm)**] [**0.039 inch (1.00 mm)**] <Insert dimension> thick.
7. Copper-Clad Stainless Steel: [**0.018 inch (0.46 mm)**] <Insert dimension> thick.

2.8 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing (Gravel Stop)[**and Fascia Cap**]: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long sections. Furnish with 6-inch- (150-mm-) wide, joint cover plates.[**Shop fabricate interior and exterior corners.**]
1. Joint Style: [**Overlapped, 4 inches (100 mm) wide**] [**Butted with expansion space and 6-inch- (150-mm-) wide, concealed backup plate**] [**Butted with expansion space and 6-inch- (150-mm-) wide, exposed cover plate**] <Insert description>.
 2. Fabricate with scuppers spaced [**10 feet (3 m)**] <Insert dimension> apart, to dimensions required with 4-inch- (100-mm-) wide flanges and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
 3. Fabricate from the Following Materials:
 - a. Copper: [**20 oz./sq. ft. (0.68 mm thick)**] <Insert weight (thickness)>.
 - b. Aluminum: [**0.050 inch (1.27 mm)**] <Insert dimension> thick.
 - c. Stainless Steel: [**0.019 inch (0.48 mm)**] <Insert dimension> thick.
 - d. Zinc-Tin Alloy-Coated Stainless Steel: [**0.018 inch (0.46 mm)**] <Insert dimension> thick.
 - e. Zinc-Tin Alloy-Coated Copper: [**20 oz./sq. ft. (0.68 mm thick)**] <Insert weight (thickness)>.
 - f. Galvanized Steel: [**0.028 inch (0.71 mm)**] <Insert dimension> thick.
 - g. Aluminum-Zinc Alloy-Coated Steel: [**0.028 inch (0.71 mm)**] <Insert dimension> thick.
 - h. Zinc: [**0.048 inch (1.25 mm)**] [**0.059 inch (1.50 mm)**] <Insert dimension> thick.
 - i. Copper-Clad Stainless Steel: [**0.018 inch (0.46 mm)**] <Insert dimension> thick.
- B. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and[**drill elongated holes for fasteners on**] interior leg. Miter corners, [**fasten and seal**] [**solder or weld**] watertight.[**Shop fabricate interior and exterior corners.**]
1. Coping Profile: [**Fig 3-4A**] [**Fig 3-4B**] [**Fig 3-4C**] [**Fig 3-4D**] [**Fig 3-4E**] [**Fig 3-4F**] [**Fig 3-4G**] according to SMACNA's "Architectural Sheet Metal Manual."
 2. Joint Style: [**Butted with expansion space and 6-inch- (150-mm-) wide, concealed backup plate**] [**Butted with expansion space and 6-inch- (150-mm-) wide, exposed cover plate**] <Insert description>.
 3. Fabricate from the Following Materials:
 - a. Copper: [**24 oz./sq. ft. (0.82 mm thick)**] <Insert weight (thickness)>.
 - b. Aluminum: [**0.050 inch (1.27 mm)**] <Insert dimension> thick.
 - c. Stainless Steel: [**0.025 inch (0.64 mm)**] <Insert dimension> thick.
 - d. Zinc-Tin Alloy-Coated Stainless Steel: [**0.024 inch (0.61 mm)**] <Insert dimension> thick.

- e. Zinc-Tin Alloy-Coated Copper: [**24 oz./sq. ft. (0.82 mm thick)**] <Insert weight (thickness)>.
 - f. Galvanized Steel: [**0.040 inch (1.02 mm)**] <Insert dimension> thick.
 - g. Aluminum-Zinc Alloy-Coated Steel: [**0.040 inch (1.02 mm)**] <Insert dimension> thick.
 - h. Zinc: [**0.048 inch (1.25 mm)**] [**0.059 inch (1.50 mm)**] <Insert dimension> thick.
 - i. Copper-Clad Stainless Steel: [**0.027 inch (0.69 mm)**] <Insert dimension> thick.
- C. [Roof] [and] [Roof-to-Wall Transition] [Roof-to-Roof Edge-Flashing (Gravel-Stop) Transition] [Roof-to-Roof Edge-Flashing (Gravel-Stop) and Fascia-Cap Transition] Expansion-Joint Cover: Fabricate from the following materials:[Shop fabricate interior and exterior corners.]
- 1. Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
 - 2. Aluminum: [**0.050 inch (1.27 mm)**] <Insert dimension> thick.
 - 3. Stainless Steel: [**0.025 inch (0.64 mm)**] <Insert dimension> thick.
 - 4. Zinc-Tin Alloy-Coated Stainless Steel: [**0.024 inch (0.61 mm)**] <Insert dimension> thick.
 - 5. Zinc-Tin Alloy-Coated Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
 - 6. Galvanized Steel: [**0.034 inch (0.86 mm)**] <Insert dimension> thick.
 - 7. Aluminum-Zinc Alloy-Coated Steel: [**0.034 inch (0.86 mm)**] <Insert dimension> thick.
 - 8. Zinc: [**0.032 inch (0.80 mm)**] [**0.039 inch (1.00 mm)**] <Insert dimension> thick.
 - 9. Copper-Clad Stainless Steel: [**0.027 inch (0.69 mm)**] <Insert dimension> thick.
- D. Base Flashing: [Shop fabricate interior and exterior corners.]Fabricate from the following materials:
- 1. Copper: [**20 oz./sq. ft. (0.68 mm thick)**] <Insert weight (thickness)>.
 - 2. Aluminum: [**0.040 inch (1.02 mm)**] <Insert dimension> thick.
 - 3. Stainless Steel: [**0.019 inch (0.48 mm)**] <Insert dimension> thick.
 - 4. Zinc-Tin Alloy-Coated Stainless Steel: [**0.018 inch (0.46 mm)**] <Insert dimension> thick.
 - 5. Zinc-Tin Alloy-Coated Copper: [**20 oz./sq. ft. (0.68 mm thick)**] <Insert weight (thickness)>.
 - 6. Galvanized Steel: [**0.028 inch (0.71 mm)**] <Insert dimension> thick.
 - 7. Aluminum-Zinc Alloy-Coated Steel: [**0.028 inch (0.71 mm)**] <Insert dimension> thick.
 - 8. Zinc: [**0.032 inch (0.80 mm)**] [**0.039 inch (1.00 mm)**] <Insert dimension> thick.
 - 9. Copper-Clad Stainless Steel: [**0.018 inch (0.46 mm)**] <Insert dimension> thick.
- E. Counterflashing: [Shop fabricate interior and exterior corners.]Fabricate from the following materials:
- 1. Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
 - 2. Aluminum: [**0.032 inch (0.81 mm)**] <Insert dimension> thick.
 - 3. Stainless Steel: [**0.019 inch (0.48 mm)**] <Insert dimension> thick.

4. Zinc-Tin Alloy-Coated Stainless Steel: [**0.018 inch (0.46 mm)**] <Insert dimension> thick.
5. Zinc-Tin Alloy-Coated Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
6. Galvanized Steel: [**0.022 inch (0.56 mm)**] <Insert dimension> thick.
7. Aluminum-Zinc Alloy-Coated Steel: [**0.022 inch (0.56 mm)**] <Insert dimension> thick.
8. Zinc: [**0.032 inch (0.80 mm)**] [**0.039 inch (1.00 mm)**] <Insert dimension> thick.
9. Copper-Clad Stainless Steel: [**0.018 inch (0.46 mm)**] <Insert dimension> thick.

F. Flashing Receivers: Fabricate from the following materials:

1. Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
2. Aluminum: [**0.032 inch (0.81 mm)**] <Insert dimension> thick.
3. Stainless Steel: [**0.016 inch (0.40 mm)**] <Insert dimension> thick.
4. Zinc-Tin Alloy-Coated Stainless Steel: [**0.015 inch (0.38 mm)**] <Insert dimension> thick.
5. Zinc-Tin Alloy-Coated Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
6. Galvanized Steel: [**0.022 inch (0.56 mm)**] <Insert dimension> thick.
7. Aluminum-Zinc Alloy-Coated Steel: [**0.022 inch (0.56 mm)**] <Insert dimension> thick.
8. Zinc: [**0.032 inch (0.80 mm)**] [**0.039 inch (1.00 mm)**] <Insert dimension> thick.
9. Copper-Clad Stainless Steel: [**0.016 inch (0.40 mm)**] <Insert dimension> thick.

G. Roof-Penetration Flashing: Fabricate from the following materials:

1. Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
2. Stainless Steel: [**0.019 inch (0.48 mm)**] <Insert dimension> thick.
3. Zinc-Tin Alloy-Coated Stainless Steel: [**0.018 inch (0.46 mm)**] <Insert dimension> thick.
4. Zinc-Tin Alloy-Coated Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
5. Galvanized Steel: [**0.028 inch (0.71 mm)**] <Insert dimension> thick.
6. Aluminum-Zinc Alloy-Coated Steel: [**0.028 inch (0.71 mm)**] <Insert dimension> thick.
7. Zinc: [**0.032 inch (0.80 mm)**] [**0.039 inch (1.00 mm)**] <Insert dimension> thick.
8. Copper-Clad Stainless Steel: [**0.018 inch (0.46 mm)**] <Insert dimension> thick.

H. Roof-Drain Flashing: Fabricate from the following materials:

1. Copper: [**12 oz./sq. ft. (0.41 mm thick)**] <Insert weight (thickness)>.
2. Stainless Steel: [**0.016 inch (0.40 mm)**] <Insert dimension> thick.
3. Zinc-Tin Alloy-Coated Stainless Steel: [**0.015 inch (0.38 mm)**] <Insert dimension> thick.
4. Copper-Clad Stainless Steel: [**0.016 inch (0.40 mm)**] <Insert dimension> thick.

2.9 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:

1. Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
2. Aluminum: [**0.032 inch (0.81 mm)**] <Insert dimension> thick.
3. Stainless Steel: [**0.016 inch (0.40 mm)**] <Insert dimension> thick.
4. Zinc-Tin Alloy-Coated Stainless Steel: [**0.015 inch (0.38 mm)**] <Insert dimension> thick.
5. Zinc-Tin Alloy-Coated Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
6. Galvanized Steel: [**0.022 inch (0.56 mm)**] <Insert dimension> thick.
7. Aluminum-Zinc Alloy-Coated Steel: [**0.022 inch (0.56 mm)**] <Insert dimension> thick.
8. Zinc: [**0.032 inch (0.80 mm)**] [**0.039 inch (1.00 mm)**] <Insert dimension> thick.
9. Copper-Clad Stainless Steel: [**0.016 inch (0.40 mm)**] <Insert dimension> thick.

B. Valley Flashing: Fabricate from the following materials:

1. Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
2. Stainless Steel: [**0.019 inch (0.48 mm)**] <Insert dimension> thick.
3. Zinc-Tin Alloy-Coated Stainless Steel: [**0.018 inch (0.46 mm)**] <Insert dimension> thick.
4. Zinc-Tin Alloy-Coated Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
5. Galvanized Steel: [**0.028 inch (0.71 mm)**] <Insert dimension> thick.
6. Aluminum-Zinc Alloy-Coated Steel: [**0.028 inch (0.71 mm)**] <Insert dimension> thick.
7. Zinc: [**0.032 inch (0.80 mm)**] [**0.039 inch (1.00 mm)**] <Insert dimension> thick.
8. Copper-Clad Stainless Steel: [**0.018 inch (0.46 mm)**] <Insert dimension> thick.

C. Drip Edges: Fabricate from the following materials:

1. Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
2. Aluminum: [**0.032 inch (0.81 mm)**] <Insert dimension> thick.
3. Stainless Steel: [**0.016 inch (0.40 mm)**] <Insert dimension> thick.
4. Zinc-Tin Alloy-Coated Stainless Steel: [**0.015 inch (0.38 mm)**] <Insert dimension> thick.
5. Zinc-Tin Alloy-Coated Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
6. Galvanized Steel: [**0.022 inch (0.56 mm)**] <Insert dimension> thick.
7. Aluminum-Zinc Alloy-Coated Steel: [**0.022 inch (0.56 mm)**] <Insert dimension> thick.
8. Zinc: [**0.032 inch (0.80 mm)**] [**0.039 inch (1.00 mm)**] <Insert dimension> thick.
9. Copper-Clad Stainless Steel: [**0.016 inch (0.40 mm)**] <Insert dimension> thick.

D. Eave, Rake[, Ridge, and Hip] Flashing: Fabricate from the following materials:

1. Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
2. Aluminum: [**0.032 inch (0.81 mm)**] <Insert dimension> thick.

3. Stainless Steel: [**0.016 inch (0.40 mm)**] <Insert dimension> thick.
 4. Zinc-Tin Alloy-Coated Stainless Steel: [**0.015 inch (0.38 mm)**] <Insert dimension> thick.
 5. Zinc-Tin Alloy-Coated Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
 6. Galvanized Steel: [**0.022 inch (0.56 mm)**] <Insert dimension> thick.
 7. Aluminum-Zinc Alloy-Coated Steel: [**0.022 inch (0.56 mm)**] <Insert dimension> thick.
 8. Zinc: [**0.032 inch (0.80 mm)**] [**0.039 inch (1.00 mm)**] <Insert dimension> thick.
 9. Copper-Clad Stainless Steel: [**0.016 inch (0.40 mm)**] <Insert dimension> thick.
- E. Counterflashing: [**Shop fabricate interior and exterior corners.**]Fabricate from the following materials:
1. Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
 2. Aluminum: [**0.032 inch (0.81 mm)**] <Insert dimension> thick.
 3. Stainless Steel: [**0.019 inch (0.48 mm)**] <Insert dimension> thick.
 4. Zinc-Tin Alloy-Coated Stainless Steel: [**0.018 inch (0.46 mm)**] <Insert dimension> thick.
 5. Zinc-Tin Alloy-Coated Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
 6. Galvanized Steel: [**0.022 inch (0.56 mm)**] <Insert dimension> thick.
 7. Aluminum-Zinc Alloy-Coated Steel: [**0.022 inch (0.56 mm)**] <Insert dimension> thick.
 8. Zinc: [**0.032 inch (0.80 mm)**] [**0.039 inch (1.00 mm)**] <Insert dimension> thick.
 9. Copper-Clad Stainless Steel: [**0.018 inch (0.46 mm)**] <Insert dimension> thick.
- F. Flashing Receivers: Fabricate from the following materials:
1. Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
 2. Aluminum: [**0.032 inch (0.81 mm)**] <Insert dimension> thick.
 3. Stainless Steel: [**0.016 inch (0.40 mm)**] <Insert dimension> thick.
 4. Zinc-Tin Alloy-Coated Stainless Steel: [**0.015 inch (0.38 mm)**] <Insert dimension> thick.
 5. Zinc-Tin Alloy-Coated Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
 6. Galvanized Steel: [**0.022 inch (0.56 mm)**] <Insert dimension> thick.
 7. Aluminum-Zinc Alloy-Coated Steel: [**0.022 inch (0.56 mm)**] <Insert dimension> thick.
 8. Zinc: [**0.032 inch (0.80 mm)**] [**0.039 inch (1.00 mm)**] <Insert dimension> thick.
 9. Copper-Clad Stainless Steel: [**0.016 inch (0.40 mm)**] <Insert dimension> thick.
- G. Roof-Penetration Flashing: Fabricate from the following materials:
1. Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
 2. Stainless Steel: [**0.019 inch (0.48 mm)**] <Insert dimension> thick.
 3. Zinc-Tin Alloy-Coated Stainless Steel: [**0.018 inch (0.46 mm)**] <Insert dimension> thick.
 4. Zinc-Tin Alloy-Coated Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.

5. Galvanized Steel: **[0.028 inch (0.71 mm)]** <Insert dimension> thick.
6. Aluminum-Zinc Alloy-Coated Steel: **[0.028 inch (0.71 mm)]** <Insert dimension> thick.
7. Zinc: **[0.032 inch (0.80 mm)] [0.039 inch (1.00 mm)]** <Insert dimension> thick.
8. Copper-Clad Stainless Steel: **[0.018 inch (0.46 mm)]** <Insert dimension> thick.

2.10 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum **96-inch-** (2400-mm-) long, but not exceeding **12-foot-** (3.6-m-) long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend **6 inches** (150 mm) beyond each side of wall openings; and form with **2-inch-** (50-mm-) high, end dams. Fabricate from the following materials:

1. Copper: **[16 oz./sq. ft. (0.55 mm thick)]** <Insert weight (thickness)>.
2. Stainless Steel: **[0.016 inch (0.40 mm)]** <Insert dimension> thick.
3. Zinc-Tin Alloy-Coated Stainless Steel: **[0.015 inch (0.38 mm)]** <Insert dimension> thick.
4. Zinc-Tin Alloy-Coated Copper: **[16 oz./sq. ft. (0.55 mm thick)]** <Insert weight (thickness)>.
5. Zinc: **[0.032 inch (0.80 mm)] [0.039 inch (1.00 mm)]** <Insert dimension> thick.
6. Copper-Clad Stainless Steel: **[0.016 inch (0.40 mm)]** <Insert dimension> thick.

- B. Opening Flashings in Frame Construction: Fabricate head, sill, **[jamb,]** and similar flashings to extend **[4 inches (100 mm)]** <Insert dimension> beyond wall openings. Form head and sill flashing with **2-inch-** (50-mm-) high, end dams. Fabricate from the following materials:

1. Copper: **[16 oz./sq. ft. (0.55 mm thick)]** <Insert weight (thickness)>.
2. Aluminum: **[0.032 inch (0.81 mm)]** <Insert dimension> thick.
3. Stainless Steel: **[0.016 inch (0.40 mm)]** <Insert dimension> thick.
4. Zinc-Tin Alloy-Coated Stainless Steel: **[0.015 inch (0.38 mm)]** <Insert dimension> thick.
5. Zinc-Tin Alloy-Coated Copper: **[16 oz./sq. ft. (0.55 mm thick)]** <Insert weight (thickness)>.
6. Galvanized Steel: **[0.022 inch (0.56 mm)]** <Insert dimension> thick.
7. Aluminum-Zinc Alloy-Coated Steel: **[0.022 inch (0.56 mm)]** <Insert dimension> thick.
8. Zinc: **[0.032 inch (0.80 mm)] [0.039 inch (1.00 mm)]** <Insert dimension> thick.
9. Copper-Clad Stainless Steel: **[0.016 inch (0.40 mm)]** <Insert dimension> thick.

- C. Wall Expansion-Joint Cover: Fabricate from the following materials:

1. Copper: **[16 oz./sq. ft. (0.55 mm thick)]** <Insert weight (thickness)>.
2. Aluminum: **[0.040 inch (1.02 mm)]** <Insert dimension> thick.
3. Stainless Steel: **[0.019 inch (0.48 mm)]** <Insert dimension> thick.
4. Zinc-Tin Alloy-Coated Stainless Steel: **[0.018 inch (0.46 mm)]** <Insert dimension> thick.

5. Zinc-Tin Alloy-Coated Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
6. Galvanized Steel: [**0.028 inch (0.71 mm)**] <Insert dimension> thick.
7. Aluminum-Zinc Alloy-Coated Steel: [**0.028 inch (0.71 mm)**] <Insert dimension> thick.
8. Zinc: [**0.032 inch (0.80 mm)**] [**0.039 inch (1.00 mm)**] <Insert dimension> thick.
9. Copper-Clad Stainless Steel: [**0.018 inch (0.46 mm)**] <Insert dimension> thick.

2.11 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:

1. Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
2. Stainless Steel: [**0.019 inch (0.48 mm)**] <Insert dimension> thick.
3. Zinc-Tin Alloy-Coated Stainless Steel: [**0.018 inch (0.46 mm)**] <Insert dimension> thick.
4. Zinc-Tin Alloy-Coated Copper: [**16 oz./sq. ft. (0.55 mm thick)**] <Insert weight (thickness)>.
5. Galvanized Steel: [**0.028 inch (0.71 mm)**] <Insert dimension> thick.
6. Aluminum-Zinc Alloy-Coated Steel: [**0.028 inch (0.71 mm)**] <Insert dimension> thick.
7. Copper-Clad Stainless Steel: [**0.018 inch (0.46 mm)**] <Insert dimension> thick.

B. Overhead-Piping Safety Pans: Fabricate from the following materials:

1. Copper: [**24 oz./sq. ft. (0.82 mm thick)**] <Insert weight (thickness)>.
2. Stainless Steel: [**0.025 inch (0.64 mm)**] <Insert dimension> thick.
3. Zinc-Tin Alloy-Coated Stainless Steel: [**0.024 inch (0.61 mm)**] <Insert dimension> thick.
4. Zinc-Tin Alloy-Coated Copper: [**24 oz./sq. ft. (0.82 mm thick)**] <Insert weight (thickness)>.
5. Galvanized Steel: [**0.040 inch (1.02 mm)**] <Insert dimension> thick.
6. Aluminum-Zinc Alloy-Coated Steel: [**0.040 inch (1.02 mm)**] <Insert dimension> thick.
7. Copper-Clad Stainless Steel: [**0.027 inch (0.69 mm)**] <Insert dimension> thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- #### A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
1. Verify compliance with requirements for installation tolerances of substrates.
 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than **2 inches** (50 mm).

B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.

C. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than **6 inches** (150 mm) staggered **24 inches** (600 mm) between courses. Overlap side edges not less than **3-1/2 inches** (90 mm). Roll laps and edges with roller. Cover underlayment within 14 days.

D. Apply slip sheet, wrinkle free, [**over underlayment**] [**directly on substrate**] <Insert **requirement**> before installing sheet metal flashing and trim.

3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners[, **solder**], protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.

2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

3. Space cleats not more than **12 inches** (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.

4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.

5. Torch cutting of sheet metal flashing and trim is not permitted.

6. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent

separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of **[uncoated-aluminum] [and] [stainless-steel]** sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of **[10 feet (3 m)] <Insert dimension>** with no joints within **24 inches (600 mm)** of corner or intersection.
1. Form expansion joints of intermeshing hooked flanges, not less than **1 inch (25 mm)** deep, filled with sealant concealed within joints.
 2. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate **[wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws] [substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance] <Insert size requirement>**.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than **1 inch (25 mm)** into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between **40 and 70 deg F (4 and 21 deg C)**, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below **40 deg F (4 deg C)**.
 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of **1-1/2 inches (38 mm)**; however, reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Do not solder **[metallic-coated steel] [and] [aluminum]** sheet.
 2. Do not pre-tin **[zinc-tin alloy-coated stainless steel] [and] [zinc-tin alloy-coated copper]**.
 3. Do not use torches for soldering.
 4. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
 5. Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for stainless steel and acid flux. Promptly remove acid flux residue from metal after

- tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
6. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.
 7. Copper-Clad Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for copper-clad stainless steel.

H. Rivets: Rivet joints in **[uncoated aluminum]** **[zinc]** where necessary for strength.

3.4 ROOF-DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters: Join sections with **[riveted and soldered joints]** **[or]** **[joints sealed with sealant]**. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor gutters in position. Provide end closures and seal watertight with sealant. Slope to downspouts.

1. Fasten gutter spacers to front and back of gutter.
2. Anchor and loosely lock back edge of gutter to continuous **[cleat]** **[eave or apron flashing]**.
3. Anchor back of gutter that extends onto roof deck with cleats spaced not more than **[24 inches (600 mm)]** **<Insert dimension>** apart.
4. Anchor gutter with **[gutter brackets]** **[straps]** **[twisted straps]** spaced not more than **[24 inches (600 mm)]** **[30 inches (760 mm)]** **[36 inches (910 mm)]** **<Insert dimension>** apart to roof deck, unless otherwise indicated, and loosely lock to front gutter bead.
5. Install gutter with expansion joints at locations indicated, but not exceeding, **[50 feet (15.24 m)]** **<Insert dimension>** apart. Install expansion-joint caps.
6. Install continuous gutter screens on gutters with noncorrosive fasteners, **[removable]** **[hinged to swing open]** for cleaning gutters.

C. Built-in Gutters: Join sections with **[riveted and soldered joints]** **[or]** **[joints sealed with sealant]**. Provide for thermal expansion. Slope to downspouts. Provide end closures and seal watertight with sealant.

1. Install underlayment layer in built-in gutter trough and extend to drip edge at eaves and under underlayment on roof sheathing. Lap sides minimum of **2 inches (50 mm)** over underlying course. Lap ends minimum of **4 inches (100 mm)**. Stagger end laps between succeeding courses at least **72 inches (1830 mm)**. Fasten with roofing nails. Install slip sheet over underlayment.
2. Anchor and loosely lock back edge of gutter to continuous **[cleat]** **[eave or apron flashing]**.
3. Anchor back of gutter that extends onto roof deck with cleats spaced not more than **[18 inches (460 mm)]** **<Insert dimension>** apart.
4. Install gutter with expansion joints at locations indicated, but not exceeding, **[50 feet (15.24 m)]** **<Insert dimension>** apart. Install expansion-joint caps.

- D. Downspouts: Join sections with **1-1/2-inch (38-mm)** telescoping joints.
1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately **60 inches (1500 mm)** o.c.
 2. Provide elbows at base of downspout to direct water away from building.
 3. Connect downspouts to underground drainage system.
- E. Splash Pans: Install where downspouts discharge on [**low-slope roofs**] <Insert **surface**>. Set in [**asphalt roofing cement**] [**or**] [**elastomeric sealant**] compatible with the substrate.
- F. Parapet Scuppers: Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
1. Anchor scupper closure trim flange to exterior wall and [**solder**] [**or**] [**seal with elastomeric sealant**] to scupper.
 2. Loosely lock front edge of scupper with conductor head.
 3. [**Solder**] [**or**] [**seal with elastomeric sealant**] exterior wall scupper flanges into back of conductor head.
- G. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of **1 inch (25 mm)** below [**scupper**] [**or**] [**gutter**] discharge.
- H. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints minimum of **4 inches (100 mm)** in direction of water flow.

3.5 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements[, **sheet metal manufacturer's written installation instructions,**] and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at [**staggered 3-inch (75-mm)**] <Insert **spacing**> centers.
- C. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.
- D. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.
1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at [**24-inch (600-mm)**] [**16-inch (400-mm)**] <Insert **dimension**> centers.

2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at **[24-inch (600-mm)] <Insert dimension>** centers.
- E. Copings: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.
- F. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of **4 inches (100 mm)** over base flashing. Install stainless-steel draw band and tighten.
- G. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing **4 inches (100 mm)** over base flashing. Lap counterflashing joints minimum of **4 inches (100 mm)**. Secure in waterproof manner by means of **[snap-in installation and sealant or lead wedges and sealant] [interlocking folded seam or blind rivets and sealant] [anchor and washer at 36-inch (910-mm) centers]** **<Insert requirement>** unless otherwise indicated.
- H. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with **[elastomeric] [butyl]** sealant and clamp flashing to pipes that penetrate roof.

3.6 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Through-Wall Flashing: Installation of through-wall flashing is specified in **[Section 042000 "Unit Masonry."]** **[Section 044200 "Exterior Stone Cladding."]** **[Section <Insert Section number> "<Insert Section title>."]**
- C. Reglets: Installation of reglets is specified in **[Section 033000 "Cast-in-Place Concrete."]** **[Section 042000 "Unit Masonry."]** **[Section <Insert Section number> "<Insert Section title>."]**
- D. Opening Flashings in Frame Construction: Install continuous head, sill, **[jamb,]** and similar flashings to extend **[4 inches (100 mm)] <Insert dimension>** beyond wall openings.

3.7 MISCELLANEOUS FLASHING INSTALLATION

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

- B. Overhead-Piping Safety Pans: Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

3.8 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of **1/4 inch in 20 feet** (6 mm in 6 m) on slope and location lines indicated on Drawings and within **1/8-inch** (3-mm) offset of adjoining faces and of alignment of matching profiles.
- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.9 CLEANING AND PROTECTION

- A. Protection: Advise Contractor of required procedures for surveillance and protection of flashings and sheet metal work during construction, to ensure that work will be without damage or deterioration, other than natural weathering at time of substantial completion.
- B. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- C. Clean and neutralize flux materials. Clean off excess solder.
- D. Clean off excess sealants.
- E. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.
- F. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 076200

SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Copings.
2. Roof-edge flashings.
3. Roof-edge drainage systems.
4. Reglets and counterflashings.

B. Related Sections:

1. **[Section 061000 "Rough Carpentry"] [Section 061053 "Miscellaneous Rough Carpentry"]** for wood nailers, curbs, and blocking.
2. Section 074113.13 "Formed Metal Roof Panels" for roof-edge drainage-system components provided by metal-roof-panel manufacturer.
3. Section 074113.16 "Standing-Seam Metal Roof Panels" for roof-edge drainage-system components provided by metal-roof-panel manufacturer.
4. Section 074113.19 "Batten-Seam Metal Roof Panels" for roof-edge drainage-system components provided by metal-roof-panel manufacturer.
5. Section 074113.23 "Insulated Metal Roof Panels" for roof-edge drainage-system components provided by metal-roof-panel manufacturer.
6. Section 076200 "Sheet Metal Flashing and Trim" for custom- and site-fabricated sheet metal flashing and trim.
7. Section 077129 "Manufactured Roof Expansion Joints" for manufactured roof expansion-joint cover assemblies.
8. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
9. Section 079200 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.
10. Section 079500 "Expansion Control" for manufactured sheet metal expansion-joint covers.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. FM Approvals' Listing: Manufacture and install [**copings**] [**roof-edge flashings**] that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, [**Class 1-60**] [**Class 1-75**] [**Class 1-90**] [**Class 1-105**] [**Class 1-120**] <Insert class>. Identify materials with FM Approvals' markings.
- C. SPRI Wind Design Standard: Manufacture and install [**copings**] [**roof-edge flashings**] tested according to SPRI ES-1 and capable of resisting the following design pressures:
 - 1. Design Pressure: [**As indicated on Drawings**] <Insert design pressure>.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): [**120 deg F (67 deg C), ambient; 180 deg F (100 deg C)**] <Insert temperature range>, material surfaces.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For roof specialties. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work. Include the following:
 - 1. Details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
 - 2. Pattern of seams and layout of fasteners, cleats, clips, and other attachments.
 - 3. Details of termination points and assemblies, including fixed points.
 - 4. Details of special conditions.
- C. Coordination Drawings: Submit coordination drawings for items interfacing with or supporting mechanical or electrical equipment, ductwork, piping, or conduit. Indicate dimensions and locations of items provided under this section, together with relationships and methods of attachment to adjacent construction and to mechanical/electrical items.

- D. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.
- E. Samples for Verification: For **[copings] [roof-edge flashings] [roof-edge drainage systems] [reglets and counterflashings]** made from **12-inch (300-mm)** lengths of full-size components including fasteners, cover joints, accessories, and attachments.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for **[copings] [and] [roof-edge flashings]**.
- B. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical roof edge, including **[fascia] [gutter] [and] [downspout] <Insert item>**, approximately **[10 feet (3.0 m)] <Insert dimension>** long, including supporting construction, seams, attachments, **[underlayment,]** and accessories.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- B. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>**.
 - 1. Meet with DEN Project Manager, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects roof specialties including installers of roofing materials and accessories.
 - 2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
 - 3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.
- C. Standards: Comply with SMACNA "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated. Comply with "NRCA Roofing and Waterproofing Manual" details for installation of units, and other standards noted in this Section.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.
- B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof specialties installation.

1.9 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: Minimum [20] [10] <Insert number> years from date of Substantial Completion.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide manufacturers' standard units, modified as necessary to comply with requirements. Shop fabricate each unit to greatest extent possible.

2.2 EXPOSED METALS

- A. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 or H01 temper.
 - 1. Non-Patinated Exposed Finish: Mill.
 - 2. Pre-Patinated Copper-Sheet Finish: Pre-patinated according to ASTM B 882.

- B. Aluminum Sheet: **ASTM B 209** (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.
1. Surface: [**Smooth, flat**] [**Embossed**] finish.
 2. Mill Finish: As manufactured.
 3. Exposed Coil-Coated Finishes: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Two-Coat Fluoropolymer: AAMA 620. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
 - b. Three-Coat Fluoropolymer: AAMA 620. System consisting of primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent PVDF resin by weight.
 - c. Concealed Surface: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of **0.5 mil** (0.013 mm).
 4. Clear Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
 5. Color Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
- C. Aluminum Extrusions: **ASTM B 221** (ASTM B 221M), alloy and temper recommended by manufacturer for type of use and finish indicated, finished as follows:
1. Exposed High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Two-Coat Fluoropolymer: [**AAMA 2604**] [**AAMA 2605**]. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
 - b. Three-Coat Fluoropolymer: AAMA 2605. System consisting of primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent PVDF resin by weight.
 2. Clear Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
 3. Color Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
- D. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.
- E. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, **G90** (Z275) coating designation.

1. Surface: [**Smooth, flat**] [**Embossed**] finish.
2. Mill-Phosphatized Finish: Manufacturer's standard for field painting.
3. Exposed Coil-Coated Finishes: Prepainted by the coil-coating process to comply with ASTM A 755/A 755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Two-Coat Fluoropolymer: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
 - b. Three-Coat Fluoropolymer: AAMA 621. System consisting of primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent PVDF resin by weight.

2.3 CONCEALED METALS

- A. Aluminum Sheet: [ASTM B 209](#) (ASTM B 209M), alloy and temper recommended by manufacturer for type of use and structural performance indicated, mill finished.
- B. Aluminum Extrusions: [ASTM B 221](#) (ASTM B 221M), alloy and temper recommended by manufacturer for type of use and structural performance indicated, mill finished.
- C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.
- D. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, [G90](#) ([Z275](#)) coating designation.

2.4 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
- B. Self-Adhering, High-Temperature Sheet: Minimum [30 to 40 mils](#) (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
 1. Thermal Stability: ASTM D 1970; stable after testing at [240 deg F](#) (116 deg C).
 2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus [20 deg F](#) (29 deg C).
 3. [Products](#): Subject to compliance with requirements, provide one of the following:
 - a. [Carlisle Coatings & Waterproofing](#); CCW WIP 300HT.
 - b. [Grace Construction Products, a unit of W. R. Grace & Co.](#); Ultra.
 - c. [Henry Company](#); Blueskin PE200 HT.
 - d. [Metal-Fab Manufacturing, LLC](#); MetShield.
 - e. [Owens Corning](#); WeatherLock Metal High Temperature Underlayment.
 - f. **<Insert manufacturer's name; product name or designation>**.
 - g. or approved equal.

- C. Polyethylene Sheet: **6-mil-** (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.
- D. Slip Sheet: Building paper, **3-lb/100 sq. ft.** (0.16-kg/sq. m) minimum, rosin sized.

2.5 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
 - 1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
 - 2. Fasteners for Copper Sheet: Copper, hardware bronze or passivated Series 300 stainless steel.
 - 3. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
 - 4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
 - 5. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
- C. Elastomeric Sealant: ASTM C 920, elastomeric [**polyurethane**] [**silicone**] polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.
- D. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- E. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.
- F. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.
- G. Solder for Copper: ASTM B 32, [**lead-free solder**] [**Grade Sn50, 50 percent tin and 50 percent lead**] <Insert solder grade>.

2.6 COPINGS

- A. Copings: Manufactured coping system consisting of formed-metal coping cap in section lengths not exceeding [**12 feet (3.6 m)**] <Insert dimension>, concealed anchorage; corner units, end cap units, and concealed splice plates with same finish as coping caps.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. [Architectural Products Company](#).
 - b. [ATAS International, Inc.](#)
 - c. [Castle Metal Products](#).
 - d. [Cheney Flashing Company](#).
 - e. [Hickman Company, W. P.](#)
 - f. [Johns Manville](#).
 - g. [Merchant & Evans, Inc.](#)
 - h. [Metal-Era, Inc.](#)
 - i. [Metal-Fab Manufacturing, LLC](#).
 - j. [MM Systems Corporation](#).
 - k. [National Sheet Metal Systems, Inc.](#)
 - l. [Perimeter Systems; a division of Southern Aluminum Finishing Company, Inc.](#)
 - m. [Petersen Aluminum Corporation](#).
 - n. <Insert manufacturer's name>.
 - o. or approved equal.
2. Coping-Cap Material: Copper, [**20 oz./sq. ft. (0.68 mm thick)**] [**weight (thickness) as required to meet performance requirements**] <Insert **weight (thickness)**>.
- a. Finish: [**Non-patinated, mill**] [**Pre-patinated dark brown**] [**Pre-patinated verdigris**] <Insert finish>.
3. Coping-Cap Material: [**Formed**] [**Extruded**] aluminum, [**0.040 inch (1.02 mm) thick**] [**0.050 inch (1.27 mm) thick**] [**0.063 inch (1.60 mm) thick**] [**0.080 inch (2.03 mm) thick**] [**0.125 inch (3.18 mm) thick**] [**thickness as required to meet performance requirements**] <Insert thickness>.
- a. Finish: [**Mill**] [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Clear anodic**] [**Color anodic**] <Insert finish>.
 - b. Color: [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
4. Coping-Cap Material: Zinc-coated steel, nominal [**0.028-inch (0.71-mm) thickness**] [**0.034-inch (0.86-mm) thickness**] [**thickness as required to meet performance requirements**] <Insert thickness>.
- a. Finish: [**Mill phosphatized for field painting**] [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] <Insert finish>.
 - b. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
5. Corners: Factory mitered and [**soldered**] [**continuously welded**] [**mechanically clinched and sealed watertight**].
6. Special Fabrications: [**Radiussed sections**] [**Arched sections**] [**Bullnose face leg**] [**Two-way sloped coping cap**] <Insert description>.

7. Coping-Cap Attachment Method: [**Snap-on**] [**Face leg hooked to continuous cleat with back leg fastener exposed**], fabricated from coping-cap material.
8. Snap-on-Coping Anchor Plates: Concealed, galvanized-steel sheet, **12 inches (300 mm)** wide, with integral cleats.
9. Face Leg Cleats: Concealed, continuous [**galvanized-steel sheet**] [**stainless steel**].

2.7 ROOF-EDGE FLASHINGS

- A. Canted Roof-Edge [**Fascia**] [**and**] [**Gravel Stop**] <Insert drawing designation>: Manufactured, two-piece, roof-edge fascia consisting of [**snap-on**] [**compression-clamped**] metal fascia cover in section lengths not exceeding [**12 feet (3.6 m)**] <Insert dimension> and a continuous formed galvanized-steel sheet cant, **0.028 inch (0.71 mm)** thick, minimum, with extended vertical leg terminating in a drip-edge cleat. Provide matching corner units.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. [Architectural Products Company](#).
- b. [ATAS International, Inc.](#)
- c. [Castle Metal Products](#).
- d. [Cheney Flashing Company](#).
- e. [Hickman Company, W. P.](#)
- f. [Johns Manville](#).
- g. [Merchant & Evans, Inc.](#)
- h. [Metal-Era, Inc.](#)
- i. [Metal-Fab Manufacturing, LLC](#).
- j. [MM Systems Corporation](#).
- k. [National Sheet Metal Systems, Inc.](#)
- l. [Petersen Aluminum Corporation](#).
- m. <Insert manufacturer's name>.
- n. or approved equal.

2. Fascia Cover: Fabricated from the following exposed metal:

- a. Formed Aluminum: [**0.040 inch (1.02 mm) thick**] [**0.050 inch (1.27 mm) thick**] [**0.063 inch (1.60 mm) thick**] [**Thickness as required to meet performance requirements**] <Insert thickness>.
- b. Extruded Aluminum: [**0.080 inch (2.03 mm) thick**] [**Thickness as required to meet performance requirements**] <Insert thickness>.
- c. Zinc-Coated Steel: Nominal [**0.028-inch (0.71-mm) thickness**] [**0.034-inch (0.86-mm) thickness**] [**thickness as required to meet performance requirements**] <Insert thickness>.

3. Corners: Factory mitered and [**soldered**] [**continuously welded**] [**mechanically clinched and sealed watertight**].
4. Splice Plates: [**Concealed**] [**Exposed**], of same material, finish, and shape as fascia cover.

5. Special Fabrications: [**Radiussed sections**] [**Arched sections**] [**Bullnose fascia cover**] [**Cornice fascia cover**] [**Cove fascia cover**] <Insert description>.
 6. Fascia Accessories: [**Fascia extenders with continuous hold-down cleats**] [**Wall cap**] [**Soffit trim**] [**Overflow scuppers**] [**Overflow scuppers with perforated screens**] [**Spillout scuppers**] [**Downspout scuppers with integral conductor head and downspout adapters**] [**Downspout scuppers with integral conductor head and downspout adapters and perforated screens**] <Insert description>.
- B. Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding [**12 feet (3.6 m)**] <Insert dimension> and a continuous formed- or extruded-aluminum anchor bar with integral drip-edge cleat to engage fascia cover. Provide matching corner units.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Hickman Company, W. P.](#)
 - b. [Johns Manville.](#)
 - c. [Metal-Era, Inc.](#)
 - d. [Metal-Fab Manufacturing, LLC.](#)
 - e. [National Sheet Metal Systems, Inc.](#)
 - f. [Perimeter Systems; a division of Southern Aluminum Finishing Company, Inc.](#)
 - g. <Insert manufacturer's name>.
 - h. or approved equal.
 2. Fascia Cover: Fabricated from the following exposed metal:
 - a. Formed Aluminum: [**0.032 inch (0.81 mm) thick**] [**0.040 inch (1.02 mm) thick**] [**0.050 inch (1.27 mm) thick**] [**0.063 inch (1.60 mm) thick**] [**Thickness as required to meet performance requirements**] <Insert thickness>.
 - b. Zinc-Coated Steel: Nominal [**0.028 inch (0.71 mm) thick**] [**0.034 inch (0.86 mm) thick**] [**thickness as required to meet performance requirements**] <Insert thickness>.
 3. Corners: Factory mitered and [**soldered**] [**continuously welded**] [**mechanically clinched and sealed watertight**].
 4. Splice Plates: [**Concealed**] [**Exposed**], of same material, finish, and shape as fascia cover.
 5. Special Fabrications: [**Radiussed sections**] [**Arched sections**] [**Bullnose fascia cover**] [**Cornice fascia cover**] [**Cove fascia cover**] <Insert description>.
 6. Fascia Accessories: [**Fascia extenders with continuous hold-down cleats**] [**Wall cap**] [**Soffit trim**] [**Overflow scuppers**] [**Overflow scuppers with perforated screens**] [**Spillout scuppers**] [**Downspout scuppers with integral conductor head and downspout adapters**] [**Downspout scuppers with**

integral conductor head and downspout adapters and perforated screens]
<Insert description>.

- C. One-Piece Gravel Stops: Manufactured, one-piece, metal gravel stop in section lengths not exceeding **[12 feet (3.6 m)]** **<Insert dimension>**, with a horizontal flange and vertical leg[, **drain-through]** fascia[**terminating in a drip edge]**, and concealed splice plates of same material, finish, and shape as gravel stop. Provide matching corner units.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Architectural Products Company.](#)
 - b. [Berger Building Products, Inc.](#)
 - c. [Castle Metal Products.](#)
 - d. [Cheney Flashing Company.](#)
 - e. [Hickman Company, W. P.](#)
 - f. [Metal-Era, Inc.](#)
 - g. [Metal-Fab Manufacturing, LLC.](#)
 - h. [MM Systems Corporation.](#)
 - i. [National Sheet Metal Systems, Inc.](#)
 - j. [Perimeter Systems: a division of Southern Aluminum Finishing Company, Inc.](#)
 - k. [Petersen Aluminum Corporation.](#)
 - l. **<Insert manufacturer's name>.**
 - m. or approved equal.
 2. Fabricate from the following exposed metal:
 - a. Copper: **[16 oz./sq. ft. (0.55 mm thick)]** **[Weight (thickness) as required to meet performance requirements]** **<Insert weight (thickness)>**.
 - b. Formed Aluminum: **[0.032 inch (0.81 mm) thick]** **[0.040 inch (1.02 mm) thick]** **[0.050 inch (1.27 mm) thick]** **[Thickness as required to meet performance requirements]** **<Insert thickness>**.
 - c. Extruded Aluminum: **[0.080 inch (2.03 mm) thick]** **[Thickness as required to meet performance requirements]** **<Insert thickness>**.
 - d. Stainless Steel: **[0.025 inch (0.64 mm) thick]** **[Thickness as required to meet performance requirements]** **<Insert thickness>**.
 - e. Zinc-Coated Steel: Nominal **[0.028-inch (0.71-mm) thickness]** **[0.034-inch (0.86-mm) thickness]** **[thickness as required to meet performance requirements]** **<Insert thickness>**.
 3. Corners: Factory mitered and **[soldered]** **[continuously welded]** **[mechanically clinched and sealed watertight]**.
 4. Accessories: **[Fascia extenders with continuous hold-down cleats]** **[Wall cap]** **[Soffit trim]** **<Insert description>**.
- D. Copper Finish: **[Non-patinated, mill]** **[Pre-patinated dark brown]** **[Pre-patinated verdigris]** **<Insert finish>**.

- E. Aluminum Finish: [Mill] [Two-coat fluoropolymer] [Three-coat fluoropolymer] [Clear anodic] [Color anodic] <Insert finish>.
 - 1. Color: [Light bronze] [Medium bronze] [Dark bronze] [Black] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.
- F. Stainless-Steel Finish: [No. 2B (bright, cold rolled)] [No. 3 (coarse, polished directional satin)] [No. 4 (bright, polished directional satin)] <Insert finish>.
- G. Zinc-Coated Steel Finish: [Mill phosphatized for field painting] [Two-coat fluoropolymer] [Three-coat fluoropolymer] <Insert finish>.
 - 1. Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.

2.8 ROOF-EDGE DRAINAGE SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. [Andreas Renner KG](#).
 - 2. [Architectural Products Company](#).
 - 3. [ATAS International, Inc.](#)
 - 4. [Berger Building Products, Inc.](#)
 - 5. [Castle Metal Products](#).
 - 6. [Cheney Flashing Company](#).
 - 7. [CopperCraft by FABRAL; a Euramax company](#).
 - 8. [Hickman Company, W. P.](#)
 - 9. [Klauer Manufacturing Company](#).
 - 10. [Merchant & Evans, Inc.](#)
 - 11. [Metal-Era, Inc.](#)
 - 12. [Metal-Fab Manufacturing, LLC](#).
 - 13. [MM Systems Corporation](#).
 - 14. [National Sheet Metal Systems, Inc.](#)
 - 15. [Perimeter Systems; a division of Southern Aluminum Finishing Company, Inc.](#)
 - 16. <Insert manufacturer's name>.
 - 17. or approved equal.
- B. Gutters: Manufactured in uniform section lengths not exceeding [12 feet (3.6 m)] <Insert dimension>, with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch (25 mm) above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.
 - 1. Fabricate from the following exposed metal:

- a. Copper: [16 oz./sq. ft. (0.55 mm thick)] [20 oz./sq. ft. (0.68 mm thick)] <Insert weight (thickness)>.
 - b. Formed Aluminum: [0.032 inch (0.81 mm)] [0.040 inch (1.02 mm)] [0.050 inch (1.27 mm)] [0.063 inch (1.60 mm)] <Insert thickness> thick.
 - c. Zinc-Coated Steel: Nominal [0.028-inch (0.71-mm)] [0.034-inch (0.86-mm)] <Insert thickness> thickness.
2. Gutter Profile: [Style A] [Style B] [Style F] [Style G] [Style H] [Style I] [Style K] [Style K highback] [Half-round single bead] [Half-round highback] [Quarter round] [Ogee] [As indicated] <Insert style> according to SMACNA's "Architectural Sheet Metal Manual."
 3. Embossed Surface: Embossed with design [as indicated by manufacturer's designations] [As selected by DEN Project Manager from manufacturer's full range] <Insert description>.
 4. Applied Fascia Cover (Concealed Gutter): Exposed, formed [copper, 16 oz./sq. ft. (0.55 mm thick)] [aluminum, 0.040 inch (1.02 mm) thick] <Insert material and weight or thickness>, with factory-mitered corners, ends, and concealed splice joints.
 5. Corners: Factory mitered and [soldered] [continuously welded] [mechanically clinched and sealed watertight].
 6. Gutter Supports: [Gutter brackets] [Straps] [Spikes and ferrules] [Manufacturer's standard supports as selected by DEN Project Manager] <Insert description> with finish matching the gutters.
 7. Special Fabrications: [Radiussed sections] <Insert description>.
 8. Gutter Accessories: [Continuous screened leaf guard with sheet metal frame] [Continuous hinged leaf guard of solid metal designed to shed leaves] [Continuous snap-in plastic leaf guard] [Bronze wire ball downspout strainer] [Wire ball downspout strainer] [Flat ends] [Bullnose ends for half-round gutter] <Insert description>.
- C. Downspouts: [Plain round] [Corrugated round] [Plain rectangular] [Corrugated rectangular] [Open-face rectangular] <Insert shape> complete with [machine-crimped] [mitered] [smooth-curve] elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
1. Copper: [16 oz./sq. ft. (0.55 mm thick)] <Insert weight (thickness)>.
 2. Formed Aluminum: [0.032 inch (0.81 mm)] [0.040 inch (1.02 mm)] [0.050 inch (1.27 mm)] [0.063 inch (1.60 mm)] <Insert thickness> thick.
 3. Extruded Aluminum: [0.125 inch (3.18 mm)] <Insert thickness> thick.
 4. Zinc-Coated Steel: Nominal [0.028-inch (0.71-mm)] [0.034-inch (0.86-mm)] <Insert thickness> thickness.
- D. Parapet Scuppers: Manufactured with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. [Fasten gravel guard angles to base of scuppers.]
1. Fabricate from the following exposed metal:
 - a. Copper: [16 oz./sq. ft. (0.55 mm thick)] <Insert weight (thickness)>.

- b. Formed Aluminum: **[0.032 inch (0.81 mm)]** <Insert thickness> thick.
 - c. Stainless Steel: **[0.019 inch (0.48 mm)]** <Insert thickness> thick.
 - d. Zinc-Coated Steel: Nominal **[0.028-inch (0.71-mm)]** <Insert thickness> thickness.
- E. Conductor Heads: Manufactured conductor heads, each with flanged back and stiffened top edge and of dimensions and shape indicated, complete with outlet tube that nests into upper end of downspout[, **exterior flange trim,**] [and] [**built-in overflow**].
- 1. Fabricate from the following exposed metal:
 - a. Copper: **[16 oz./sq. ft. (0.55 mm thick)]** <Insert weight (thickness)>.
 - b. Formed Aluminum: **[0.032 inch (0.81 mm)]** <Insert thickness> thick.
 - c. Stainless Steel: **[0.016 inch (0.40 mm)]** <Insert thickness> thick.
 - d. Zinc-Coated Steel: Nominal **[0.028-inch (0.71-mm)]** <Insert thickness> thickness.
- F. Splash Pans: Fabricate from the following exposed metal:
- 1. Copper: **[16 oz./sq. ft. (0.55 mm thick)]** <Insert weight (thickness)>.
 - 2. Formed Aluminum: **[0.040 inch (1.02 mm)]** <Insert thickness> thick.
 - 3. Stainless Steel: **[0.019 inch (0.48 mm)]** <Insert thickness> thick.
 - 4. Zinc-Coated Steel: Nominal **[0.028-inch (0.71-mm)]** <Insert thickness> thickness.
- G. Copper Finish: **[Non-patinated, mill]** [**Pre-patinated dark brown**] [**Pre-patinated verdigris**] <Insert finish>.
- H. Aluminum Finish: **[Mill]** [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Clear anodic**] [**Color anodic**] <Insert finish>.
- 1. Color: **[Light bronze]** [**Medium bronze]** [**Dark bronze]** [**Black]** [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
- I. Stainless-Steel Finish: **[No. 2B (bright, cold rolled, unpolished)]** [**No. 3 (coarse, polished directional satin)**] [**No. 4 (bright, polished directional satin)**] <Insert finish>.
- J. Zinc-Coated Steel Finish: **[Mill phosphatized for field painting]** [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] <Insert finish>.
- 1. Color: **[As indicated by manufacturer's designations]** [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.

2.9 REGLETS AND COUNTERFLASHINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [Castle Metal Products.](#)
 2. [Cheney Flashing Company.](#)
 3. [Fry Reglet Corporation.](#)
 4. [Heckmann Building Products Inc.](#)
 5. [Hickman Company, W. P.](#)
 6. [Keystone Flashing Company, Inc.](#)
 7. [Metal-Era, Inc.](#)
 8. [Metal-Fab Manufacturing, LLC.](#)
 9. [MM Systems Corporation.](#)
 10. [National Sheet Metal Systems, Inc.](#)
 11. or approved equal.
- B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:
1. Copper: [16 oz./sq. ft. (0.55 mm thick)] <Insert weight (thickness)>.
 2. Formed Aluminum: [0.024 inch (0.61 mm)] [0.050 inch (1.27 mm)] <Insert thickness> thick.
 3. Stainless Steel: [0.019 inch (0.48 mm)] [0.025 inch (0.64 mm)] <Insert thickness> thick.
 4. Zinc-Coated Steel: Nominal [0.022-inch (0.56-mm)] [0.028-inch (0.71-mm)] <Insert thickness> thickness.
 5. Corners: Factory mitered and [soldered] [continuously welded] [mechanically clinched and sealed watertight].
 6. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
 7. Stucco Type, Embedded: Provide reglets with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
 8. Concrete Type, Embedded: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
 9. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.
 10. Multiuse Type, Embedded: For multiuse embedment in [cast-in-place concrete] [masonry mortar joints].
- C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches (100 mm) and in lengths not exceeding [12 feet (3.6 m)] <Insert dimension> designed to snap into [reglets] [or] [through-wall-flashing receiver] and compress against base flashings with joints lapped, from the following exposed metal:
1. Copper: [16 oz./sq. ft. (0.55 mm thick)] <Insert weight (thickness)>.
 2. Formed Aluminum: [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] <Insert thickness> thick.

3. Stainless Steel: [**0.019 inch (0.48 mm)**] [**0.025 inch (0.64 mm)**] <Insert **thickness**> thick.
4. Zinc-Coated Steel: Nominal [**0.022-inch (0.56-mm)**] [**0.028-inch (0.71-mm)**] <Insert **thickness**> thickness.

D. Accessories:

1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.
3. <Insert **accessory**>.

E. Copper Finish: [**Non-patinated, mill**] [**Pre-patinated dark brown**] [**Pre-patinated verdigris**] <Insert **finish**>.

F. Aluminum Finish: [**Mill**] [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] [**Clear anodic**] [**Color anodic**] <Insert **finish**>.

1. Color: [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert **color**>.

G. Stainless-Steel Finish: [**No. 2B (bright, cold rolled, unpolished)**] [**No. 3 (coarse, polished directional satin)**] [**No. 4 (bright, polished directional satin)**] <Insert **finish**>.

H. Zinc-Coated Steel Finish: [**Mill phosphatized for field painting**] [**Two-coat fluoropolymer**] [**Three-coat fluoropolymer**] <Insert **finish**>.

1. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert **color**>.

2.10 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.
- C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's instructions and recommendations. Coordinate with installation of roof deck and other substrates to receive accessory units, and vapor barriers, roof insulation, roofing and flashing, as required to ensure that each element of the Work performs properly, and that combined elements are waterproof and weathertight. Anchor units securely to supporting structural substrates, adequate to withstand lateral and thermal stresses as well as inward and outward loading pressures.
 - 1. Except as otherwise indicated install roof accessory items in accordance with construction details of "NRCA Roofing and Waterproofing Manual".

3.3 UNDERLAYMENT INSTALLATION

- A. Felt Underlayment: Install with adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than **2 inches** (50 mm).
- B. Self-Adhering Sheet Underlayment: Install wrinkle free. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water. Overlap edges not less than **3-1/2 inches** (90 mm). Roll laps with roller. Cover underlayment within 14 days.
- C. Polyethylene Sheet: Install with adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped and taped joints of not less than **2 inches** (50 mm).
- D. Slip Sheet: Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than **2 inches** (50 mm).

3.4 INSTALLATION, GENERAL

- A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete roof-specialty systems.
1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
 2. Provide uniform, neat seams with minimum exposure of solder and sealant.
 3. Install roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
 4. Torch cutting of roof specialties is not permitted.
 5. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
1. Coat concealed side of **[uncoated aluminum] [and] [stainless-steel]** roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of **[felt underlayment and cover with a slip sheet] [self-adhering, high-temperature sheet underlayment] [or] [polyethylene sheet]**.
 3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.
- C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
1. Space movement joints at a maximum of **[12 feet (3.6 m)] <Insert dimension>** with no joints within **[18 inches (450 mm)] <Insert dimension>** of corners or intersections unless otherwise shown on Drawings.
 2. When ambient temperature at time of installation is between **40 and 70 deg F (4 and 21 deg C)**, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.
- D. Fastener Sizes: Use fasteners of sizes that will penetrate **[wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws] [substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance] <Insert size requirement>**.
- E. Seal joints with **[elastomeric] [butyl]** sealant as required by roofing-specialty manufacturer.
- F. Seal joints as required for watertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below **40 deg F (4 deg C)**.

- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of **1-1/2 inches (38 mm)** except reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3.5 COPING INSTALLATION

- A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor copings to meet performance requirements.
1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at **[30-inch (760-mm) centers] [40-inch (1015-mm) centers] [manufacturer's required spacing that meets performance requirements]** <Insert spacing>.
 2. Interlock face leg drip edge into continuous cleat anchored to substrate at **[24-inch (600-mm) centers] [16-inch (400-mm) centers] [manufacturer's required spacing that meets performance requirements]** <Insert spacing>. Anchor back leg of coping with screw fasteners and elastomeric washers at **[24-inch (600-mm) centers] [16-inch (400-mm) centers] [manufacturer's required spacing that meets performance requirements]** <Insert spacing>.

3.6 ROOF-EDGE FLASHING INSTALLATION

- A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

3.7 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

- A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.
- B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than **[12 inches (305 mm)] [24 inches (610 mm)] [30 inches (762 mm)]** <Insert dimension> apart. Attach ends with rivets and **[seal with sealant] [solder]** to make watertight. Slope to downspouts.
1. Install gutter with expansion joints at locations indicated but not exceeding **[50 feet (15.2 m)]** <Insert dimension> apart. Install expansion joint caps.
 2. Install continuous leaf guards on gutters with noncorrosive fasteners, **[removable] [hinged to swing open]** for cleaning gutters.

- C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and **1 inch (25 mm)** away from walls; locate fasteners at top and bottom and at approximately **[60 inches (1500 mm)] <Insert dimension>** o.c.
 - 1. Provide elbows at base of downspout to direct water away from building.
 - 2. Connect downspouts to underground drainage system indicated.
- D. Splash Pans: Install where downspouts discharge on **[low-slope roofs] <Insert surface>**. Set in **[asphalt roofing cement] [elastomeric sealant]**.
- E. Parapet Scuppers: Install scuppers through parapet where indicated. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
 - 1. Anchor scupper closure trim flange to exterior wall and seal or solder to scupper.
 - 2. Loosely lock front edge of scupper with conductor head.
 - 3. Seal or solder exterior wall scupper flanges into back of conductor head.
- F. Conductor Heads: Anchor securely to wall with elevation of conductor top edge **1 inch (25 mm)** below **[scupper] [gutter]** discharge.

3.8 REGLET AND COUNTERFLASHING INSTALLATION

- A. General: Coordinate installation of reglets and counterflashings with installation of base flashings.
- B. Embedded Reglets: See **[Section 033000 "Cast-in-Place Concrete"] [and] [Section 042000 "Unit Masonry"]** for installation of reglets.
- C. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap **4 inches (100 mm)** over top edge of base flashings.
- D. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap **4 inches (100 mm)** over top edge of base flashings. Lap counterflashing joints a minimum of **4 inches (100 mm)** and bed with **[elastomeric] [butyl]** sealant. Fit counterflashings tightly to base flashings.

3.9 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces including removing

unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

- D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 077100

SECTION 077129 - MANUFACTURED ROOF EXPANSION JOINTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Bellows-type roof expansion joints.
- 2. Aluminum roof expansion joints.

- B. Related Requirements:

- 1. Section 061000 "Rough Carpentry" for wooden curbs or cants for mounting roof expansion joints.
- 2. Section <Insert Section number> "<Insert Section title>" for roofing system.
- 3. Section 076200 "Sheet Metal Flashing and Trim" for shop- and field-fabricated sheet metal expansion-joint systems, flashing, and other sheet metal items.
- 4. Section 077200 "Roof Accessories" for manufactured and prefabricated metal roof curbs.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site][location and time as determined by DEN Project Manager] <Insert location>**.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include data substantiating that materials comply with requirements.

- B. LEED Submittals:

- 1. Product Data for Credit EQ 4.1: For installation adhesives, documentation including printed statement of VOC content.

2. Laboratory Test Reports for Credit EQ 4: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For roof expansion joints.
1. Include plans, elevations, sections, and attachment details.
 2. Include details of splices, intersections, transitions, fittings, method of field assembly, and location and size of each field splice.
 3. Provide isometric drawings of intersections, terminations, and changes in joint direction or planes, depicting how components interconnect with each other and adjacent construction to allow movement and achieve waterproof continuity.
- D. Samples: For each exposed product and for each color specified, **6 inches** (150 mm) in size.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each fire-barrier provided as part of a roof-expansion-joint assembly, for tests performed by a qualified testing agency.
- C. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Installer of roofing membrane.

1.7 WARRANTY

- A. Special Warranty: Manufacturer and Installer agree to repair or replace roof expansion joints and components that leak, deteriorate beyond normal weathering, or otherwise fail in materials or workmanship within specified warranty period.
1. Warranty Period: Minimum **[two (2)]** <Insert number> years from date of Substantial Completion.
- B. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace roof expansion joints that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than five Hunter units when tested according to ASTM D 2244.

- b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Warranty Period: Minimum **[20] [10] <Insert number>** years from date of Substantial Completion.

1.8 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Roof expansion joints shall withstand exposure to weather, remain watertight, and resist the movements indicated without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint seals, failure of connections, and other detrimental effects.
1. Temperature Change: **[120 deg F (67 deg C), ambient; 180 deg F (100 deg C)] <Insert temperature range>**, material surfaces.
- C. Fire-Test-Response Characteristics: Provide fire-barrier assemblies with fire-test-response characteristics as determined by testing identical products, per test method indicated, by UL or another testing agency acceptable to authorities having jurisdiction. Assemblies shall be capable of anticipated movement while maintaining fire rating. Fire-barrier products shall bear classification marking of qualified testing agency.

2.2 BELLOWS-TYPE ROOF EXPANSION JOINTS

- A. Source Limitations: Obtain bellows-type roof expansion joints approved by roofing manufacturer and that are part of roofing membrane warranty.
- B. Flanged Bellows Roof Expansion Joint **<Insert drawing designation>**: Manufactured, continuous, waterproof, joint-cover assembly, consisting of exposed membrane bellows, laminated to flexible, closed-cell support foam, and secured along each edge to a **3- to 4-inch-** (76- to 100-mm-) wide metal flange for nailing to substrate. Provide each size and type indicated[, **factory-fabricated units for corner and joint**

intersections and horizontal and vertical transitions including those to other building expansion joints], splicing units, adhesives, and other components as recommended by roof-expansion-joint manufacturer for complete installation. Fabricate each assembly specifically for installation configuration indicated on Drawings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.
 - b. Balco, Inc.
 - c. Building Materials Corporation of America; GAF Materials Corporation.
 - d. C/S Group.
 - e. InPro Corporation.
 - f. Johns Manville; a Berkshire Hathaway company.
 - g. MM Systems Corporation.
 - h. Watson Bowman Acme Corp.
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
2. Joint Movement Capability: Plus and minus **[25 percent of joint size] [50 percent of joint size] [As indicated on Drawings] <Insert dimension or percentage>**.
3. Bellows: **[EPDM] [Neoprene] [PVC] <Insert material>** flexible membrane, nominal **[60 mils (1.5 mm)] <Insert thickness>** thick.
 - a. Color: **[Black] [White] <Insert color>**.
4. Flanges: **[Galvanized steel, 0.022 inch (0.56 mm) thick] [Copper, 16 oz./sq. ft. (0.55 mm thick)] [Stainless steel, 0.019 inch (0.48 mm) thick] [Aluminum, 0.032 inch (0.81 mm) thick] [Non-metallic PVC membrane] <Insert requirement>**.
 - a. Form: **[Flat to fit cants] [Angle formed to fit curbs] <Insert requirement>** as indicated on Drawings.
 - b. Mortar Flanges: Where flanges will be embedded in concrete or mortar, provide perforated-metal mortar flanges.
5. Cover Membrane: **[EPDM] [Neoprene] [PVC] <Insert material>** flexible membrane, factory laminated to bellows and covering entire joint assembly and curbs.
 - a. Color: **[Black] [White] <Insert color>**.
6. Secondary Seal: Continuous, waterproof **[PVC]** membrane within joint and attached to substrate on sides of joint below the primary bellows assembly.
 - a. Drain-Tube Assemblies: Equip secondary seal with drain tubes and seals to direct collected moisture **[to drain] [to exterior-wall expansion joint cover] [as indicated on Drawings] <Insert requirement>**.

- b. Thermal Insulation: Fill space above secondary seal with **[mineral-fiber blanket] [manufacturer's standard, factory-installed glass-fiber] <Insert requirement>** insulation; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84.
 7. Fire Barrier: Manufacturer's standard fire-resistive joint system with ratings determined per **[ASTM E 1966 or UL 2079] [ASTM E 119]** to resist spread of fire and to accommodate building thermal **[and seismic]** movements without impairing its ability to resist the passage of fire and hot gases.
 - a. Fire-Resistance Rating: Not less than **[1-hour] [2-hour] [fire-resistance rating of the roof assembly] <Insert rating>**.
- C. Extruded Bellows Roof Expansion Joint **<Insert drawing designation>**: Manufactured, continuous, waterproof, joint-cover assembly; consisting of primary and secondary, single-layered, elastomeric seals; secured along each edge with extruded-aluminum retainers for fastening to substrate. Provide each size and type indicated[, **factory-fabricated units for corner and joint intersections and horizontal and vertical transitions including those to other building expansion joints**], splicing units, adhesives, and other components as recommended by roof-expansion-joint manufacturer for complete installation. Fabricate each assembly specifically for installation configuration indicated on Drawings.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C/S Group.
 - b. Michael Rizza Company.
 - c. MM Systems Corporation.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
 2. Joint Movement Capability: Plus and minus **[25 percent of joint size] [50 percent of joint size] [As indicated on Drawings] <Insert dimension or percentage>**.
 3. Primary Seal: Silicone extrusion; color: **[Black] [White] [Bronze] [Sandstone] [Gray] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 4. Drain-Tube Assemblies: Equip secondary seal with drain tubes and seals to direct collected moisture **[to drain] [to exterior-wall expansion joint cover] [as indicated on Drawings] <Insert requirement>**.

2.3 ALUMINUM ROOF EXPANSION JOINTS

- A. Aluminum Roof Expansion Joint **<Insert drawing designation>**: Manufactured, continuous, waterproof, joint-cover assembly; consisting of a formed or extruded metal cover secured to extruded aluminum frames, with water-resistant gasketing between cover and frames, and with provision for securing assembly to substrate and sealing assembly to roofing membrane or flashing. Provide each size and type indicated[,

factory-fabricated units for corner and joint intersections and horizontal and vertical transitions including those to other building expansion joints], splicing units, adhesives, and other components as recommended by roof-expansion-joint manufacturer for complete installation. Fabricate each assembly specifically for installation configuration indicated on Drawings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.
 - b. Balco, Inc.
 - c. C/S Group.
 - d. InPro Corporation.
 - e. MM Systems Corporation.
 - f. Nystrom Building Products.
 - g. Watson Bowman Acme Corp.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.
2. Joint Movement Capability: Plus and minus **[25 percent of joint size] [50 percent of joint size] [As indicated on Drawings] <Insert dimension or percentage>**.
3. Frame Members: Extruded aluminum configured **[for curbs] [for sloped cants] [with integral 5-1/2-inch tall aluminum curb] <Insert requirement>** as indicated; with exposed finish **[matching cover] [as selected by DEN Project Manager from manufacturer's full range] <Insert requirement>**.
4. Cover: **[Formed aluminum] [Extruded aluminum] [Formed or extruded aluminum] [Stainless steel] <Insert material>**; thickness **[as recommended by manufacturer] <Insert thickness>**.
 - a. Aluminum Finish: **[Mill] [Clear anodic] [Color anodic] [High-performance organic] <Insert finish>**.
 - b. Aluminum Finish Color: **[Light bronze] [Medium bronze] [Dark bronze] [As indicated by manufacturer's designations] [As selected by DEN Project Manager from manufacturer's full range] <Insert requirement>**.
 - c. Stainless Steel Finish: **[2B] <Insert finish>**.
5. Centering Devices: **[Centering bars] [Snap-on spring clips attached to the cover] <Insert item>**.
6. Secondary Seal: Continuous, waterproof **[PVC]** membrane within joint and attached to substrate on sides of joint below the cover.
 - a. Drain-Tube Assemblies: Equip secondary seal with drain tubes and seals to direct collected moisture **[to drain] [to exterior-wall expansion joint cover] [as indicated on Drawings] <Insert requirement>**.
 - b. Thermal Insulation: Fill space above secondary seal with **[mineral-fiber blanket] <Insert requirement>** insulation; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84.

7. Fire Barrier: Manufacturer's standard fire-resistive joint system with ratings determined per [ASTM E 1966 or UL 2079] [ASTM E 119] to resist spread of fire and accommodate building thermal[and seismic] movements without impairing its ability to resist the passage of fire and hot gases.
 - a. Fire-Resistance Rating: Not less than [1-hour] [2-hour] [fire-resistance rating of the roof assembly] <Insert rating>.

2.4 MATERIALS

- A. Galvanized-Steel Sheet: ASTM A 653/A 653M, hot-dip zinc-coating designation G90 (Z275).
- B. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 or H01 temper.
- C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.
- D. Aluminum: ASTM B 209 (ASTM B 209M) for sheet and plate, ASTM B 221 (ASTM B 221M) for extrusions; alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.
 1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious or preservative-treated wood materials.
 2. Mill Finish: As manufactured.
 3. Class II, Clear Anodic Finish: Architectural Class II, clear coating 0.010 mm or thicker, complying with AAMA 611.
 4. Class I, Clear Anodic Finish: Architectural Class I, clear coating 0.018 mm or thicker, complying with AAMA 611.
 5. Class I, Color Anodic Finish: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker, complying with AAMA 611.
 6. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Two-Coat Fluoropolymer: System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
 - b. Three-Coat Fluoropolymer: System consisting of primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent PVDF resin by weight.
- E. EPDM Membrane: ASTM D 4637, Type standard with manufacturer for application.
- F. Neoprene Membrane: Neoprene sheet recommended by EPDM manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil; and as standard with roof-expansion-joint manufacturer for application.
- G. PVC Membrane: ASTM D 4434, Type standard with manufacturer for application.
- H. Silicone Extrusions: ASTM D 2000, UV stabilized, and that does not propagate flame.

- I. Adhesives: As recommended by roof-expansion-joint manufacturer and with a VOC content of [70] <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- J. Adhesives: As recommended by roof-expansion-joint manufacturer and that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- K. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to withstand design loads.
 - 1. Exposed Fasteners: Gasketed. Use screws with hex washer heads matching color of material being fastened.
- L. Mineral-Fiber Blanket: ASTM C 665.
- M. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Examine roof-joint openings, inside surfaces of parapets, and expansion-control joint systems that interface with roof expansion joints, for suitable conditions where roof expansion joints will be installed.
- C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written instructions for handling and installing roof expansion joints.
 - 1. Anchor roof expansion joints securely in place, with provisions for required movement. Use fasteners, protective coatings, sealants, and miscellaneous items as required to complete roof expansion joints.
 - 2. Install roof expansion joints true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
 - 3. Provide for linear thermal expansion of roof expansion joint materials.
 - 4. Provide uniform profile of roof expansion joint throughout its length; do not stretch or squeeze membranes.

5. Provide uniform, neat seams.
 6. Install roof expansion joints to fit substrates and to result in watertight performance.
 7. Torch cutting of roof expansion joints is not permitted.
 8. Do not use graphite pencils to mark aluminum surfaces.
- B. Directional Changes and Other Expansion-Control Joint Systems: Coordinate installation of roof expansion joints with other expansion-control joint systems to result in watertight performance. Install **factory-fabricated** units at directional changes and at transitions between roof expansion joints and exterior expansion-control joint systems specified in Section 079500 "Expansion Control" to provide continuous, uninterrupted, and watertight joints.
- C. Splices: Splice roof expansion joints with materials provided by roof-expansion-joint manufacturer for this purpose, to provide continuous, uninterrupted, and waterproof joints.
1. Install waterproof splices and prefabricated end dams to prevent leakage of secondary-seal membrane.
- D. Fire Barrier: Install fire barrier where indicated to provide continuous, uninterrupted fire resistance throughout length of roof expansion joint, including transitions and end joints.
- E. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

3.3 PROTECTION

- A. Protect roof expansion joints from foot traffic, displacement, or other damage.
- B. Remove and replace roof expansion joints and components that become damaged by moisture or otherwise.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 077129

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Roof curbs.
2. Equipment supports.
3. Roof hatches.
4. Hatch-type heat and smoke vents.
5. Dropout-type heat and smoke vents.
6. Gravity ventilators.
7. Pipe supports.
8. Roof walkways.
9. Preformed flashing sleeves.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
2. Section 055213 "Pipe and Tube Railings" for safety railing systems not attached to roof-hatch curbs.
3. Section 076100 "Sheet Metal Roofing" for shop- and field-formed roof curbs and snow guards for sheet metal roofing.
4. Section 076200 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.
5. Section 077100 "Roof Specialties" for manufactured fasciae, copings, gravel stops, gutters and downspouts, and counterflashing.
6. Section 077129 "Manufactured Roof Expansion Joints" for manufactured roof expansion-joint covers.
7. Section 077253 "Snow Guards" for snow guards.
8. Section 086200 "Unit Skylights" for single- and double-glazed domed plastic skylights with curb frame.
9. Section 233423 "HVAC Power Ventilators" for power roof-mounted ventilators.
10. **[Section 283111 "Digital, Addressable Fire-Alarm System"] [Section 283112 "Zoned (DC Loop) Fire-Alarm System"]** for interconnects to automatically operated heat and smoke vents.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For roof accessories. Show fabrication and installation details. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, weights, loadings, required clearances, methods of field assembly, components, and special conditions. Distinguish between plant- and field-assembled work.
- C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.
 - 1. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for roof accessories with factory-applied color finishes.
 - 2. Samples for Verification: For each type of exposed finish required, prepared on Samples in manufacturer's standard sizes, and of same thickness and material indicated for the Work. If finishes involve normal color or shade variations, include sample sets showing the full range of variations expected.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
 - 1. Size and location of roof accessories specified in this Section.
 - 2. Method of attaching roof accessories to roof or building structure.
 - 3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
 - 4. Required clearances.
- B. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 COORDINATION

- A. Coordinate layout and installation of roof accessories with [**roofing membrane and base flashing and**]interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.8 QUALITY ASSURANCE

- A. Standards: Comply with SMACNA "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated. Comply with "NRCA Roofing and Waterproofing Manual" details for installation of units.

1.9 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: Minimum [**20**] [**10**] **<Insert number>** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

- A. Provide manufacturers' standard units, modified as necessary to comply with requirements. Shop fabricate each unit to greatest extent possible.

2.2 METAL MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, **G90 (Z275)** coating designation[**and mill phosphatized for field painting where indicated**].
1. Mill-Phosphatized Finish: Manufacturer's standard for field painting.
 2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of **0.2 mil (0.005 mm)**.
 3. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A 755/A 755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
 4. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of **1 mil (0.025 mm)** for topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of **2 mils (0.05 mm)**.
 5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of **0.5 mil (0.013 mm)**.
- B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, **AZ50 (AZM150)** coated.
1. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of **0.2 mil (0.005 mm)**.
 2. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A 755/A 755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

3. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of **1 mil (0.025 mm)** for topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of **2 mils (0.05 mm)**.
 4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of **0.5 mil (0.013 mm)**.
- C. Aluminum Sheet: **ASTM B 209 (ASTM B 209M)**, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
1. Mill Finish: As manufactured.
 2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of **0.2 mil (0.005 mm)**.
 3. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
 4. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.
 5. Exposed Coil-Coated Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Two-Coat Fluoropolymer Finish: AAMA 620. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
 6. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils (0.04 mm)**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 7. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of **0.5 mil (0.013 mm)**.
- D. Aluminum Extrusions and Tubes: **ASTM B 221 (ASTM B 221M)**, manufacturer's standard alloy and temper for type of use, finished to match assembly where used, otherwise mill finished.
- E. Copper Sheet: ASTM B 370, manufacturer's standard temper.
- F. Stainless-Steel Sheet and Shapes: ASTM A 240/A 240M or ASTM A 666, Type 304.
- G. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.
- H. Steel Tube: ASTM A 500, round tube.

- I. Galvanized-Steel Tube: ASTM A 500, round tube, hot-dip galvanized according to ASTM A 123/A 123M.
- J. Steel Pipe: ASTM A 53/A 53M, galvanized.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Acrylic Glazing: ASTM D 4802, thermoformable, monolithic sheet, manufacturer's standard, Type UVA (formulated with UV absorber), Finish 1 (smooth or polished).
- C. Polycarbonate Glazing: Thermoformable, monolithic polycarbonate sheets manufactured by extrusion process, burglar-resistance rated according to UL 972 with an average impact strength of [12 to 16 ft-lbf/in. (640 to 854 J/m)] <Insert value> of width when tested according to ASTM D 256, Method A (Izod).
- D. Cellulosic-Fiber Board Insulation: ASTM C 208, Type II, Grade 1, thickness as indicated.
- E. Glass-Fiber Board Insulation: ASTM C 726, thickness as indicated.
- F. Polyisocyanurate Board Insulation: ASTM C 1289, thickness as indicated.
- G. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, [**containing no arsenic or chromium,**] and complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.
- H. Security Grilles: [3/4-inch (19-mm)] <Insert dimension> diameter, ASTM A 1011/A 1011M steel bars spaced [6 inches (150 mm)] <Insert dimension> o.c. in one direction and [12 inches (300 mm)] <Insert dimension> o.c. in the other; factory finished as follows:
 - 1. Surface Preparation: Remove mill scale and rust, if any, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 - 2. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment.
 - 3. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, lead- and chromate-free, universal primer; selected for resistance to normal atmospheric corrosion, for compatibility with substrate and field-applied finish paint system indicated, and for capability to provide a sound foundation for field-applied topcoats under prolonged exposure.
- I. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.
- J. Underlayment:

1. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
 2. Polyethylene Sheet: **6-mil-** (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.
 3. Slip Sheet: Building paper, **3-lb/100 sq. ft.** (0.16-kg/sq. m) minimum, rosin sized.
- K. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 3. Fasteners for Copper Sheet: Copper, hardware bronze, or passivated Series 300 stainless steel.
 4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- L. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- M. Elastomeric Sealant: ASTM C 920, elastomeric [**polyurethane**] [**silicone**] polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.
- N. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.
- O. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.
- 2.4 ROOF CURBS
- A. Roof Curbs: Internally reinforced roof-curb units[**with integral spring-type vibration isolators and**] capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints,[**integral metal cant,**] [**stepped integral metal cant raised the thickness of roof insulation,**] and integrally formed deck-mounting flange at perimeter bottom.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [AES Industries, Inc.](#)
 - b. Colony Custom Curbs.
 - c. Commodity Products Company, Inc.
 - d. Conn-Fab Sales, Inc.
 - e. [Curbs Plus, Inc.](#)

- f. [Custom Solution Roof and Metal Products.](#)
 - g. Gieske Custom Metal Fabricators.
 - h. Goeller Enterprises.
 - i. [Greenheck Fan Corporation.](#)
 - j. [LM Curbs.](#)
 - k. Loren Cook Company.
 - l. [Metallic Products Corp.](#)
 - m. [Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.](#)
 - n. [Pate Company \(The\).](#)
 - o. [Roof Products, Inc.](#)
 - p. [Safe Air of Illinois.](#)
 - q. [Thybar Corporation.](#)
 - r. Uni-Curb, Inc.
 - s. [Vent Products Co., Inc.](#)
 - t. <Insert manufacturer's name>.
 - u. or approved equal.
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Loads: <Insert load requirements>.
- D. Material: Structural quality ASTM A 570, grade as required, [**Zinc-coated (galvanized)**] [**Aluminum-zinc alloy-coated**] steel sheet, [**0.079 inch (2.01 mm)**] <Insert dimension> thick, prepared for factory prime and paint finish.
1. Finish: Factory primed and painted with minimum 2-mil thickness of [**Two-coat fluoropolymer**] [**Baked enamel or powder coat**] <Insert finish> finish.
 2. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
- E. Construction:
1. Insulation: Factory insulated with [**1-1/2-inch- (38-mm-)**] <Insert dimension> thick [**cellulosic**] [**glass**]-fiber board insulation.
 2. Liner: Same material as curb, of manufacturer's standard thickness and finish.
 3. Factory-installed wood nailer at top of curb, continuous around curb perimeter.
 4. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
 5. Fabricate curbs to minimum height of [**12 inches (300 mm)**] <Insert dimension> unless otherwise indicated.
 6. Top Surface: Level around perimeter with roof slope accommodated by sloping the deck-mounting flange.
 7. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
 8. Security Grille: Provide where indicated.

2.5 EQUIPMENT SUPPORTS

- A. Equipment Supports: Internally reinforced metal equipment supports capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints, [**integral metal cant,**] [**stepped integral metal cant raised the thickness of roof insulation,**] and integrally formed deck-mounting flange at perimeter bottom.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [AES Industries, Inc.](#)
 - b. Colony Custom Curbs.
 - c. Commodity Products Company, Inc.
 - d. Conn-Fab Sales, Inc.
 - e. [Curbs Plus, Inc.](#)
 - f. [Custom Solution Roof and Metal Products.](#)
 - g. Gieske Custom Metal Fabricators.
 - h. Goeller Enterprises.
 - i. [Greenheck Fan Corporation.](#)
 - j. [LM Curbs.](#)
 - k. Loren Cook Company.
 - l. [Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.](#)
 - m. [Pate Company \(The\).](#)
 - n. [Roof Products, Inc.](#)
 - o. [Thybar Corporation.](#)
 - p. Uni-Curb, Inc.
 - q. [Vent Products Co., Inc.](#)
 - r. **<Insert manufacturer's name>**.
 - s. or approved equal.
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Loads: **<Insert load requirements>**.
- D. Material: Structural quality ASTM A370, grade as required, [**Zinc-coated (galvanized)**] steel sheet, [**0.079 inch (2.01 mm)**] **<Insert dimension>** thick, prepared for factory prime and paint finish.
1. Finish: Factory primed and painted with minimum 2-mil thickness of [**Two-coat fluoropolymer**] [**Baked enamel or powder coat**] **<Insert finish>** finish.
 2. Color: [**As indicated by manufacturer's designations**] [**Match DI A Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] **<Insert color>**.
- E. Construction:

1. Insulation: Factory insulated with [**1-1/2-inch- (38-mm-)**] **<Insert dimension>** thick [**cellulosic**] [**glass**]-fiber board insulation.
2. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
3. Factory-installed continuous wood nailers [**3-1/2 inches (90 mm)**] [**5-1/2 inches (140 mm)**] **<Insert dimension>** wide at tops of equipment supports.
4. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
5. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
6. Fabricate equipment supports to minimum height of [**12 inches (300 mm)**] **<Insert dimension>** unless otherwise indicated.
7. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.
8. Security Grille: Provide where indicated.

2.6 ROOF HATCH

- A. Roof Hatches: Metal roof-hatch units with lids and insulated [**single**] [**double**]-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, [**integral metal cant,**] [**stepped integral metal cant raised the thickness of roof insulation,**] and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [AES Industries, Inc.](#)
 - b. [Babcock-Davis.](#)
 - c. [Bilco Company \(The\).](#)
 - d. Bohem Skylites, Inc.
 - e. [Bristolite Skylights.](#)
 - f. [Custom Solution Roof and Metal Products.](#)
 - g. [Dur-Red Products.](#)
 - h. [Hi Pro International, Inc.](#)
 - i. [J. L. Industries, Inc.](#)
 - j. Faulkner Plastics, Inc.
 - k. Hillsdale Industries, Inc.
 - l. [Metallic Products Corp.](#)
 - m. [Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.](#)
 - n. [Naturalite Skylight Systems; Vistawall Group \(The\).](#)
 - o. [Nystrom.](#)
 - p. [O'Keeffe's Inc.](#)
 - q. [Pate Company \(The\).](#)
 - r. Plasteco, Inc.
 - s. [Precision Ladders, LLC.](#)
 - t. Wasco Products, Inc.

- u. **<Insert manufacturer's name>**.
 - v. or approved equal.
- B. Type and Size: Single-leaf lid unless otherwise indicated, [**30 by 36 inches (750 by 900 mm)**] [**30 by 54 inches (750 by 1370 mm)**] [**30 by 96 inches (750 by 2440 mm)**] **<Insert dimensions>**.
- C. Loads: Minimum [**40-lbf/sq. ft. (1.9-kPa)**] **<Insert value>** external live load and [**20-lbf/sq. ft. (0.95-kPa)**] **<Insert value>** internal uplift load.
- D. Hatch Material: [**Zinc-coated (galvanized)**] steel sheet, [**0.079 inch (2.01 mm)**] **<Insert dimension>** thick.
- 1. Finish: Factory primed and painted with minimum 2-mil thickness of [**Two-coat fluoropolymer**] [**Baked enamel or powder coat**] **<Insert finish>** finish.
 - 2. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] **<Insert color>**.
- E. Construction:
- 1. Insulation: 1" thick [**Cellulosic-fiber**] [**Glass-fiber**] [**Polyisocyanurate**] board.
 - 2. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
 - 3. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
 - 4. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
 - 5. Fabricate curbs to minimum height of [**12 inches (300 mm)**] **<Insert dimension>** unless otherwise indicated.
 - 6. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is [**constant**] [**tapered to accommodate roof slope so that top surfaces of perimeter curb are level**]. Equip hatch with water diverter or cricket on side that obstructs water flow.
- F. Hardware: [**Galvanized**] [**Stainless**]-steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.
- 1. Provide two-point latch on lids larger than **84 inches (2130 mm)**.
 - 2. Provide remote-control operation.
- G. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
- 1. Height: [**42 inches (1060 mm)**] **<Insert dimension>** above finished roof deck.
 - 2. Posts and Rails: Galvanized-steel pipe, **1-1/4 inches (31 mm)** in diameter or galvanized-steel tube, **1-5/8 inches (41 mm)** in diameter.
 - 3. Flat Bar: Galvanized steel, **2 inches (50 mm)** high by **3/8 inch (9 mm)** thick.

4. Maximum Opening Size: System constructed to prevent passage of a sphere **21 inches (533 mm)** in diameter.
5. Chain Passway Barrier: Galvanized proof coil chain with quick link on fixed end.
6. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
7. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
8. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
9. Fabricate joints exposed to weather to be watertight.
10. Fasteners: Manufacturer's standard, finished to match railing system.
11. Finish: **[Manufacturer's standard] <Insert finish>**.
 - a. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.

H. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.

1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
2. Height: **[42 inches (1060 mm)] <Insert dimension>** above finished roof deck.
3. Material: **[Steel tube] [Stainless steel] [Aluminum]**.
4. Post: **[1-5/8-inch- (41-mm-)] <Insert dimension>** diameter pipe.
5. Finish: **[Manufacturer's standard baked enamel or powder coat] <Insert finish>**.
 - a. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.

2.7 HEAT AND SMOKE VENTS

A. Hatch-Type Heat and Smoke Vents: Manufacturer's standard, with **[single] [double]**-walled insulated curbs, welded or mechanically fastened and sealed corner joints, integral condensation gutter, and cap flashing. Fabricate with insulated double-walled lid and continuous weathertight perimeter lid gaskets, and equip with automatic self-lifting mechanisms and UL-listed **[fusible links rated at 165 deg F (74 deg C)] [fire-suppression system] [smoke-detection system]**.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Babcock-Davis](#).
 - b. [Bilco Company \(The\)](#).
 - c. [Bristolite Skylights](#).
 - d. Custom Curb, Inc.

- e. [Dur-Red Products.](#)
 - f. Goeller Enterprises.
 - g. [Hi Pro International, Inc.](#)
 - h. [J. L. Industries, Inc.](#)
 - i. [Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.](#)
 - j. [Naturalite Skylight Systems; Vistawall Group \(The\).](#)
 - k. [Nystrom.](#)
 - l. [O'Keeffe's Inc.](#)
 - m. [Pate Company \(The\).](#)
 - n. ThyCurb, Inc.
 - o. Wasco Products, Inc.
 - p. [Western Canwell.](#)
 - q. <Insert manufacturer's name>.
 - r. or approved equal.
2. Type and Size: Single-leaf lid, [**30 by 36 inches (750 by 900 mm)**] [**30 by 54 inches (750 by 1370 mm)**] [**30 by 96 inches (750 by 2440 mm)**] <Insert dimensions>.
3. Type and Size: Double-leaf lid, [**72 by 96 inches (1830 by 2440 mm)**] <Insert dimensions>.
4. Loads: Minimum [**40-lbf/sq. ft. (1.9-kPa)**] <Insert value> external live load and [**30-lbf/sq. ft. (1.4-kPa)**] <Insert value> internal uplift load.
- a. When release is actuated, lid shall open against [**10-lbf/sq. ft. (0.5-kPa)**] <Insert value> snow or wind load and lock in position.
 - b. Hatch-Lid Glazing: Minimum [**40-lbf/sq. ft. (1.9-kPa)**] <Insert value> external live load and [**20-lbf/sq. ft. (0.95-kPa)**] <Insert value> internal uplift load.
5. Heat and Smoke Vent Standard: Provide units that have been tested and [**listed to comply with UL 793**] [**and**] [**are FM Approved**].
6. Curb, Framing, and Lid Material: [**Zinc-coated (galvanized)**] [**Aluminum-zinc alloy-coated**] steel sheet, [**0.079 inch (2.01 mm)**] <Insert dimension> thick.
- a. Finish: Primed [**Two-coat fluoropoly**] factory primed and painted finish [**Baked enamel or powder coat**] <Insert finish>.
 - b. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
7. Curb, Framing, and Lid Material: Aluminum sheet, [**0.090 inch (2.28 mm)**] <Insert dimension> thick.
- a. Finish: [**Mill**] [**Factory prime coating**] [**Clear anodic**] [**Color anodic**] [**Two-coat fluoropolymer**] [**Baked enamel or powder coat**] <Insert finish>.
 - b. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] [**Light bronze**] [**Medium bronze**] [**Dark bronze**] <Insert color>.

8. Curb, Framing, and Lid Material: Stainless-steel sheet, **[0.078 inch (1.98 mm)]** <Insert dimension> thick.
 - a. Finish: **[Manufacturer's standard] [No. 2D, directional polish finish]** <Insert finish>.
 9. Construction:
 - a. Insulation: **[Cellulosic-fiber] [Glass-fiber] [Polyisocyanurate]** board.
 - b. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
 - c. Hatch Lid: Glazed, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
 - d. Exterior Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
 - e. Fabricate curbs to minimum height of **[12 inches (300 mm)]** <Insert dimension> unless otherwise indicated.
 - f. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is **[constant] [tapered to accommodate roof slope so that top surfaces of perimeter curb are level]**. Equip hatch with water diverter or cricket on side that obstructs water flow.
 - g. Security Grille: Provide where indicated.
 10. Hatch-Lid Glazing: **[Single] [Double] [acrylic] [polycarbonate]** glazing of thickness capable of resisting indicated loads; **[colorless, transparent] [white, translucent]** <Insert color requirement>.
 11. Hardware: Manufacturer's standard, corrosion resistant or hot-dip galvanized; with hinges, hold-open devices, and independent manual-release devices for **[inside] [and] [outside]** operation of lids.
- B. Dropout-Type Heat and Smoke Vents: Manufacturer's standard, gravity operated and automatic; with **[single] [double]**-walled insulated curbs and frame, welded or mechanically fastened and sealed corner joints, integral condensation gutter, cap flashing, and heat-sensitive dome glazing that will deform and drop out of vent opening according to heat and smoke vent standard indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Construction Specialties, Inc.](#)
 - b. Custom Curb, Inc.
 - c. Dur-Red Products, Inc.
 - d. Goeller Enterprises.
 - e. HiPro International, Inc.
 - f. Milcor, Inc.
 - g. [Naturalite Skylight Systems; Vistawall Group \(The\).](#)
 - h. O'Keeffe's, Inc.
 - i. [Pate Company \(The\).](#)
 - j. [Plasteco, Inc.](#)
 - k. Wasco Products, Inc.

- f. Inner Double-Dome Color: **[Colorless, transparent] [White, translucent] [Gray tinted, transparent] [Bronze tinted, transparent] <Insert requirement>**.
8. Hardware: Manufacturer's standard, corrosion resistant or hot-dip galvanized; with hinges, hold-open devices, and independent manual-release devices for **[inside] [and] [outside]** operation of lids.

2.8 GRAVITY VENTILATORS

- A. Low-Profile, Cylindrical-Style Gravity Ventilators: Manufacturer's standard, fabricated as indicated, with manufacturer's standard welded or sealed mechanical joints.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Active Ventilation Products, Inc.](#)
 - b. [Greenheck Fan Corporation.](#)
 - c. [Loren Cook Company.](#)
 - d. [Metallic Products Corp.](#)
 - e. [Thaler Metal USA Inc.](#)
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
 2. Construction: Integral base flange, vent cylinder, cylinder bird screen, and **[rain cap] [hood]**.
 3. Dimensions: **[As indicated on Drawings] <Insert dimensions>**.
 4. Configuration: **[As indicated on Drawings] <Insert requirements>**.
 5. Bird Screens: Manufacturer's standard mesh with rewirable frame.
 6. Insect Screens: Manufacturer's standard mesh with rewirable frame.
 7. Vent Cylinder, Base Flange, and **[Rain-Cap] [Hood]** Material: **[Zinc-coated (galvanized) steel] [Aluminum] [Copper] [Stainless-steel]** sheet, of manufacturer's standard thickness.
 8. Finish: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert finish>**.
- B. Louvered Penthouse-Style Gravity Ventilators: Manufacturer's standard, fabricated as indicated, with manufacturer's standard welded or sealed mechanical joints.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Dur-Red Products.](#)
 - b. [Greenheck Fan Corporation.](#)
 - c. [Loren Cook Company.](#)
 - d. [Safe Air of Illinois.](#)
 - e. [Vent Products Co., Inc.](#)
 - f. **<Insert manufacturer's name>**.

- g. or approved equal.
 2. Construction: Integral frame with base flange, weathertight cap[**with clear acrylic dome**] [**with white translucent acrylic dome**], and weatherproof sidewall louvers.
 3. Dimensions: [**As indicated on Drawings**] <Insert dimensions>.
 4. Configuration: [**As indicated on Drawings**] <Insert requirements>.
 5. Bird Screens: Manufacturer's standard mesh with rewirable frame.
 6. Insect Screens: Manufacturer's standard mesh with rewirable frame.
 7. Frame, Base Flange, Cap, and Louver Material: [**Zinc-coated (galvanized) steel**] [**Aluminum**] [**Stainless-steel**] sheet, of manufacturer's standard thickness.
 8. Finish: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert finish>.
- C. Turbine-Style Gravity Ventilators: Manufacturer's standard, fabricated as indicated, with manufacturer's standard welded or sealed mechanical joints:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Air Vent, Inc.; a Gibraltar company.](#)
 - b. [Metallic Products Corp.](#)
 - c. <Insert manufacturer's name>.
 - d. or approved equal.
 2. Provide integral weathertight base cap, outlet duct, and rotating louvered turbine.
 3. Dimensions: [**As indicated on Drawings**] <Insert dimensions>.
 4. Configuration: [**As indicated on Drawings**] <Insert requirements>.
 5. Bird Screens: Manufacturer's standard mesh with rewirable frame.
 6. Insect Screens: Manufacturer's standard mesh with rewirable frame.
 7. Weathertight Base Cap, Outlet Duct, and Turbine Material: [**Zinc-coated (galvanized) steel**] [**Aluminum**] sheet, of manufacturer's standard thickness.
 8. Finish: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert finish>.

2.9 PIPE SUPPORTS

- A. Pipe Supports: Adjustable-height, extruded-aluminum tube, filled with urethane insulation; [**2 inches (50 mm)**] <Insert dimension> in diameter; with aluminum baseplate, EPDM base seal, manufacturer's recommended hardware for mounting to structure or structural roof deck as indicated, and extruded-aluminum carrier assemblies; suitable for quantity of pipe runs and sizes.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Thaler Metal USA Inc.](#)

- b. **<Insert manufacturer's name>**.
 - c. or approved equal.
 2. Pipe Support Height: As indicated on Drawings.
 3. Roller Assembly: With stainless-steel roller, sized for supported pipes.
 4. Pipe Support Flashing: Manufacturer's standard [**insulated**] sleeve flashing with integral base flange; [**aluminum sheet, 0.063 inch (1.60 mm) thick**] [**copper sheet, 16 oz. (0.55 mm) thick**].
 5. Finish: [**Manufacturer's standard**] **<Insert finish>**.
- B. [**Terrace**] Lighting Supports: Epoxy-coated, hollow steel pipe support, filled with urethane insulation; with epoxy-coated steel baseplate, EPDM base seal, manufacturer's recommended hardware for mounting to structure or structural roof deck as indicated, and threaded stainless-steel cap.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Thaler Metal USA Inc.](#)
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.
 2. Height: [**14 inches (356 mm)**] [**18 inches (457 mm)**] **<Insert dimension>**.
 3. Lighting Pole Mounting: [**Stainless-steel lighting pole adapter**] [**Epoxy-coated steel plate with stainless-steel studs**].
 4. Pipe Support Flashing: Manufacturer's standard[**insulated**] sleeve flashing with integral base flange; [**aluminum sheet, 0.063 inch (1.60 mm) thick**] [**copper sheet, 16 oz. (0.55 mm) thick**].
 5. Finish: [**Manufacturer's standard**] **<Insert finish>**.
- C. Light-Duty Pipe Supports: Extruded-aluminum base assembly and Type 304 stainless-steel roller assembly for pipe sizes indicated, including manufacturer's recommended load-distributing baseplate.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Thaler Metal USA Inc.](#)
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.
 2. Finish: [**Manufacturer's standard**] **<Insert finish>**.
- D. Duct Supports: Extruded-aluminum, urethane-insulated supports, [**2 inches (50 mm)**] **<Insert dimension>** in diameter; with manufacturer's recommended hardware for mounting to structure or structural roof deck.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. [Thaler Metal USA Inc.](#)
 - b. <Insert manufacturer's name>.
 - c. or approved equal.
2. Finish: **[Manufacturer's standard]** <Insert finish>.

2.10 ROOF WALKWAYS

- A. Roof Walkway: Metal planking formed from multiple C-shaped channels with upper surface punched in serrated diamond or rectangular shapes to produce raised slip-resistant surface and drainage holes. Provide support framing, brackets, connectors, nosings, and other accessories and components needed for complete installation. Include step units or stairs of similar construction for changes in elevation. Equip with safety railings that are acceptable to authorities having jurisdiction, where height of walkway or stairs requires them.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [GS Metals Corp.](#)
 - b. [Miro Industries, Inc.](#)
 - c. [PHP Systems/Design.](#)
 - d. [Unistrut Corporation.](#)
 - e. <Insert manufacturer's name>.
 - f. or approved equal.
2. Plank Width: **[4-3/4 inches (121 mm)] [7 inches (178 mm)] [9-1/2 inches (241 mm)] [11-3/4 inches (298 mm)] [18-3/4 inches (476 mm)] [24 inches (610 mm)] [As indicated]**.
3. Walkway Width: **[As indicated]** <Insert dimension>.
4. Channel Depth: **[1-1/2 inches (38 mm)] [2 inches (50 mm)] [2-1/2 inches (64 mm)] [3 inches (76 mm)] [As indicated]**.
5. Metal Material: **[0.079-inch- (2.01-mm-) thick zinc-coated (galvanized) steel sheet] [0.108-inch- (2.74-mm-) thick zinc-coated (galvanized) steel sheet] [0.062-inch- (1.59-mm-) thick stainless-steel sheet]** <Insert material and thickness>.
6. Support Stands: Manufacturer's standard, with protective pads compatible with roofing material.
7. Support Pads: Continuous wood isolation pads, pressure-preservative treated as specified in **[Section 061000 "Rough Carpentry"] [Section 061053 "Miscellaneous Rough Carpentry"]**; attach roof-walkway supports to pads so that supports are separated from roof membrane surface and walkway support loads are distributed evenly.
8. Finish: **[Manufacturer's standard]** <Insert finish>.

2.11 PREFORMED FLASHING SLEEVES

- A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, [**12 inches (300 mm)**] <Insert dimension> high, with removable metal hood and [**slotted**] [**perforated**] metal collar.
- Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - [Custom Solution Roof and Metal Products.](#)
 - [Thaler Metal USA Inc.](#)
 - <Insert manufacturer's name>.
 - or approved equal.
 - Metal: [**Aluminum sheet, 0.063 inch (1.60 mm) thick**] [**Copper sheet, 16 oz. (0.55 mm) thick**] <Insert material and thickness>.
 - Diameter: [**As indicated**] [**3 inches (76 mm)**] [**4 inches (100 mm)**] [**5 inches (125 mm)**] [**6 inches (150 mm)**] [**7 inches (175 mm)**] [**8 inches (200 mm)**] [**9 inches (225 mm)**] [**10 inches (250 mm)**] <Insert dimension>.
 - Finish: [**Manufacturer's standard**] <Insert finish>.
- B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.
- Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - [Custom Solution Roof and Metal Products.](#)
 - [Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.](#)
 - [Thaler Metal USA Inc.](#)
 - <Insert manufacturer's name>.
 - or approved equal.
 - Metal: [**Aluminum sheet, 0.063 inch (1.60 mm) thick**] [**Copper sheet, 16 oz. (0.55 mm) thick**] <Insert material and thickness>.
 - Height: [**7 inches (175 mm)**] [**13 inches (330 mm)**] [**19 inches (480 mm)**] <Insert dimension>.
 - Diameter: [**As indicated**] [**2 inches (50 mm)**] [**3 inches (76 mm)**] [**4 inches (100 mm)**] [**5 inches (125 mm)**] [**6 inches (150 mm)**] <Insert dimension>.
 - Finish: [**Manufacturer's standard**] <Insert finish>.

2.12 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions. Coordinate with installation of roof deck and other substrates to receive accessory units, and vapor barriers, roof insulation, roofing, and flashing; as required to ensure that each element of the work performs properly and that combined elements are waterproof and weathertight. Anchor units securely to supporting structural substrates, adequate to withstand lateral and thermal stresses as well as inward and outward loading pressures.
 - 1. Except as otherwise indicated install roof accessory items in accordance with construction details of "NRCA Roofing and Waterproofing Manual".
 - 2. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
 - 3. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
 - 4. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
 - 5. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
 - 1. Coat concealed side of **[uncoated aluminum]** **[stainless-steel]** roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene sheet.
 - 3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

- C. Cap Flashing: Where cap flashing is required as component of accessory, install to provide adequate waterproof overlap with roofing or roof flashing (as counter flashing). Seal with thick bead of mastic sealant, except where overlap is indicated to be left open for ventilation.
- D. Roof Curb Installation: Install each roof curb so top surface is level.
- E. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.
- F. Roof-Hatch Installation:
1. Install roof hatch so top surface of hatch curb is level.
 2. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
 3. Attach safety railing system to roof-hatch curb.
 4. Attach ladder-assist post according to manufacturer's written instructions.
- G. Heat and Smoke Vent Installation:
1. Install heat and smoke vent so top perimeter surfaces are level.
 2. Install and test heat and smoke vents and their components for proper operation according to NFPA 204.
- H. Gravity Ventilator Installation: Verify that gravity ventilators operate properly and have unrestricted airflow. Clean, lubricate, and adjust operating mechanisms.
- I. Pipe Support Installation: Install pipe supports so top surfaces are in contact with and provide equally distributed support along length of supported item.
- J. Security Grilles: Weld bar intersections and[, **using tamper-resistant bolts, attach the**] ends of bars to structural frame or primary curb walls.
- K. Roof Walkway Installation:
1. Verify that locations of access and servicing points for roof-mounted equipment are served by locations of roof walkways.
 2. Remove ballast from top surface of low-slope roofing at locations of contact with roof-walkway supports.
 3. Install roof walkway support pads prior to placement of roof walkway support stands onto low-slope roofing.
 4. Redistribute removed ballast after installation of support pads.
- L. Preformed Flashing-Sleeve Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions.
- M. Seal joints with [**elastomeric**] [**or**] [**butyl**] sealant as required by roof accessory manufacturer.
- N. Operational Units: Test operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

3.3 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780.
- B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- C. Clean exposed surfaces according to manufacturer's written instructions.
- D. Clean off excess sealants.
- E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 077200

SECTION 077253 - SNOW GUARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pad-type, flat-mounted snow guards.
 - 2. Pad-type, seam-mounted snow guards.
 - 3. Rail-type, flat-mounted snow guards.
 - 4. Rail-type, seam-mounted snow guards.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for snow guards.
 - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: Include roof plans showing layouts and attachment details of snow guards.
 - 1. Include details of rail-type snow guards.
 - 2. Include calculation of number and location of snow guards based on snow load, roof slope, roof type, components, spacings, and finish.
- C. Samples: **[Full-size unit] [Base, bracket, and 12-inch- (300-mm-) long rail]**.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of snow guard, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.5 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Performance Requirements: Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1. Temperature Change: [**120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces**] <Insert temperature change>.

- B. Structural Performance:

1. Snow Loads: [**As indicated on Drawings**] <Insert loading requirements>.

2.2 PAD-TYPE SNOW GUARDS

- A. Flat-Mounted Metal Snow Guard Pads:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. [Alpine SnowGuards; a division of Vermont Slate & Copper Services, Inc.](#)
- b. [Berger Building Products.](#)
- c. [PMC Industries, Inc.](#)
- d. [Roofers Edge.](#)
- e. [Sieger Snow Guards Inc.](#)
- f. [Sno-Gem, Inc.](#)
- g. [SnoGuard.](#)
- h. [TRA-MAGE, Inc.](#)
- i. [Zaleski Snow-Guards for Roofs, Inc.](#)
- j. <Insert manufacturer's name>.
- k. or approved equal.

2. Material: [**Aluminum**] [**Cast aluminum**] [**Cast bronze**] [**Copper sheet**] [**Zinc sheet**] [**Zinc-tin-alloy-coated copper sheet**] [**Stainless-steel sheet**] [**Manufacturer's standard noncorrosive metal**] <Insert material>.
3. Finish and Color: Powder coat; [**color as selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
4. Finish: [**Mill**] [**Factory-primed black epoxy**] <Insert finish>.

B. Seam-Mounted Metal Snow Guard Pads:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Alpine SnowGuards; a division of Vermont Slate & Copper Services, Inc.](#)
 - b. [Berger Building Products.](#)
 - c. <Insert manufacturer's name>.
 - d. or approved equal.
2. Material, Finish, and Color: Cast aluminum; powder coat; [color as selected by DEN Project Manager from manufacturer's full range] <Insert color>.
3. Material and Finish: [Cast aluminum; mill] [Cast aluminum; factory-primed black epoxy] [Cast bronze; polished] [Cast brass; polished] <Insert material and finish>.

C. Seam-Mounted Plastic Snow Guard Pads:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Polar Blox.](#)
 - b. <Insert manufacturer's name>.
 - c. or approved equal.
2. Material: Clear UV-stabilized polycarbonate.

2.3 RAIL-TYPE SNOW GUARDS

A. Flat-Mounted, Rail-Type Snow Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Alpine SnowGuards; a division of Vermont Slate & Copper Services, Inc.](#)
 - b. [Berger Building Products.](#)
 - c. [Sieger Snow Guards Inc.](#)
 - d. [SnoGuard.](#)
 - e. [Snow Management Systems; a division of Contek, Inc.](#)
 - f. [TRA-MAGE, Inc.](#)
 - g. <Insert manufacturer's name>.
 - h. or approved equal.
2. Description: Units fabricated from metal baseplate anchored to [adjustable] [fixed] bracket and equipped with [two] [three] bars.
3. Brackets and Baseplate: [Aluminum] [Bronze or brass] [Stainless steel] <Insert material>.
4. Bars: [Aluminum; mill finished] [Aluminum; clear anodized] [Stainless steel; mill finished] <Insert material>.

B. Seam-Mounted, Rail-Type Snow Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Alpine SnowGuards; a division of Vermont Slate & Copper Services, Inc.](#)
 - b. [LMCurbs.](#)
 - c. [Metal Roof Innovations, Ltd.; S-5! Attachment Solutions.](#)
 - d. [Snow Management Systems; a division of Contek, Inc.](#)
 - e. [TRA-MAGE, Inc.](#)
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
2. Description: Snow guard rails fabricated from metal pipes, bars, or extrusions, anchored to brackets and equipped with **[one rail] [two rails] [three rails] [one rail with color-matching inserts of material and finish used for metal roofing]**.
3. Material and Finish: Aluminum; **[mill] [clear anodized] <Insert finish>**.
4. Material and Finish: Stainless steel; **[mill] [No. 2B] [No. 4] <Insert finish>**.
5. Material and Finish: Brass; **[polished] <Insert finish>**.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, snow guard attachment, and other conditions affecting performance of the Work.
 1. Verify compatibility with and suitability of substrates including compatibility with existing finishes or primers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and prepare substrates for bonding snow guards.
- B. Prime substrates according to snow guard manufacturer's written instructions.

3.3 INSTALLATION

- A. Install snow guards according to manufacturer's written instructions. **[Space rows as recommended by manufacturer.]**
- B. Attachment for Metal Shingle Roofing:

1. Flat-Mounted, Snow Guard Pads: [**Mechanical anchor and counterflashing sleeve system**] <Insert attachment>.
- C. Attachment for Tile Roofing:
1. Flat-Mounted, Snow Guard Pads: [**Hook and mechanically anchored through predrilled holes concealed by roof tiles**] <Insert attachment>.
 2. Flat-Mounted, Rail-Type Snow Guards: [**Mounting plates bolted or screwed to the roof in place of a roof tile**] <Insert requirement>.
- D. Attachment for Copper Roofing:
1. Flat-Mounted, Snow Guard Pads: [**Soldered**] <Insert attachment>.
- E. Attachment for Standing-Seam Metal Roofing:
1. Do not use fasteners that will penetrate metal roofing, or fastening methods that void metal roofing finish warranty.
 2. Seam-Mounted Metal Snow Guard Pads: [**Stainless-steel clamps attached to vertical ribs of standing-seam metal roof panels**] <Insert attachment>.
 3. Seam-Mounted Plastic Snow Guard Pads: [**Stainless-steel clamps attached to vertical ribs of standing-seam metal roof panels**] <Insert attachment>.
 4. Seam-Mounted, Rail-Type Snow Guards: [**Stainless-steel clamps attached to vertical ribs of standing-seam metal roof panels**] <Insert attachment>.
- F. Attachment for <Insert roofing type> Roofing:
1. <Insert requirements>.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 077253

SECTION 078100 - APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes sprayed fire-resistive materials (SFRM).
- B. Related Requirements:
 - 1. Section 078123 "Intumescent Mastic Fireproofing" for mastic and intumescent fire-resistive coatings.
 - 2. Section 099646 "Intumescent Painting" for intumescent paints that are fire retarding but not fire resistive.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 DEFINITIONS

- A. Concealed Sprayed on Fireproofing: Concealed sprayed on fireproofing refers to applications where sprayed on materials are applied to surfaces that will be concealed from view when the Work is completed.
- B. Exposed Sprayed on Fireproofing: Exposed sprayed on fireproofing refers to applications where sprayed on materials are applied to surfaces that are exposed to view when the Work is completed.
- C. W/D Ratio: Weight-to-heated-perimeter ratio, the W/D ratio for a steel shape is determined by dividing the weight per linear foot (W) by the exposed surface area of the steel member (D); the higher the ratio, the greater the member's fire resistance, thus requiring less protection when calculating rating.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>**.
 - 1. Review products, design ratings, restrained and unrestrained conditions,

- densities, thicknesses, bond strengths, and other performance requirements.
2. Review coordination of application of fireproofing materials with other trades, project schedule, and project requirements.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 1. Product Data for Credit EQ 4.2: For paints and coatings, documentation including printed statement of VOC content.
 2. Laboratory Test Reports for Credit EQ 4: For paints and coatings used inside the weatherproofing system, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Framing plans, schedules, or both, indicating the following:
 1. Extent of fireproofing for each construction and fire-resistance rating.
 2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
 3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
 4. Treatment of fireproofing after application.
- D. Samples: For each exposed product and for each color and texture specified, **[in manufacturer's standard dimensions] [4 inches (102 mm) square] <Insert dimensions>** in size.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[Installer] [and] [testing agency]**.
- B. Product Certificates: For each type of fireproofing.
- C. Evaluation Reports: For fireproofing, from ICC-ES.
- D. Preconstruction Test Reports: For fireproofing.
- E. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with

other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.
- B. Testing Laboratory Qualifications: To qualify for acceptance, an independent testing laboratory must demonstrate to DEN Project Manager's satisfaction, based on evaluation of laboratory submitted criteria conforming to ASTM E 605, that it has the experience and capability to conduct satisfactorily the testing indicated without delaying the progress of the Work and that it complies with Section 01400, "Quality Control Requirements".
- C. Single Source Responsibility: Obtain sprayed on fireproofing materials from a single manufacturer for each different product required.
- D. Fire Performance Characteristics: Provide materials and construction that are identical to those tested for the following fire performance characteristics, per test method indicated, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction.
- E. Fire Resistance Ratings: As indicated by reference to design designation in UL "Fire Resistance Directory" for fire resistance rated assemblies in which sprayed on fireproofing serves as direct applied protection, tested per ASTM E 119.
- F. Surface Burning Characteristics: As indicated for each sprayed on fireproofing product required, tested per ASTM E 84 and listed in UL "Building Materials Directory".
- G. Warranty: Installer to warrant material and installation for two (2) years.
- H. Prior to the start of the application of the sprayed fireproofing a meeting will be held with the DEN Project Manager, Resident Engineer, General Contractor, City Inspector, Third Party Inspector, Fireproofing Applicator, Fireproofing Manufacturer and other parties as deemed necessary to review submittals, sequencing, project conditions and scheduling.
- I. Manufacturer shall submit a certificate that all products specified by the section are 100% asbestos free and mineral wool free.
- J. Field-Constructed Mockups: Prior to installation of exposed sprayed on fireproofing, apply each product indicated for exposed applications, in locations indicated or selected by DEN Project Manager , to represent completed work for qualities of appearance, materials and application.
 - 1. **Build mockups [to verify selections made under Sample submittals and to demonstrate aesthetic effects] [to set quality standards for materials and execution] [and] [for preconstruction testing].**

2. Build mockup of **[each type of fireproofing and different substrate] [and] [each required finish] <Insert description>** as shown on Drawings.
3. Extent of Mock Ups: Approximately 100 sq. ft. of surface for each product indicated.
4. Retain mock ups during construction as standard for judging completed work.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: **[Owner will engage] [Engage]** a qualified testing agency to perform preconstruction testing on **[field mockups of]** fireproofing.
 1. Provide test specimens and assemblies representative of proposed materials and construction.
- B. Preconstruction Adhesion and Compatibility Testing: Test for compliance with requirements for specified performance and test methods.
 1. Bond Strength: Test for cohesive and adhesive strength according to ASTM E 736. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
 2. Density: Test for density according to ASTM E 605. Provide density indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
 3. Verify that manufacturer, through its own laboratory testing or field experience, attests that primers or coatings are compatible with fireproofing.
 4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 5. For materials failing tests, obtain applied-fireproofing manufacturer's written instructions for corrective measures including the use of specially formulated bonding agents or primers.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in original, unopened packages with manufacturers' labels identifying products legible and intact. Include on labels names of products and manufacturers, date of manufacture and shelf life.
- B. Use materials with limited shelf life within period indicated. Remove from project site and discard any materials whose shelf life has expired.
- C. Store materials inside, under cover, off the ground and in a manner to keep them dry until ready to use. Remove from project site and discard any materials that have been exposed to moisture or have otherwise deteriorated.

1.11 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is [**40 deg F (4.4 deg C)**] <Insert temperature> or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
1. Do not apply fireproofing when ambient or substrate temperature is below recommendations by fireproofing manufacturer.
- B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

1.12 SEQUENCING

- A. Sequence and coordinate application of sprayed on fireproofing with other, related work specified in other sections to comply with the following requirements:
1. Provide temporary enclosures to prevent deterioration of sprayed on fireproofing for interior applications due to exposure to unfavorable environmental conditions.
 2. Avoid unnecessary exposure of sprayed on fireproofing to abrasion and other damage.
 3. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, tested, and corrections made to any defective fireproofing.
- B. CONSTRUCTION WASTE MANAGEMENT
1. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.
- B. Source Limitations: Obtain fireproofing[**for each fire-resistance design**] from single source.
- C. Fire-Resistance Design: Indicated on Drawings, tested according to [**ASTM E 119**] [**ASTM E 119 or UL 263**] <Insert testing requirement> by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.
- D. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction[.][**and the following VOC limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):**]
 1. Flat Paints and Coatings: 50 g/L.
 2. Nonflat Paints and Coatings: 150 g/L.
 3. Primers, Sealers, and Undercoaters: 200 g/L.
 4. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
- E. Low-Emitting Materials: Fireproofing used within the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. Asbestos: Provide products containing no asbestos.

2.2 SPRAYED FIRE-RESISTIVE MATERIALS

- A. SFRM **<Insert drawing designation>**: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and **[mixed with water at Project site to form a slurry or mortar before conveyance and application] [or] [conveyed in a dry state and mixed with atomized water at place of application]**.
- B. Products manufactured by the Construction Products Division of W.R. Grace and Co., or its approved processing distributors, are specified to establish a standard of material and quality.
- C. Concealed Sprayed-On Fireproofing Materials:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Grace, W. R. & Co. - Conn.; Grace Construction Products; **[Monokote MK-6 Series]**
 - b. **<Insert manufacturer>**
 - c. or approved equal.
 - 1) Manufacturers not listed, who request approval, shall submit a completed Request for "Or Equal" approval form, contained in Part 1, Instructions to Bidders.
 - 2) Listed manufacturers other than the company whose products are specified, W.R. Grace Co., shall submit in addition to requirements of this section, the following:
 - a) Proposed U.L. numbers, W/D calculations.
 - b) A complete description of the process.
 - c) Samples of each product.

- d) A list of at least three (3) other projects of similar nature to this project where product has been in use.
 - e) Certificate stating that all materials comply with specified requirements, signed by the manufacturer.
2. Application: Designated for exterior use by a qualified testing agency acceptable to authorities having jurisdiction.
 3. Bond Strength: Minimum [**300 -lbf/sq. ft. (14.36 -kPa)**] <Insert value> cohesive and adhesive strength based on field testing according to ASTM E 736.
 4. Density: Not less than [**15 lb/cu. ft. (240 kg/cu. m)** and] <Insert requirement> as specified in the approved fire-resistance design, according to ASTM E 605.
 5. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E 605, whichever is thicker, but not less than **0.375 inch (9 mm)**.
 6. Combustion Characteristics: ASTM E 136.
 7. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: [**0**] <Insert number> .
 - b. Smoke-Developed Index: [**0**] <Insert number> .
 8. Compressive Strength: Maximum 10% deformation when subjected to [**1200 lbf/sq. in. (8268 kPa)**] <Insert value> according to ASTM E 761.
 9. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
 10. Deflection: No cracking, spalling, or delamination according to ASTM E 759.
 11. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
 12. Air Erosion: Maximum weight loss of [**0.000 g/sq. ft. (0.000 g/sq. m)**] <Insert value> in 24 hours according to ASTM E 859.
 13. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in [**no growth on specimens per ASTM G 21**] .
 14. Sound Absorption: [**NRC**] [or] [**SAA**] of [**0.50 to 0.75**] [**0.60 to 0.70**] [**0.65 to 0.75**] [**not less than 0.60**] <Insert range or single value> according to ASTM C 423 for Type A mounting according to ASTM E 795.
 15. Finish: [**Spray-textured finish**] <Insert requirement>
- D. Exposed Sprayed-On Fireproofing Materials:
1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Grace, W. R. & Co. - Conn.; Grace Construction Products; [**Monokote MK Z-106 Series**].
 - b. <Insert manufacturer>
 - c. or approved equal.
 - 1) Manufacturers not listed, who request approval, shall submit a completed Request for "Or Equal" approval form, contained in Part 1, Instructions to Bidders.

- 2) Listed manufacturers other than the company whose products are specified, W.R. Grace Co., shall submit in addition to requirements of this section, the following:
 - a) Proposed U.L. numbers, W/D calculations.
 - b) A complete description of the process.
 - c) Samples of each product.
 - d) A list of at least three (3) other projects of similar nature to this project where product has been in use.
 - e) Certificate stating that all materials comply with specified requirements, signed by the manufacturer.
 2. Application: Designated for exterior use by a qualified testing agency acceptable to authorities having jurisdiction.
 3. Bond Strength: Minimum **[2000-lbf/sq. ft. (95.76-kPa)] <Insert value>** cohesive and adhesive strength based on field testing according to ASTM E 736.
 4. Density: Not less than **[22 lb/cu. ft. (350 kg/cu. m) and] <Insert requirement>** as specified in the approved fire-resistance design, according to ASTM E 605.
 5. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E 605, whichever is thicker, but not less than **0.375 inch (9 mm)**.
 6. Combustion Characteristics: ASTM E 136.
 7. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: **[0] <Insert number>**.
 - b. Smoke-Developed Index: **[0] <Insert number>** .
 8. Compressive Strength: Maximum 10% deformation when subjected to **[100 lbf/sq. in. (689 kPa)] <Insert value>** according to ASTM E 761.
 9. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
 10. Deflection: No cracking, spalling, or delamination according to ASTM E 759.
 11. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
 12. Air Erosion: Maximum weight loss of **[0.000 g/sq. ft. (0.000 g/sq. m)] <Insert value>** in 24 hours according to ASTM E 859.
 13. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in **[no growth on specimens per ASTM G 21]**.
 14. Sound Absorption: **[NRC] [or] [SAA] of [0.50 to 0.75] [0.60 to 0.70] [0.65 to 0.75] [not less than 0.60] <Insert range or single value>** according to ASTM C 423 for Type A mounting according to ASTM E 795.
 15. Finish: **[Spray-textured finish] <Insert requirement>**.
- E. High-Density Fireproofing for Exposed Columns:
1. General: Exposed steel columns up to full height shall be coated with high-density sprayed-on fireproofing, unless the column is to be encased in concrete as indicated on the Drawings.
 2. Products: Subject to compliance with requirements, provide one of the following:

- a. Grace, W. R. & Co. - Conn.; Grace Construction Products; **[Monokote MK Z-146 Series]**.
 - b. **<Insert Manufacturer>**
 - c. or approved equal.
 - 1) Manufacturers not listed, who request approval, shall submit a completed Request for "Or Equal" approval form, contained in Part 1, Instructions to Bidders.
 - 2) Listed manufacturers other than the company whose products are specified, W.R. Grace Co., shall submit in addition to requirements of this section, the following:
 - a) Proposed U.L. numbers, W/D calculations.
 - b) A complete description of the process.
 - c) Samples of each product.
 - d) A list of at least three (3) other projects of similar nature to this project where product has been in use.
 - e) Certificate stating that all materials comply with specified requirements, signed by the manufacturer.
3. Application: Designated for exterior use by a qualified testing agency acceptable to authorities having jurisdiction.
 4. Bond Strength: Minimum **[10000-lbf/sq. ft. (478.8-kPa)] <Insert value>** cohesive and adhesive strength based on field testing according to ASTM E 736.
 5. Density: Not less than **[40 lb/cu. ft. (636.36 kg/cu. m)] <Insert requirement>** and as specified in the approved fire-resistance design, according to ASTM E 605.
 6. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E 605, whichever is thicker, but not less than **0.375 inch (9 mm)**.
 7. Combustion Characteristics: ASTM E 136.
 8. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: **[0] <Insert number>**.
 - b. Smoke-Developed Index: **[0] <Insert number>** .
9. Compressive Strength: Maximum 10% deformation when subjected to **[500 lbf/sq. in. (3445 kPa)] <Insert value>** according to ASTM E 761.
 10. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
 11. Deflection: No cracking, spalling, or delamination according to ASTM E 759.
 12. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
 13. Air Erosion: Maximum weight loss of **[0.000 g/sq. ft. (0.000 g/sq. m)] <Insert value>** in 24 hours according to ASTM E 859.
 14. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in **[no growth on specimens per ASTM G 21]**.
 15. Sound Absorption: **[NRC] [or] [SAA] of [0.50 to 0.75] [0.60 to 0.70] [0.65 to 0.75] [not less than 0.60] <Insert range or single value>** according to ASTM C 423 for Type A mounting according to ASTM E 795.

16. Finish: **[Spray-textured finish]** <Insert requirement>.

2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
- B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with one or both of the following requirements:
 - 1. Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 2. Primer's bond strength in required fire-resistance design complies with specified bond strength for fireproofing and with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests according to ASTM E 736.
- C. Bonding Agent: Product approved by fireproofing manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.
- D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required, according to fire-resistance designs indicated and fireproofing manufacturer's written recommendations. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive fireproofing.
- E. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by fireproofing manufacturer.
- F. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by fireproofing manufacturer. Include pins and attachment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design. Verify compliance with the following:
 - 1. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other

- foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
2. For steel, sheet metal ducts and other substrates suspected of being coated with oil, rolling compounds or other substances not readily identifiable but potentially capable of impairing bond, conduct tests recommended by fireproofing manufacturer to determine their presence and effect on adhesion of fireproofing.
 3. Objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
 4. Substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.
- B. Do not proceed with installation of fireproofing until unsatisfactory conditions have been corrected.
- C. Verify that concrete work on steel deck has been completed before beginning fireproofing work.
- D. Verify that roof construction, installation of rooftop HVAC equipment, and other related work is complete before beginning fireproofing work.
- E. Conduct tests according to fireproofing manufacturer's written recommendations to verify that substrates are free of substances capable of interfering with bond.
- F. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.
- B. Provide temporary enclosure as required to confine spraying operations, protect the environment, and to ensure adequate ambient conditions for temperature and ventilation.
- C. Clean substrates of substances that could impair bond of fireproofing, including oil, grease, rolling compounds, incompatible primers, and loose mill scale, or any other conditions that may affect proper application of fireproofing materials.
- D. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.
- E. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

- A. Coordinate installation of fireproofing with other work in order to minimize the need for other trades to cut or remove fireproofing. As other trades successively complete installation of their work, maintain protection of structure afforded by fireproofing by patching any areas that have been removed or damaged prior to concealment of fireproofing by other work.
- B. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.
- C. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- D. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
 - 1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
 - 2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.
- E. Metal Decks:
 - 1. Do not apply fireproofing to underside of metal deck substrates until concrete topping, if any, has been completed.
 - 2. Do not apply fireproofing to underside of metal roof deck until roofing has been completed; prohibit roof traffic during application and drying of fireproofing.
- F. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written recommendations for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.
- G. Spray apply fireproofing to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.
- H. Extend fireproofing in full thickness over entire area of each substrate to be protected.
- I. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.
- J. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply fireproofing that differs in color from that of encapsulant over which it is applied.

- K. Where sealers are used, apply products that are tinted to differentiate them from fireproofing over which they are applied.
- L. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.
- M. Cure fireproofing according to fireproofing manufacturer's written recommendations.
- N. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.
- O. Finishes: Where indicated, apply fireproofing to produce the following finishes:
 - 1. Provide a uniform finish complying with description indicated for each type of material and matching DEN Project Manager's sample, or if none, finish approved by DEN Project Manager for field-erected mockup.
 - 2. Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.
 - 3. Spray-Textured Finish: Finish left as spray applied with no further treatment, unless indicated.
 - 4. Use trowel-on only in small areas for patching.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Test and inspect as required by the IBC, 1704.10.
- B. Extent and Testing Methodology: Arrange for testing of completed fireproofing in successive stages in areas of extent described below. Do not proceed with fireproofing of next area until test results for previously completed work evidence compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.
- C. Extent of Each Test Area: Once every 10,000 sq. ft. of floor area, and no less than once per story, whichever produces the greatest number of test areas.
- D. Within each area, testing laboratory shall randomly select a typical bay, and test each fireproofed structural element within it for thickness and density per ASTM E 605.
- E. Within each area, testing laboratory shall randomly select one typical structural element of each type and test fireproofing for cohesion/adhesion per ASTM E 736.
- F. Testing Laboratory shall report test results within 48 hours of test in writing to Contractor and DEN Project Manager.
- G. Fireproofing will be considered defective if it does not pass tests and inspections.

1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

H. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- B. Protect fireproofing, according to advice of manufacturer, from damage resulting from construction operations or other causes, so fireproofing will be without damage or deterioration at time of Substantial Completion.
- C. All patching and repairing of sprayed fireproofing, due to damage by other trades, shall be performed under this section and paid for by the trade(s) responsible for the damage.
- D. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.
- E. Repair fireproofing damaged by other work before concealing it with other construction.
- F. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 078100

SECTION 078200 - BOARD FIREPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Calcium silicate board fire protection.
- 2. Mineral-fiber board fire protection.

- B. Related Sections:

- 1. Section 078100 "Applied Fireproofing" for applied coatings.
- 2. Section 078413 "Penetration Firestopping."
- 3. Section 078446 "Fire-Resistive Joint Systems."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Shop Drawings: Structural framing plans indicating the following:

- 1. Locations and types of surface preparations required before applying board fire protection.
- 2. Extent of board fire protection for each construction and fire-resistance rating, including the following:
 - a. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1) For steel joist assemblies, include applicable fire-resistance design designations, with each steel joist tested with same maximum tensile stress as each steel joist indicated **[on Drawings] [in a schedule]**. Design designations with steel joists tested at lower maximum tensile stress than those indicated are not permitted.
 - b. Minimum thicknesses needed to achieve required fire-resistance ratings of structural components and assemblies.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of board fire protection, from manufacturer.
- B. Research/Evaluation Reports: For board fire protection.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain board fire-protection materials from single source from single manufacturer.
- B. Fire-Resistance Ratings: Indicated by design designations from [**UL's "Fire Resistance Directory"**] [**UL's "Fire Resistance Directory"** or from the listings of another testing and inspecting agency] <Insert testing agency> acceptable to authorities having jurisdiction, for board fireproofing serving as direct-applied protection tested per ASTM E 119.
- C. Mockups: Build mockups to set quality standards for fabrication and installation.
 - 1. Approval of mockups is for other material and construction qualities specifically approved by Architect in writing.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at [**Project site**] <Insert location>.
 - 1. Review methods and procedures related to board fire protection including, but not limited to, the following:
 - a. Structural load limitations.
 - b. Construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.6 COORDINATION

- A. Coordinate installation of board fire protection with other construction specified in other Sections.
 - 1. Do not install board fire protection on structural members until piping and other construction behind fire-resistive materials have been completed, uninterrupted coverage of fire-resistive materials can be provided, and the need for subsequent cutting and patching of fire-resistive materials has been eliminated.
 - 2. Do not install enclosing or concealing construction until after board fire protection has been applied and inspected by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 BOARD FIRE PROTECTION

A. Calcium Silicate Board: Rigid board containing no asbestos and consisting primarily of lime, silica, inert fillers, and cellulosic reinforcing fibers; of thickness required to produce fire-resistance rating indicated; with flame-spread and smoke-developed indexes of zero per ASTM E 84; passing ASTM E 136 for combustion characteristics.

1. Products: Subject to compliance with requirements, **[provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:**

- a. BNZ Materials, Inc.; Marinite I.
- b. IIG, a Calsilite/Johns Manville Joint Venture; Super **[Firetemp L] [Firetemp M]**.
- c. **<Insert manufacturer's name; product name or designation>**.

2. Finish: Sanded finish on **[both sides] [one side]**.

B. Mineral-Fiber Board: **[Unfaced] [Foil-faced] [Fiberglass mat-faced]** rigid board produced by combining slag-wool-/rock-wool fibers with thermosetting resin binders passing ASTM E 136 for combustion characteristics; of thickness required to produce fire-resistance rating indicated.

1. Products: Subject to compliance with requirements, **[provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:**

- a. Albi Manufacturing, Division of StanChem Inc.; DriClad.
- b. Isolatek International, Inc.; Cafco-Board.
- c. **<Insert manufacturer's name; product name or designation>**.

2. Maximum Density: **[8 lb/cu. ft. (128 kg/cu. m)] [10 lb/cu. ft. (160 kg/cu. m)] [12 lb/cu. ft. (192 kg/cu. m)] <Insert value>** per ASTM C 612.

3. Surface-Burning Characteristics: Flame-spread and smoke-developed indexes of **[15] [zero]** and **[5] [zero]**, respectively, per ASTM E 84.

2.2 ACCESSORIES

A. Anchorage Accessories: Provide manufacturer's standard board-anchorage components complying with related design of UL or of another testing and inspecting agency acceptable to authorities having jurisdiction.

B. Joint Treatment and Finishing Materials: For exposed calcium silicate board applications, provide joint treatment tape and joint compounds recommended in writing by board manufacturer for finishing surfaces.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove rust and scale from steel substrates at welded steel stud anchorage locations.

3.2 INSTALLATION

- A. Install board fire protection according to manufacturer's written instructions.
- B. Install board fire protection to comply with requirements for layer thicknesses and number, construction of joints and corners, and anchorage methods applicable to fire-resistance-rated assemblies indicated.
- C. Finish exposed calcium silicate board to comply with board manufacturer's written instructions and as follows:
 - 1. At joints in calcium silicate board, embed tape in joint compound and apply first, fill, and finish coats of joint compounds over tape, fastener heads, and accessories.
 - 2. Apply a thin, uniform skim coat of joint compound over entire surface.
 - 3. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects, tool marks, and ridges.

3.3 PROTECTION

- A. Replace or repair board fire protection that has been cut away to facilitate other construction. Maintain complete coverage of full thickness on members and substrates protected by board fire protection.
 - 1. Provide final protection and maintain conditions in a manner acceptable to Installer, manufacturer, and authorities having jurisdiction to ensure that board fire protection is without damage or deterioration at time of Substantial Completion.

END OF SECTION 078200

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Penetrations in fire-resistance-rated walls.
 - 2. Penetrations in horizontal assemblies.
 - 3. Penetrations in smoke barriers.
- B. Related Sections:
 - 1. Section 078446 "Fire-Resistive Joint Systems" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For penetration firestopping sealants and sealant primers, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit IEQ 4: For penetration firestopping sealants and sealant primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

D. Product Samples for each type of product used.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

C. Manufacturer's Certificate.

D. Certified Test Reports: With product data, submit copies of certified test reports showing compliance with specified performance values, including R-values (aged values for plastic insulations), densities, compression strengths, fire performance characteristics, perm ratings, water absorption ratings, and similar properties.

1. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of penetration firestopping, evidencing full compliance with requirements.

E. Warranty: Submit copy of installer's warranty.

1.5 MAINTENANCE STOCK

A. Provide minimum two (2) gallons of each type of sealant. Store as directed by DEN Project Manager.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

B. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

- C. Installer Certificate: Engage an Installer who has successfully completed within the last 3 years at least three (3) sealer applications similar in type and size to that of this Project and is approved by manufacturer for this type of installation.
- D. Manufacturers Certificate: Not less than five (5) years experience manufacturing types of product specified.
- E. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
 - 1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
 - b. Classification markings on penetration firestopping correspond to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek ETL SEMKO in its "Directory of Listed Building Products."
 - 3) FM Global in its "Building Materials Approval Guide."
 - 4) **<Insert name of qualified testing and inspecting agency>.**
- F. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Engineer] <Insert location>.**
- G. Install all firestopping materials to comply with all applicable authorities and referenced standards, and comply with requirements of the Denver Building Code.
- H. Warranty: Installer to warrant that the firestopping system will provide a permanent installation.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Joint Substrate Conditions: Do not proceed with installation of firestop joint sealers until all contaminants capable of interfering with their adhesion are removed from joint substrates.
- C. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.
- C. Notify <Owner's> testing agency at least seven (7) days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.
- D. CONSTRUCTION WASTE MANAGEMENT
 - 1. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. A/D Fire Protection Systems Inc.
 - 2. Grace Construction Products.
 - 3. Hilti, Inc.
 - 4. Johns Manville.
 - 5. Nelson Firestop Products.
 - 6. NUCO Inc.
 - 7. Passive Fire Protection Partners.
 - 8. RectorSeal Corporation.
 - 9. Specified Technologies Inc.
 - 10. 3M Fire Protection Products.
 - 11. Tremco, Inc.; Tremco Fire Protection Systems Group.
 - 12. USG Corporation.
 - 13. <Insert manufacturer's name>.
 - 14. or approved equal.

2.2 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of **0.01-inch wg** (2.49 Pa).
1. Fire-resistance-rated walls include **[fire walls] [fire-barrier walls] [smoke-barrier walls] [and] [fire partitions]**.
 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of **0.01-inch wg** (2.49 Pa).
1. Horizontal assemblies include **[floors] [floor/ceiling assemblies] [and] [ceiling membranes of roof/ceiling assemblies]**.
 2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
 3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
- D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.
1. L-Rating: Not exceeding **5.0 cfm/sq. ft.** (0.025 cu. m/s per sq. m) of penetration opening at **0.30-inch wg** (74.7 Pa) at both ambient and elevated temperatures.
- E. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.
- F. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- G. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- H. Low-Emitting Materials: Penetration firestopping sealants and sealant primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- I. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-wool-fiber or rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fire-rated form board.
 - d. Fillers for sealants.
2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.3 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.4 FIRESTOPPING INSULATING MATERIALS

- A. General: Provide insulating materials that comply with requirements indicated for materials, compliance with referenced standards, and other characteristics.
- B. Semi-Refractory Fiber Board Safing Insulation: Semi-rigid boards designed for use as a firestop at openings between edge of slab and exterior wall panels at tops of rated walls and as shown, produced by combining semi-refractory mineral fiber manufactured from slag with thermosetting resin binders to comply with ASTM C 612, Class 1 and 2; nominal density of 4.0 lbs. per cu. ft.; passing ASTM E 136 for combustion characteristics; R-value of 4.0 at 75 deg. F (23.9 deg. C), meeting point exceeding 2000 deg. F. Supports to be 26 gauge galvanized steel.
- C. Manufacturers of Semi-Refractory Fiber Insulation:
 1. United States Gypsum Co.
 2. <Insert manufacturer>
 3. or approved equal.

2.5 MIXING

- A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturers' recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.
- C. General Protection: Protect insulations from physical damage and from becoming wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage, and protection during installation.

3.2 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.4 INSTALLATION

- A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.
- C. Install fill materials for firestopping by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and

- penetrating items as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.
- D. At full height fire rated walls: Install firesafing insulation as shown on the drawings at wall head condition and as required to meet Denver Building Code requirements.
- E. Protect all fire safing insulation by installing 22 gage galvanized sheet metal closure at top and bottom, which complies with the DBC for protection of fire safing insulation.
- F. Tool exposed surfaces of mortar or sealants.
- G. At plastic pipes penetrating floors provide a gauge galvanized steel sleeve around pipes, fire stop sealant within sleeve.
- H. At opening between exterior walls and floors/roofs install firesafing insulation per DBC requirements and in accordance with AAMA Tir-A3

3.5 IDENTIFICATION

- A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within **6 inches (150 mm)** of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
- 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing and inspecting agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.6 FIELD QUALITY CONTROL

- A. **<Owner> <Contractor>** will engage a qualified testing agency to perform tests and inspections.
- B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.
- C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

3.7 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

3.8 PENETRATION FIRESTOPPING SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. Where Intertek ETL SEMKO-listed systems are indicated, they refer to design numbers in Intertek ETL SEMKO's "Directory of Listed Building Products" under "Firestop Systems."
- C. Where FM Global-approved systems are indicated, they refer to design numbers listed in FM Global's "Building Materials Approval Guide" under "Wall and Floor Penetration Fire Stops."
- D. Firestopping with No Penetrating Items[**FS-<#>**]:
 - 1. UL-Classified Systems: [**C-AJ-**] [**C-BJ-**] [**F-A-**] [**F-B-**] [**F-C-**] [**W-J-**] [**W-L-**] **<Insert four-digit number> [0001-0999]**.
 - 2. Intertek ETL SEMKO-Listed Systems: **<Insert design numbers>**.
 - 3. FM Global-Approved Systems: **<Insert design numbers>**.
 - 4. F-Rating: [**1 hour**] [**2 hours**] **<Insert number of hours>**.
 - 5. T-Rating: [**1 hour**] [**2 hours**] **<Insert number of hours>**.
 - 6. L-Rating at Ambient: Less than **<Insert cfm/sq. ft. (cu. m/s per sq. m)>**.
 - 7. L-Rating at **400 deg F (204 deg C)**: Less than **<Insert cfm/sq. ft. (cu. m/s per sq. m)>**.
 - 8. W-Rating: No leakage of water at completion of water leakage testing.
 - 9. Type of Fill Materials: [**As required to achieve rating**] **<Insert material>**.
- E. Firestopping for Metallic Pipes, Conduit, or Tubing[**FS-<#>**]:
 - 1. UL-Classified Systems: [**C-AJ-**] [**C-BJ-**] [**C-BK-**] [**F-A-**] [**F-B-**] [**F-C-**] [**F-E-**] [**W-J-**] [**W-K-**] [**W-L-**] [**W-N-**] **<Insert four-digit number> [1001-1999]**.
 - 2. Intertek ETL SEMKO-Listed Systems: **<Insert design number>**.
 - 3. FM Global-Approved Systems: **<Insert design number>**.
 - 4. F-Rating: [**1 hour**] [**2 hours**] **<Insert number of hours>**.
 - 5. T-Rating: [**1 hour**] [**2 hours**] **<Insert number of hours>**.
 - 6. L-Rating at Ambient: Less than **<Insert cfm/sq. ft. (cu. m/s per sq. m)>**.

7. L-Rating at 400 deg F (204 deg C): Less than <Insert cfm/sq. ft. (cu. m/s per sq. m)>.
8. W-Rating: No leakage of water at completion of water leakage testing.
9. Type of Fill Materials: **[As required to achieve rating]** <Insert material>.

F. Firestopping for Nonmetallic Pipe, Conduit, or Tubing[**FS-<#>**]:

1. UL-Classified Systems: [**C-AJ-**] [**C-BJ-**] [**C-BK-**] [**F-A-**] [**F-B-**] [**F-C-**] [**F-E-**] [**W-J-**] [**W-K-**] [**W-L-**] [**W-N-**] <Insert four-digit number> [2001-2999].
2. Intertek ETL SEMKO-Listed Systems: <Insert design number>.
3. FM Global-Approved Systems: <Insert design number>.
4. F-Rating: [1 hour] [2 hours] <Insert number of hours>.
5. T-Rating: [1 hour] [2 hours] <Insert number of hours>.
6. L-Rating at Ambient: Less than <Insert cfm/sq. ft. (cu. m/s per sq. m)>.
7. L-Rating at 400 deg F (204 deg C): Less than <Insert cfm/sq. ft. (cu. m/s per sq. m)>.
8. W-Rating: No leakage of water at completion of water leakage testing.
9. Type of Fill Materials: **[As required to achieve rating]** <Insert material>.

G. Firestopping for Electrical Cables[**FS-<#>**]:

1. UL-Classified Systems: [**C-AJ-**] [**C-BJ-**] [**C-BK-**] [**F-A-**] [**F-B-**] [**F-C-**] [**F-E-**] [**W-J-**] [**W-K-**] [**W-L-**] <Insert four-digit number> [3001-3999].
2. Intertek ETL SEMKO-Listed Systems: <Insert design number>.
3. FM Global-Approved Systems: <Insert design number>.
4. F-Rating: [1 hour] [2 hours] <Insert number of hours>.
5. T-Rating: [1 hour] [2 hours] <Insert number of hours>.
6. L-Rating at Ambient: Less than <Insert cfm/sq. ft. (cu. m/s per sq. m)>.
7. L-Rating at 400 deg F (204 deg C): Less than <Insert cfm/sq. ft. (cu. m/s per sq. m)>.
8. W-Rating: No leakage of water at completion of water leakage testing.
9. Type of Fill Materials: **[As required to achieve rating]** <Insert material>.

H. Firestopping for Cable Trays with Electric Cables[**FS-<#>**]:

1. UL-Classified Systems: [**C-AJ-**] [**C-BJ-**] [**F-A-**] [**F-B-**] [**F-C-**] [**W-J-**] [**W-K-**] [**W-L-**] <Insert four-digit number> [4001-4999].
2. Intertek ETL SEMKO-Listed Systems: <Insert design number>.
3. FM Global-Approved Systems: <Insert design number>.
4. F-Rating: [1 hour] [2 hours] <Insert number of hours>.
5. T-Rating: [1 hour] [2 hours] <Insert number of hours>.
6. L-Rating at Ambient: Less than <Insert cfm/sq. ft. (cu. m/s per sq. m)>.
7. L-Rating at 400 deg F (204 deg C): Less than <Insert cfm/sq. ft. (cu. m/s per sq. m)>.
8. W-Rating: No leakage of water at completion of water leakage testing.
9. Type of Fill Materials: **[As required to achieve rating]** <Insert material>.

I. Firestopping for Insulated Pipes[**FS-<#>**]:

1. UL-Classified Systems: [**C-AJ-**] [**C-BJ-**] [**C-BK-**] [**F-A-**] [**F-B-**] [**F-C-**] [**F-E-**] [**W-J-**]

- [W-L-] [W-N-] <Insert four-digit number> [5001-5999].**
 2. Intertek ETL SEMKO-Listed Systems: **<Insert design number>.**
 3. FM Global-Approved Systems: **<Insert design number>.**
 4. F-Rating: **[1 hour] [2 hours] <Insert number of hours>.**
 5. T-Rating: **[1 hour] [2 hours] <Insert number of hours>.**
 6. L-Rating at Ambient: Less than **<Insert cfm/sq. ft. (cu. m/s per sq. m)>.**
 7. L-Rating at **400 deg F (204 deg C):** Less than **<Insert cfm/sq. ft. (cu. m/s per sq. m)>.**
 8. W-Rating: No leakage of water at completion of water leakage testing.
 9. Type of Fill Materials: **[As required to achieve rating] <Insert material>.**
- J. Firestopping for Miscellaneous Electrical Penetrants[**FS-<#>**]:
1. UL-Classified Systems: **[C-AJ-] [C-BJ-] [F-A-] [W-L-] [W-J-] <Insert four-digit number> [6001-6999].**
 2. Intertek ETL SEMKO-Listed Systems: **<Insert design number>.**
 3. FM Global-Approved Systems: **<Insert design number>.**
 4. F-Rating: **[1 hour] [2 hours] <Insert number of hours>.**
 5. T-Rating: **[1 hour] [2 hours] <Insert number of hours>.**
 6. L-Rating at Ambient: Less than **<Insert cfm/sq. ft. (cu. m/s per sq. m)>.**
 7. L-Rating at **400 deg F (204 deg C):** Less than **<Insert cfm/sq. ft. (cu. m/s per sq. m)>.**
 8. W-Rating: No leakage of water at completion of water leakage testing.
 9. Type of Fill Materials: **[As required to achieve rating] <Insert material>.**
- K. Firestopping for Miscellaneous Mechanical Penetrants[**FS-<#>**]:
1. UL-Classified Systems: **[C-AJ-] [C-BJ-] [F-A-] [F-B-] [F-C-] [F-E-] [W-J-] [W-L-] [W-N-] <Insert four-digit number> [7001-7999].**
 2. Intertek ETL SEMKO-Listed Systems: **<Insert design number>.**
 3. FM Global-Approved Systems: **<Insert design number>.**
 4. F-Rating: **[1 hour] [2 hours] <Insert number of hours>.**
 5. T-Rating: **[1 hour] [2 hours] <Insert number of hours>.**
 6. L-Rating at Ambient: Less than **<Insert cfm/sq. ft. (cu. m/s per sq. m)>.**
 7. L-Rating at **400 deg F (204 deg C):** Less than **<Insert cfm/sq. ft. (cu. m/s per sq. m)>.**
 8. W-Rating: No leakage of water at completion of water leakage testing.
 9. Type of Fill Materials: **[As required to achieve rating] <Insert material>.**
- L. Firestopping for Groupings of Penetrants[**FS-<#>**]:
1. UL-Classified Systems: **[C-AJ-] [C-BJ-] [F-A-] [F-B-] [F-C-] [F-E-] [W-J-] [W-L-] <Insert four-digit number> [8001-8999].**
 2. Intertek ETL SEMKO-Listed Systems: **<Insert design number>.**
 3. FM Global-Approved Systems: **<Insert design number>.**
 4. F-Rating: **[1 hour] [2 hours] <Insert number of hours>.**
 5. T-Rating: **[1 hour] [2 hours] <Insert number of hours>.**
 6. L-Rating at Ambient: Less than **<Insert cfm/sq. ft. (cu. m/s per sq. m)>.**
 7. L-Rating at **400 deg F (204 deg C):** Less than **<Insert cfm/sq. ft. (cu. m/s per sq. m)>.**

8. W-Rating: No leakage of water at completion of water leakage testing.
9. Type of Fill Materials: **[As required to achieve rating] <Insert material>**.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement will be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the lump sum contract price.

END OF SECTION 078413

SECTION 078446 - FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Joints in or between fire-resistance-rated constructions.
 - 2. Joints at exterior curtain-wall/floor intersections.
 - 3. Joints in smoke barriers.
- B. Related Sections:
 - 1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers.
 - 2. Section 079500 "Expansion Control" for fire-resistive architectural joint systems.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated from manufacturers for each joint firestop sealer grout or safing insulation product required, including instructions for joint preparation and joint sealer application and insulation installation instructions.
 - 1. Include data substantiating that materials comply with requirements.
- B. Certified Test Reports: With product data, submit copies of certified test reports showing compliance with specified performance values, including r-values (aged values for plastic insulations), densities, compression strengths, fire performance characteristics, perm ratings, water absorption ratings, and similar properties.
- C. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For fire-resistive joint system sealants, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit IEQ 4: For fire-resistive joint system sealants, documentation indicating that products comply with the testing and product

requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- D. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.
 - 1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- E. Samples of each product to be used.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Installer Certificate: Engage an Installer who has successfully completed within the last three (3) years at least three (3) sealer applications similar in type and size to that of this Project and is approved by manufacturer for this type of installation.
- C. Installer Certificates: From Installer indicating fire-resistive joint systems have been installed in compliance with requirements and manufacturer's written recommendations.
- D. Manufacturer's Certificates: From manufacturers of joint firestop sealers and safing insulation attesting that their products comply with specification requirements and are suitable for the use indicated.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fire-resistive joint systems, evidencing compliance with requirements.
- F. Copy of warranty from Contractor for firestopping system installation.

1.5 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 MAINTENANCE SUBMITTALS

- A. Overstock: Provide minimum two (2) gallons of each type of product used. Store materials as directed by DEN Project Manager.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."
- B. Installer Qualifications: A firm experienced in installing fire-resistive joint systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its fire-resistive joint system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- C. Installer Certificate: Engage an Installer who has successfully completed within the last three (3) years at least three (3) sealer applications similar in type and size to that of this Project and is approved by manufacturer(s) for this type of installation.
- D. Manufacturers Certificate: Not less than five (5) years experience manufacturing types of product specified.
- E. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:
1. Fire-resistive joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 2. Fire-resistive joint systems are identical to those tested per testing standard referenced in "Fire-Resistive Joint Systems" Article. Provide rated systems complying with the following requirements:
 - a. Fire-resistive joint system products bear classification marking of qualified testing agency.
 - b. Fire-resistive joint systems correspond to those indicated by reference to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek ETL SEMKO in its "Directory of Listed Building Products."
 - 3) **<Insert name of qualified testing agency>**.
 3. Install firestopping materials to comply with the following:
 - a. Openings between walls and connecting floors shall be per ASTM E 119 and comply with Underwriters Laboratories designs J-900 and U-900.
 - b. Openings around all pipes, ductwork, conduit, or similar penetrating a rated wall, floor or roof assembly shall comply with ASTM E 814.
 - c. Head of wall firestopping at fire rated full height partitions shall comply with ASTM E 119.
 - d. The current Denver Building Code.
- F. Preinstallation Conference: Conduct conference at **[Project site] [location and time]**

as determined by DEN Project Manager]<Insert location>.

1. Pre-installation conference to be attended by installer, contractor, DEN Project Manager, and representatives from affected trades.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturers' recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.
- C. General Protection: Protect insulations from physical damage and from becoming wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage, and protection during installation.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure fire-resistive joint systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.
- C. Joint Substrate Conditions: Do not proceed with installation of firestop joint sealers until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.10 COORDINATION

- A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.
- B. Coordinate sizing of joints to accommodate fire-resistive joint systems.
- C. Notify Owner's testing agency at least seven (7) days in advance of fire-resistive joint system installations; confirm dates and times on day preceding each series of installations.

1.11 WARRANTY

- A. Installer to warrant that the firestopping system will provide a permanent installation.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 FIRE-RESISTIVE JOINT SYSTEMS

- A. Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079:
1. Joints include those installed in or between fire-resistance-rated **[walls] [floor or floor/ceiling assemblies] [and] [roofs or roof/ceiling assemblies]**.
 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.
 3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A/D Fire Protection Systems Inc.
 - b. CEMCO.
 - c. Fire Trak Corp.
 - d. Grace Construction Products.
 - e. Hilti, Inc.
 - f. Johns Manville.
 - g. Nelson Firestop Products.
 - h. NUCO Inc.
 - i. Passive Fire Protection Partners.
 - j. RectorSeal Corporation.
 - k. Specified Technologies Inc.
 - l. 3M Fire Protection Products.
 - m. Tremco, Inc.; Tremco Fire Protection Systems Group.
 - n. USG Corporation.
 - o. **<Insert manufacturer's name>**.
 - p. or approved equal.
- C. Joints at Exterior Curtain-Wall/Floor Intersections: Provide fire-resistive joint systems with rating determined by ASTM E 119 based on testing at a positive pressure differential of **0.01-inch wg** (2.49 Pa) or ASTM E 2307.

1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A/D Fire Protection Systems Inc.
 - b. Grace Construction Products.
 - c. Hilti, Inc.
 - d. Johns Manville.
 - e. Nelson Firestop Products.
 - f. NUCO Inc.
 - g. Passive Fire Protection Partners.
 - h. RectorSeal Corporation.
 - i. Specified Technologies Inc.
 - j. 3M Fire Protection Products.
 - k. Thermafiber, Inc.
 - l. Tremco, Inc.; Tremco Fire Protection Systems Group.
 - m. USG Corporation.
 - n. **<Insert manufacturer's name>**.
 - o. or approved equal.
- D. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079.
1. L-Rating: Not exceeding **5.0 cfm/ft** (0.00775 cu. m/s x m) of joint at **0.30 inch wg** (74.7 Pa) at both ambient and elevated temperatures.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A/D Fire Protection Systems Inc.
 - b. Grace Construction Products.
 - c. Hilti, Inc.
 - d. Johns Manville.
 - e. Nelson Firestop Products.
 - f. NUCO Inc.
 - g. Passive Fire Protection Partners.
 - h. RectorSeal Corporation.
 - i. Specified Technologies Inc.
 - j. 3M Fire Protection Products.
 - k. Tremco, Inc.; Tremco Fire Protection Systems Group.
 - l. USG Corporation.
 - m. **<Insert manufacturer's name>**.
 - n. or approved equal.
- E. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

- F. VOC Content: Fire-resistive joint system sealants shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Architectural Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- G. Low-Emitting Materials: Fire-resistive joint system sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- H. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials, including dust, paints, except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer; old joint sealers, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation by vacuuming or blowing out joints with oil-free compressed air.
 3. Remove laitance and form-release agents from concrete.
 4. Clean concrete, masonry, unglazed surfaces of ceramic tile and similar porous joint substrate surfaces, by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealers.

- B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated, except where more stringent requirements apply.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply fill materials so they contact and adhere to substrates formed by joints.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.
- D. At Full Height Fire Rated Walls: Install firesafing insulation as shown on the drawings at wall head condition and as required to meet Denver Building Code (DBC) requirements.
- E. Protect all fire safing insulation by installing 22 gage galvanized sheet metal closure at top and bottom, which complies with the DBC for protection of fire safing insulation.
- F. Tool exposed surfaces of mortar or sealants.
- G. At plastic pipes penetrating floors provide a gauge galvanized steel sleeve around pipes, fire stop sealant within sleeve.
- H. At opening between exterior walls and floors/roofs install firesafing insulation per DBC requirements and in accordance with AAMA Tir-A3.

3.4 IDENTIFICATION

- A. Identify fire-resistive joint systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within **6 inches (150 mm)** of joint edge so labels will be visible to anyone seeking to remove or penetrate joint system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
1. The words "Warning - Fire-Resistive Joint System - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Where deficiencies are found or fire-resistive joint systems are damaged or removed due to testing, repair or replace fire-resistive joint systems so they comply with requirements.
- C. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.7 FIRE-RESISTIVE JOINT SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product [**Category XHBN**] [or] [**Category XHDG**].

- B. Where Intertek ETL SEMKO-listed systems are indicated, they refer to design numbers in Intertek ETL SEMKO's "Directory of Listed Building Products" under product category [**Expansion/Seismic Joints**] [or] [**Firestop Systems**].
- C. Floor-to-Floor, Fire-Resistive Joint Systems[**FRJS-<#>**]:
1. UL-Classified Systems: FF-[**D**] [**S**]-<Insert four-digit number> [0000-0999] [1000-1999] [2000-2999] [3000-3999] [4000-4999].
 2. Assembly Rating: [1 hour] [2 hours] <Insert number of hours>.
 3. Nominal Joint Width: [As indicated] <Insert dimension>.
 4. Movement Capabilities: [**Class I**] [**Class II**] [**Class III**] - <Insert number> percent [**compression or extension**] [compression, extension, or horizontal shear].
 5. L-Rating at Ambient: Less than <Insert cfm/ft. (cu. m/s x m)>.
 6. L-Rating at 400 deg F (204 deg C): Less than <Insert cfm/ft. (cu. m/s x m)>.
 7. W-Rating: No leakage of water at completion of water leakage testing.
- D. Wall-to-Wall, Fire-Resistive Joint Systems[**FRJS-<#>**]:
1. UL-Classified Systems: WW-[**D**] [**S**]-<Insert four-digit number> [0000-0999] [1000-1999] [2000-2999] [3000-3999] [4000-4999].
 2. Assembly Rating: [1 hour] [2 hours] <Insert number of hours>.
 3. Nominal Joint Width: [As indicated] <Insert dimension>.
 4. Movement Capabilities: [**Class I**] [**Class II**] [**Class III**] - <Insert number> percent[**compression or extension**].
 5. L-Rating at Ambient: Less than <Insert cfm/ft. (cu. m/s x m)>.
 6. L-Rating at 400 deg F (204 deg C): Less than <Insert cfm/ft. (cu. m/s x m)>.
- E. Floor-to-Wall, Fire-Resistive Joint Systems[**FRJS-<#>**]:
1. UL-Classified Systems: FW-[**D**] [**S**]-<Insert four-digit number> [0000-0999] [1000-1999] [2000-2999] [3000-3999] [4000-4999].
 2. Assembly Rating: [1 hour] [2 hours] <Insert number of hours>.
 3. Nominal Joint Width: [As indicated] <Insert dimension>.
 4. Movement Capabilities: [**Class I**] [**Class II**] [**Class III**] - <Insert number> percent [**compression or extension**] [compression, extension, or horizontal shear].
 5. L-Rating at Ambient: Less than <Insert cfm/ft. (cu. m/s x m)>.
 6. L-Rating at 400 deg F (204 deg C): Less than <Insert cfm/ft. (cu. m/s x m)>.
- F. Head-of-Wall, Fire-Resistive Joint Systems[**FRJS-<#>**]:
1. UL-Classified Systems: HW-[**D**] [**S**]-<Insert four-digit number> [0000-0999] [1000-1999] [2000-2999] [3000-3999] [4000-4999].
 2. Intertek ETL SEMKO-Listed Systems: <Insert design number>.
 3. Assembly Rating: [1 hour] [2 hours] <Insert number of hours>.
 4. Nominal Joint Width: [As indicated] <Insert dimension>.
 5. Movement Capabilities: [**Class I**] [**Class II**] [**Class III**] - <Insert number> percent[**compression or extension**].
 6. L-Rating at Ambient: Less than <Insert cfm/ft. (cu. m/s x m)>.
 7. L-Rating at 400 deg F (204 deg C): Less than <Insert cfm/ft. (cu. m/s x m)>.

- G. Bottom-of-Wall, Fire-Resistive Joint Systems[**FRJS-<#>**]:
1. UL-Classified Systems: BW-[D] [S]-<Insert four-digit number> [0000-0999] [1000-1999] [2000-2999] [3000-3999] [4000-4999].
 2. Assembly Rating: [1 hour] [2 hours] <Insert number of hours>.
 3. Nominal Joint Width: [As indicated] <Insert dimension>.
 4. Movement Capabilities: [Class I] [Class II] [Class III] - <Insert number> percent[**compression or extension**].
 5. L-Rating at Ambient: Less than <Insert cfm/ft. (cu. m/s x m)>.
 6. L-Rating at 400 deg F (204 deg C): Less than <Insert cfm/ft. (cu. m/s x m)>.
- H. Wall-to-Wall, Fire-Resistive Joint Systems Intended for Use as Corner Guards[**FRJS-<#>**]:
1. UL-Classified Systems: CG-[D] [S]-<Insert four-digit number> [0000-0999] [1000-1999] [2000-2999] [3000-3999] [4000-4999].
 2. Assembly Rating: [1 hour] [2 hours] <Insert number of hours>.
 3. Nominal Joint Width: [As indicated] <Insert dimension>.
 4. Movement Capabilities: [Class I] [Class II] [Class III] - <Insert number> percent[**compression or extension**].
 5. L-Rating at Ambient: Less than <Insert cfm/ft. (cu. m/s x m)>.
 6. L-Rating at 400 deg F (204 deg C): Less than <Insert cfm/ft. (cu. m/s x m)>.
- I. Perimeter Fire-Resistive Joint Systems[**PFRJS-<#>**]:
1. UL-Classified Perimeter Fire-Containment Systems: CW-[D] [S]-<Insert four-digit number> [0000-0999] [1000-1999] [2000-2999].
 2. Intertek ETL SEMKO-Listed, Perimeter Fire-Barrier Systems: <Insert design number>.
 3. Integrity Rating: [1 hour] [2 hours] <Insert number of hours>.
 4. Insulation Rating: [0 hour] [1/4 hour] [3/4 hour] [1 hour] <Insert number of hours>.
 5. Linear Opening Width: [2-1/2 inches (63 mm)] [8 inches (203 mm)] [As indicated] <Insert dimension>, maximum.
 6. Movement Capabilities: [Class I] [Class II] [Class III] - <Insert number> percent[**compression or extension**].
 7. L-Rating at Ambient Temperature: Less than <Insert cfm/ft. (cu. m/s x m)>.
 8. L-Rating at 400 deg F (204 deg C): Less than <Insert cfm/ft. (cu. m/s x m)>.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 078446

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Polysulfide joint sealants.
4. Latex joint sealants.
5. Solvent-release-curing joint sealants.
6. Preformed joint sealants.
7. Acoustical joint sealants.

B. Related Sections:

1. Section 042000 "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
2. Section 079500 "Expansion Control" for building expansion joints.
3. Section 078446 "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
4. Section 084423 "Structural-Sealant-Glazed Curtain Walls" for structural and other glazing sealants.
5. Section 088000 "Glazing" for glazing sealants.
6. Section 088400 "Plastic Glazing" for plastic glazing sealants.
7. Section 092613 "Gypsum Veneer Plastering" for sealing perimeter joints and penetrations.
8. Section 092900 "Gypsum Board" for sealing perimeter joints.
9. Section 093000 "Tiling" for sealing tile joints.
10. **[Section 095113 "Acoustical Panel Ceilings"] [and] [Section 095123 "Acoustical Tile Ceilings"]** for sealing edge moldings at perimeters with acoustical sealant.
11. Section 321373 "Concrete Paving Joint Sealants" for sealing joints in pavements, walkways, and curbing.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
1. Use **[ASTM C 1087]** [**manufacturer's standard test method**] to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 2. Submit not fewer than **[eight (8)]** <Insert number> pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
 5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints where indicated on Project or, if not indicated, as directed by DEN Project Manager.
 2. Conduct field tests for each application indicated below:
 - a. Each kind of sealant and joint substrate indicated.
 3. Notify DEN Project Manager seven (7) days in advance of dates and times when test joints will be erected.
 4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
 - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
 6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of

noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

1.5 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
1. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, documentation including printed statement of VOC content.
 2. Laboratory Test Reports for Credit IEQ 4: For sealants and sealant primers used inside the weatherproofing system, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- D. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in **1/2-inch-** (13-mm-) wide joints formed between two **6-inch-** (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- E. Joint-Sealant Schedule: Include the following information:
1. Joint-sealant application, joint location, and designation.
 2. Joint-sealant manufacturer and product name.
 3. Joint-sealant formulation.
 4. Joint-sealant color.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified [**Installer**] [**and**] [**testing agency**].
- B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- C. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.

- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
 - E. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
 - F. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
 - G. Field-Adhesion Test Reports: For each sealant application tested.
 - H. Warranties: Sample of special warranties.
- 1.7 CLOSEOUT SUBMITTALS
- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
 - B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.
- 1.9 QUALITY ASSURANCE
- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
 - B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
 - C. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
- D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.
- E. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>**.

1.10 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer **[or are below 40 deg F (5 deg C)]**.
 2. When joint substrates are wet.
 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.11 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Minimum **[two (2)] <Insert number>** years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Minimum **[twenty (20)] <Insert number>** years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 3. Mechanical damage caused by individuals, tools, or other outside agents.

4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 1. Architectural Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Low-Emitting Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- E. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- F. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

- G. Colors of Exposed Joint Sealants: **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's samples]** **[As selected by DEN Project Manager from manufacturer's full range]**.

2.2 SILICONE JOINT SEALANTS

- A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; **[790]** **[NS Parking Structure Sealant]**.
 - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
 - c. May National Associates, Inc.; **[Bondaflex Sil 290]** **[Bondaflex Sil 728 NS]**.
 - d. Pecora Corporation; **[301 NS]** **[311 NS]** **[890]** **[890FTS]**.
 - e. Sika Corporation, Construction Products Division; SikaSil-C990.
 - f. Tremco Incorporated; **[Spectrem 1]** **[Spectrem 800]**.
 - g. **<Insert manufacturer's name; product>**.
 - h. or approved equal.

- B. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Omniseal 50.
 - b. Dow Corning Corporation; **[756 SMS]** **[791]** **[795]** **[995]**.
 - c. GE Advanced Materials - Silicones; **[SilGlaze II SCS2800]** **[SilPruf NB SCS9000]** **[SilPruf SCS2000]** **[UltraPruf II SCS2900]**.
 - d. May National Associates, Inc.; Bondaflex Sil 295.
 - e. Pecora Corporation; **[864]** **[895]** **[898]**.
 - f. Polymeric Systems, Inc.; PSI-641.
 - g. Sika Corporation, Construction Products Division; SikaSil-C995.
 - h. Tremco Incorporated; **[Spectrem 2]** **[Spectrem 3]**.
 - i. **<Insert manufacturer's name; product>**.
 - j. or approved equal.

- C. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 799.
 - b. GE Advanced Materials - Silicones; **[UltraGlaze SSG4000]** **[UltraGlaze SSG4000AC]**.
 - c. May National Associates, Inc.; **[Bondaflex Sil 200 GPN]** **[Bondaflex Sil 201 FC]**.
 - d. Polymeric Systems, Inc.; PSI-631.

- e. Schnee-Morehead, Inc.; SM5731 Poly-Glaze Plus.
 - f. Tremco Incorporated; [**Proglaze SSG**] [**Tremsil 600**].
 - g. <Insert manufacturer's name; product>.
 - h. or approved equal.
- D. Single-Component, Nonsag, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Bostik, Inc.; Chem-Calk 1200.
 - b. Dow Corning Corporation; 999-A.
 - c. GE Advanced Materials - Silicones; [**Contractors SCS1000**] [**Construction SCS1200**].
 - d. May National Associates, Inc.; [**Sil 100 GC**] [**Sil 100 GP**] [**Sil 100 WF**].
 - e. Pecora Corporation; 860.
 - f. Polymeric Systems, Inc.; PSI-601.
 - g. Schnee-Morehead, Inc.; SM5732 Polyglaze.
 - h. Tremco Incorporated; [**Proglaze**] [**Tremsil 200**].
 - i. <Insert manufacturer's name; product>.
 - j. or approved equal.
- E. Single-Component, Nonsag, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use T.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; [**790**] [**NS Parking Structure Sealant**].
 - b. May National Associates, Inc.; Bondaflex Sil 728 NS.
 - c. Pecora Corporation; [**301 NS**] [**311 NS**].
 - d. Tremco Incorporated; Spectrem 800.
 - e. <Insert manufacturer's name; product>.
 - f. or approved equal.
- F. Single-Component, Pourable, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade P, Class 100/50, for Use T.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; [**890-SL**] [**SL Parking Structure Sealant**].
 - b. May National Associates, Inc.; Bondaflex [**Sil 728 SG**] [**Sil 728 SL**].
 - c. Pecora Corporation; [**300 SL**] [**310 SL**].
 - d. Tremco Incorporated; Spectrem 900 SL.
 - e. <Insert manufacturer's name; product>.
 - f. or approved equal.
- G. Multicomponent, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type M, Grade NS, Class 50, for Use NT.
- 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Tremco Incorporated; Spectrem 4TS.
 - b. **<Insert manufacturer's name; product>**.
 - c. or approved equal.

- H. Multicomponent, Pourable, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type M, Grade P, Class 100/50, for Use T.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; FC Parking Structure Sealant.
 - b. May National Associates, Inc.; Bondaflex Sil 728 RCS.
 - c. **<Insert manufacturer's name; product>**.
 - d. or approved equal.

- I. Mildew-Resistant, Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pecora Corporation; 898.
 - b. **<Insert manufacturer's name; product>**.
 - c. or approved equal.

- J. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Omniplus.
 - b. Dow Corning Corporation; 786 Mildew Resistant.
 - c. GE Advanced Materials - Silicones; Sanitary SCS1700.
 - d. May National Associates, Inc.; Bondaflex Sil 100 WF.
 - e. Tremco Incorporated; Tremsil 200 Sanitary.
 - f. **<Insert manufacturer's name; product>**.
 - g. or approved equal.

2.3 URETHANE JOINT SEALANTS

- A. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Sika Corporation, Construction Products Division; Sikaflex - 15LM.
 - b. Tremco Incorporated; **[Vulkem 921] [Dymonic FC]**.
 - c. **<Insert manufacturer's name; product>**.
 - d. or approved equal.

- B. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pacific Polymers International, Inc.; Elasto-Thane 230 LM Type II.
 - b. Polymeric Systems, Inc.; PSI-901.
 - c. <Insert manufacturer's name; product>.
 - d. or approved equal.

- C. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; [**Sonolastic NP1**] [**Sonolastic TX1**] [**Sonolastic Ultra**].
 - b. Bostik, Inc.; Chem-Calk [**900**] [**915**] [**916 Textured**].
 - c. May National Associates, Inc.; [**Bondaflex PUR 25**] [**Bondaflex PUR 25 Textured**] [**Bondaflex PUR 40 FC**].
 - d. Pacific Polymers International, Inc.; Elasto-Thane 230 Type II.
 - e. Pecora Corporation; Dynatrol I-XL.
 - f. Polymeric Systems, Inc.; Flexiprene 1000.
 - g. Schnee-Morehead, Inc.; [**Permathane SM7100**] [**Permathane SM7108**] [**Permathane SM7110**].
 - h. Sika Corporation, Construction Products Division; Sikaflex - 1a.
 - i. Tremco Incorporated; [**Dymonic**] [**Vulkem 116**].
 - j. <Insert manufacturer's name; product>.
 - k. or approved equal.

- D. Single-Component, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use T.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; [**Sonolastic NP1**] [**Sonolastic Ultra**].
 - b. May National Associates, Inc.; Bondaflex PUR 40 FC.
 - c. Pacific Polymers International, Inc.; Elasto-Thane 230 Type II.
 - d. Sika Corporation, Construction Products Division; Sikaflex - 1a.
 - e. Tremco Incorporated; Vulkem 116.
 - f. <Insert manufacturer's name; product>.
 - g. or approved equal.

- E. Single-Component, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type S, Grade P, Class 25, for Use T.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Sonolastic SL 1.
 - b. Bostik, Inc.; Chem-Calk 950.
 - c. May National Associates, Inc.; Bondaflex PUR 35 SL.
 - d. Pecora Corporation; Urexpan NR-201.
 - e. Polymeric Systems, Inc.; Flexiprene 952.

- f. Schnee-Morehead, Inc.; Permthane SM7101.
 - g. Sika Corporation. Construction Products Division; Sikaflex - 1CSL.
 - h. Tremco Incorporated; Vulkem 45.
 - i. <Insert manufacturer's name; product>.
 - j. or approved equal.

- F. Multicomponent, Nonsag, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 50, for Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pecora Corporation; Dynatrol II.
 - b. Polymeric Systems, Inc.; PSI-270.
 - c. Tremco Incorporated; [Dymeric 240] [Dymeric 240 FC].
 - d. <Insert manufacturer's name; product>.
 - e. or approved equal.

- G. Multicomponent, Nonsag, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Sonolastic NP 2.
 - b. Bostik, Inc.; Chem-Calk 500.
 - c. May National Associates, Inc.; Bondaflex PUR 2 NS.
 - d. Pacific Polymers International, Inc.; [Elasto-Thane 227 High Shore Type II] [Elasto-Thane 227 R Type II] [Elasto-Thane 227 Type II].
 - e. Pecora Corporation; Dynatred.
 - f. Sika Corporation, Construction Products Division; [Sikaflex - 2c NS] [Sikaflex - 2c EZ Mix].
 - g. Tremco Incorporated; Vulkem 227.
 - h. <Insert manufacturer's name; product>.
 - i. or approved equal.

- H. Multicomponent, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 50, for Use T.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Polymeric Systems, Inc.; PSI-270.
 - b. Tremco Incorporated; Dymeric 240 FC.
 - c. <Insert manufacturer's name; product>.
 - d. or approved equal.

- I. Multicomponent, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use T.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Sonolastic NP 2.

- b. LymTal International, Inc.; Iso-Flex 885 SG.
 - c. May National Associates, Inc.; Bondaflex PUR 2 NS.
 - d. Pacific Polymers International, Inc.; [**Elasto-Thane 227 High Shore Type II**] [**Elasto-Thane 227 Type II**].
 - e. Pecora Corporation; Dynatred.
 - f. Sika Corporation, Construction Products Division; [**Sikaflex - 2c NS**] [**Sikaflex - 2c EZ Mix**].
 - g. Tremco Incorporated; Vulkem 227.
 - h. **<Insert manufacturer's name; product>**.
 - i. or approved equal.
- J. Immersible, Single-Component, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Uses T and I.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Sonolastic NP1.
 - b. Sika Corporation, Construction Products Division; Sikaflex - 1a.
 - c. Tremco Incorporated; Vulkem 116.
 - d. **<Insert manufacturer's name; product>**.
 - e. or approved equal.
- K. Immersible, Single-Component, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type S, Grade P, Class 25, for Uses T and I.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Sika Corporation, Construction Products Division; Sikaflex - 1CSL.
 - b. Tremco Incorporated; Vulkem 45.
 - c. **<Insert manufacturer's name; product>**.
 - d. or approved equal.
- L. Immersible Multicomponent, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Uses T and I.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Sonolastic NP 2.
 - b. LymTal International, Inc.; Iso-Flex 885 SG.
 - c. May National Associates, Inc.; Bondaflex PUR 2 NS.
 - d. Pecora Corporation; Dynatred.
 - e. Tremco Incorporated; Vulkem 227.
 - f. **<Insert manufacturer's name; product>**.
 - g. or approved equal.
- M. Immersible Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type M, Grade P, Class 25, for Use T and I.
- 1. Products: Subject to compliance with requirements, provide one of the following:

- a. LymTal International, Inc.; Iso-Flex 880 GB.
- b. May National Associates, Inc.; Bondaflex PUR 2 SL.
- c. Tremco Incorporated; Vulkem 245.
- d. **<Insert manufacturer's name; product>**.
- e. or approved equal.

2.4 POLYSULFIDE JOINT SEALANTS

- A. Single-Component, Nonsag, Polysulfide Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pacific Polymers International, Inc.; Elastoseal 230 Type I.
 - b. W. R. Meadows, Inc.; Deck-O-Seal One Step.
 - c. **<Insert manufacturer's name; product>**.
 - d. or approved equal.
- B. Multicomponent, Nonsag, Polysulfide Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use NT.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Sonolastic Polysulfide Sealant.
 - b. Pacific Polymers International, Inc.; Elasto-Seal 227 Type II.
 - c. Pecora Corporation; Synthacalk GC-2+.
 - d. W. R. Meadows, Inc.; Deck-O-Seal Gun Grade.
 - e. **<Insert manufacturer's name; product>**.
 - f. or approved equal.
- C. Multicomponent, Nonsag, Traffic-Grade, Polysulfide Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use T.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Sonolastic Polysulfide Sealant.
 - b. Pecora Corporation; Synthacalk GC-2+.
 - c. **<Insert manufacturer's name; product>**.
 - d. or approved equal.
- D. Multicomponent, Pourable, Traffic-Grade, Polysulfide Joint Sealant: ASTM C 920, Type M, Grade P, Class 25, for Use T.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pacific Polymers International, Inc.; Elastoseal 227 Type I.
 - b. W. R. Meadows, Inc.; [**Deck-O-Seal 125**] [**Deck-O-Seal 150**].
 - c. **<Insert manufacturer's name; product>**.
 - d. or approved equal.

- E. Immersible, Multicomponent Nonsag, Traffic-Grade, Polysulfide Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use T and Use I.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pecora Corporation; Synthacalk GC-2+.
 - b. **<Insert manufacturer's name; product>**.
 - c. or approved equal.

2.5 LATEX JOINT SEALANTS

- A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Sonolac.
 - b. Bostik, Inc.; Chem-Calk 600.
 - c. May National Associates, Inc.; [**Bondaflex 600**] [**Bondaflex Sil-A 700**].
 - d. Pecora Corporation; AC-20+.
 - e. Schnee-Morehead, Inc.; SM 8200.
 - f. Tremco Incorporated; Tremflex 834.
 - g. **<Insert manufacturer's name; product>**.
 - h. or approved equal.

2.6 SOLVENT-RELEASE-CURING JOINT SEALANTS

- A. Acrylic-Based Joint Sealant: ASTM C 1311.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Schnee-Morehead, Inc.; Acryl-R Acrylic Sealant.
 - b. Tremco Incorporated; Mono 555.
 - c. **<Insert manufacturer's name; product>**.
 - d. or approved equal.
- B. Butyl-Rubber-Based Joint Sealant: ASTM C 1311.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Bostik, Inc.; Chem-Calk 300.
 - b. Pecora Corporation; BC-158.
 - c. Tremco Incorporated; Tremco Butyl Sealant.
 - d. **<Insert manufacturer's name; product>**.
 - e. or approved equal.

2.7 PREFORMED JOINT SEALANTS

- A. Preformed Silicone Joint Sealants: Manufacturer's standard sealant consisting of precured low-modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral-curing silicone sealant for bonding extrusions to substrates.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Dow Corning Corporation; 123 Silicone Seal.
- b. GE Advanced Materials - Silicones; UltraSpan US1100.
- c. May National Associates, Inc.; Bondaflex Silbridge 300.
- d. Pecora Corporation; Sil-Span.
- e. Sealex, Inc.; ImmerSeal.
- f. **<Insert manufacturer's name; product>**.
- g. or approved equal.

- B. Preformed Foam Joint Sealant: Manufacturer's standard preformed, precompressed, open-cell foam sealant manufactured from urethane foam with minimum density of **10 lb/cu. ft.** (160 kg/cu. m) and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit joint widths indicated; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Dayton Superior Specialty Chemicals; Polytite Standard.
- b. EMSEAL Joint Systems, Ltd.; Emseal 25V.
- c. Sandell Manufacturing Co., Inc.; Polyseal.
- d. Schul International, Inc.; **[Sealtite] [Sealtite 50N]**.
- e. Willseal USA, LLC; **[Willseal 150] [Willseal 250]**.
- f. **<Insert manufacturer's name; product>**.
- g. or approved equal.

2.8 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Pecora Corporation; **[AC-20 FTR] [AIS-919]**.
- b. USG Corporation; SHEETROCK Acoustical Sealant.
- c. **<Insert manufacturer's name; product>**.
- d. or approved equal.

2.9 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, [**Type C (closed-cell material with a surface skin)**] [**Type O (open-cell material)**] [**Type B (bicellular material with a surface skin)**] [**or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated**], and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.10 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following

requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - d. Exterior insulation and finish systems (EIFS).
 - e. **<Insert other porous joint substrate>**.
 3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
 - e. **<Insert other nonporous joint substrate>**.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.
- ### 3.3 INSTALLATION OF JOINT SEALANTS
- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
 - B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
 4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
- G. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:
1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
 2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's written instructions and covering a bonding area of not less than **3/8 inch** (10 mm). Hold edge of sealant bead **1/4 inch** (6 mm) inside masking tape.
 3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.

4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.

H. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.

I. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall engage a qualified independent testing and inspecting agency acceptable to the Owner to perform field tests and inspections, and prepare reports.

B. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

- a. Perform [10] <Insert number> tests for the first [1000 feet (300 m)] <Insert dimension> of joint length for each kind of sealant and joint substrate.
- b. Perform 1 test for each [1000 feet (300 m)] <Insert dimension> of joint length thereafter or 1 test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

- a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:

- a. Whether sealants filled joint cavities and are free of voids.
- b. Whether sealant dimensions and configurations comply with specified requirements.
- c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- C. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces[<JS-#>].
1. Joint Locations:
 - a. Control and expansion joints in brick pavers.
 - b. Isolation and contraction joints in cast-in-place concrete slabs.
 - c. Joints between plant-precaster architectural concrete paving units.
 - d. Joints in stone paving units[, **including steps**].
 - e. Tile control and expansion joints.
 - f. Joints between different materials listed above.
 - g. **<Insert other joints>**.
 - h. Other joints as indicated.
 2. Silicone Joint Sealant: [**Single component, nonsag, traffic grade, neutral curing**] [**Single component, pourable, traffic grade, neutral curing**] [**Multicomponent, pourable, traffic grade, neutral curing**].

3. Urethane Joint Sealant: [**Single component, nonsag, traffic grade**] [**Single component, pourable, traffic grade**] [**Multicomponent, nonsag, traffic grade, Class 50**] [**Multicomponent, nonsag, traffic grade, Class 25**].
 4. Polysulfide Joint Sealant: [**Multicomponent, nonsag, traffic grade**] [**Multicomponent, pourable, traffic grade**].
 5. Preformed Joint Sealant: Preformed foam sealant.
 6. Joint Sealant: <Insert joint sealant>.
 7. Joint-Sealant Color: [**As selected by DEN Project Manager** from manufacturer's full range of colors] <Insert color>.
- B. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces subject to water immersion[<JS-#>].
1. Joint Locations:
 - a. Joints in pedestrian plazas.
 - b. Joints in swimming pool decks.
 - c. <Insert other joints>.
 - d. Other joints as indicated.
 2. Urethane Joint Sealant: [**Immersible, single component, nonsag, traffic grade**] [**Immersible, single component, pourable, traffic grade**] [**Immersible, multicomponent, nonsag, traffic grade**] [**Immersible, multicomponent, pourable, traffic grade**].
 3. Polysulfide Joint Sealant: Immersible, multicomponent, nonsag, traffic grade.
 4. Joint Sealant: <Insert joint sealant>.
 5. Joint-Sealant Color: [**As selected by DEN Project Manager** from manufacturer's full range of colors] <Insert color>.
- C. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces[<JS-#>].
1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Joints between plant-precaster architectural concrete units.
 - c. Control and expansion joints in unit masonry.
 - d. Joints in dimension stone cladding.
 - e. Joints in glass unit masonry assemblies.
 - f. Joints in exterior insulation and finish systems.
 - g. Joints between metal panels.
 - h. Joints between different materials listed above.
 - i. Perimeter joints between materials listed above and frames of [**doors**] [**windows**] [**and**] [**louvers**].
 - j. Control and expansion joints in [**ceilings**] [**and other**] [**overhead surfaces**].
 - k. <Insert other joints>.
 - l. Other joints as indicated.
 2. Silicone Joint Sealant: [**Single component, nonsag, neutral curing, Class**

- 100/50] [Single component, nonsag, neutral curing, Class 50] [Single component, nonsag, neutral curing, Class 25] [Single component, nonsag, acid curing] [Multicomponent, nonsag, neutral curing].**
3. Urethane Joint Sealant: **[Single component, nonsag, Class 100/50] [Single component, nonsag, Class 50] [Single component, nonsag, Class 25] [Multicomponent, nonsag,, Class 50] [Multicomponent, nonsag,, Class 25].**
 4. Polysulfide Joint Sealant: **[Single component, nonsag] [Multicomponent, nonsag].**
 5. Preformed Joint Sealant: **[Preformed silicone] [Preformed foam].**
 6. Joint Sealant: **<Insert joint sealant>.**
 7. Joint-Sealant Color: **[As selected by DEN Project Manager from manufacturer's full range of colors] <Insert color>.**
- D. Joint-Sealant Application: Interior joints in horizontal traffic surfaces[**<JS-#>**].
1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in stone flooring.
 - c. Control and expansion joints in brick flooring.
 - d. Control and expansion joints in tile flooring.
 - e. **<Insert other joints>.**
 - f. Other joints as indicated.
 2. Silicone Joint Sealant: **[Single component, nonsag, traffic grade, neutral curing] [Single component, pourable, traffic grade, neutral curing] [Multicomponent, pourable, traffic grade, neutral curing].**
 3. Urethane Joint Sealant: **[Single component, nonsag, traffic grade] [Single component, pourable, traffic grade] [Multicomponent, nonsag, traffic grade, Class 50] [Multicomponent, nonsag, traffic grade, Class 25].**
 4. Polysulfide Joint Sealant: **[Multicomponent, nonsag, traffic grade] [Multicomponent, pourable, traffic grade].**
 5. Preformed Joint Sealant: Preformed foam.
 6. Joint Sealant: **<Insert joint sealant>.**
 7. Joint-Sealant Color: **[As selected by DEN Project Manager from manufacturer's full range of colors] <Insert color>.**
- E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces[**<JS-#>**].
1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Tile control and expansion joints.
 - d. Vertical joints on exposed surfaces of **[interior unit masonry] [concrete] [walls] [and] [partitions].**
 - e. Joints on underside of plant-precast structural concrete **[beams] [and] [planks].**

- f. Perimeter joints between interior wall surfaces and frames of **[interior doors] [windows] [and] [elevator entrances]**.
 - g. **<Insert other joints>**.
 - h. Other joints as indicated.
 2. Joint Sealant: **[Latex] [Acrylic based] [Butyl rubber based] <Insert joint sealant>**.
 3. Joint-Sealant Color: **[As selected by DEN Project Manager]** from manufacturer's full range of colors] **<Insert color>**.
- F. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces[**<JS-#>**].
 1. Joint Sealant Location:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - c. **<Insert other joints>**.
 - d. Other joints as indicated.
 2. Joint Sealant: **[Mildew resistant, single component, nonsag, neutral curing, Silicone] [Single component, nonsag, mildew resistant, acid curing] <Insert joint sealant>**.
 3. Joint-Sealant Color: **[As selected by DEN Project Manager]** from manufacturer's full range of colors] **<Insert color>**.
- G. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces[**<JS-#>**].
 1. Joint Location:
 - a. Acoustical joints where indicated.
 - b. Other joints as indicated.
 2. Joint Sealant: **[Acoustical] <Insert joint sealant>**.
 3. Joint-Sealant Color: **[As selected by DEN Project Manager]** from manufacturer's full range] **<Insert color>**.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 079200

SECTION 079500 - EXPANSION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Interior expansion control systems.
- 2. Exterior wall expansion control systems.
- 3. Parking and open-air structure expansion control systems.

- B. Related Requirements:

- 1. Section 077129 "Manufactured Roof Expansion Joints" for factory-fabricated roof expansion control.
- 2. Section 078446 "Fire-Resistive Joint Systems" for liquid-applied joint sealants in fire-resistive building joints.
- 3. Section 079200 "Joint Sealants" for liquid-applied joint sealants and for elastomeric sealants without metal frames.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product data.

- 1. Include data substantiating that materials comply with requirements.

- B. Shop Drawings: For each expansion control system specified. Include plans, elevations, sections, details, splices, blockout requirement, attachments to other work, and line diagrams showing entire route of each expansion control system. Where expansion control systems change planes, provide isometric or clearly detailed drawing depicting how components interconnect.

- C. Samples: For each exposed expansion control system and for each color and texture specified, full width by 6 inches (150 mm) long in size.

- D. Samples for Initial Selection: For each type of expansion control system indicated.

1. Include manufacturer's color charts showing the full range of colors and finishes available for each exposed metal and elastomeric seal material.
- E. Samples for Verification: For each type of expansion control system indicated, full width by 6 inches (150 mm) long in size.
- F. Product Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
1. Manufacturer and model number for each expansion control system.
 2. Expansion control system location cross-referenced to Drawings.
 3. Nominal joint width.
 4. Movement capability.
 5. Classification as thermal or seismic.
 6. Materials, colors, and finishes.
 7. Product options.
 8. Fire-resistance ratings.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each fire barrier provided as part of an expansion control system, for tests performed by a qualified testing agency.

1.5 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. General: Provide expansion control systems of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.
1. Furnish units in longest practicable lengths to minimize field splicing. Install with hairline mitered corners where expansion control systems change direction or abut other materials.
 2. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion control systems.
- B. Coordination: Coordinate installation of exterior wall[**and soffit**] expansion control systems with roof expansion control systems to ensure that wall transitions are watertight. Roof expansion joint assemblies are specified elsewhere.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Where indicated, provide expansion control systems with fire barriers identical to those of systems tested for fire resistance per UL 2079 or ASTM E 1966 by a testing and inspecting agency acceptable to authorities having jurisdiction.
1. Hose Stream Test: Wall-to-wall and wall-to-ceiling systems shall be subjected to hose stream testing.
- B. Seismic Performance: Expansion control systems shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7] <Insert requirement>.
1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified[**and the system will be fully operational after the seismic event**]."
 2. Component Importance Factor is [1.5] [1.0].

2.3 INTERIOR EXPANSION CONTROL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Architectural Art Mfg., Inc.; Division of Pittcon Industries.
 2. Balco, Inc.
 3. Construction Specialties, Inc.
 4. JointMaster/InPro Corporation.
 5. Michael Rizza Company, LLC.
 6. MM Systems Corporation.
 7. Nystrom, Inc.
 8. Watson Bowman Acme Corp.; a BASF Construction Chemicals business.
 9. <Insert manufacturer's name>.
 10. or approved equal.
- B. Source Limitations: Obtain expansion control systems from single source from single manufacturer.
- C. Floor-to-Floor <Insert drawing designation>:
1. Design Criteria:
 - a. Nominal Joint Width: [As indicated on Drawings] [As scheduled] <Insert width>.
 - b. Minimum Joint Width: [As indicated on Drawings] [As scheduled] <Insert width>.
 - c. Maximum Joint Width: [As indicated on Drawings] [As scheduled] <Insert width>.
 - d. Movement Capability: [As indicated on Drawings] [As scheduled] [-25 percent/+75 percent] <Insert percentage>.
 - e. Type of Movement: [As indicated on Drawings] [As scheduled] [Thermal] [Seismic].

- f. Load Capacity:
 - 1) Uniform Load: **[150 lb/sq. ft. (732 kg/sq. m)] <Insert load>**.
 - 2) Concentrated Load: **[2000 lb (907 kg)] <Insert load>**.
 - 3) Maximum Deflection: **[0.5 inch (13 mm)] <Insert deflection>**.
 - g. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than **[that indicated] [that of adjacent construction] [1 hour] [1-1/2 hours] [2 hours] [3 hours] [4 hours] <Insert rating>**.
2. Type: **[Cover plate] [Center plate] [Glide plate] [Hidden sightline] [Pan] [Elastomeric seal, recessed] [Elastomeric seal, surface mounted] [Dual elastomeric seal]**.
- a. Cover-Plate Design: **[Plain] [Serrated] [Abrasive filled] [Recessed to accept field-applied finish materials]**.
 - 1) Cover-Plate Recess Depth: **[As required to accommodate adjacent flooring] [1/8 inch (3 mm)] [3/8 inch (10 mm)] <Insert depth>**.
 - b. Metal: Aluminum.
 - 1) Finish: **[Mill] [Clear anodic, Class I] [Clear anodic, Class II] [Color anodic, Class I] [Color anodic, Class II] [Manufacturer's standard] <Insert finish>**.
 - c. Metal: Stainless steel.
 - 1) Finish: **[No. 2B] [No. 4] [Manufacturer's standard] <Insert finish>**.
 - d. Metal: **[Bronze] [Brass]**.
 - 1) Finish: **[Mill] [Manufacturer's standard] <Insert finish>**.
 - e. Seal Material: **[Santoprene] [Manufacturer's standard] <Insert material>**.
 - 1) Color: **[Black] [Brown] [Beige] [Tan] [Gray] [White] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
- D. Floor-to-Wall **<Insert drawing designation>**:
- 1. Design Criteria:
 - a. Nominal Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - b. Minimum Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - c. Maximum Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.

- d. Movement Capability: **[As indicated on Drawings] [As scheduled] [-25 percent/+75 percent] <Insert percentage>**.
 - e. Type of Movement: **[As indicated on Drawings] [As scheduled] [Thermal] [Seismic]**.
 - f. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than **[that indicated] [that of adjacent construction] [1 hour] [1-1/2 hours] [2 hours] [3 hours] [4 hours] <Insert rating>**.
2. Type: **[Cover plate] [Center plate] [Glide plate] [Hidden sightline] [Pan] [Elastomeric seal, recessed] [Elastomeric seal, surface mounted] [Dual elastomeric seal]**.
- a. Cover-Plate Design: **[Plain] [Serrated] [Abrasive filled] [Recessed to accept field-applied finish materials]**.
 - 1) Cover-Plate Recess Depth: **[As required to accommodate adjacent flooring] [1/8 inch (3 mm)] [3/8 inch (10 mm)] <Insert depth>**.
 - b. Metal: Aluminum.
 - 1) Finish: **[Mill] [Clear anodic, Class I] [Clear anodic, Class II] [Color anodic, Class I] [Color anodic, Class II] [Manufacturer's standard] <Insert finish>**.
 - c. Metal: Stainless steel.
 - 1) Finish: **[No. 2B] [No. 4] [Manufacturer's standard] <Insert finish>**.
 - d. Metal: **[Bronze] [Brass]**.
 - 1) Finish: **[Mill] [Manufacturer's standard] <Insert finish>**.
 - e. Seal Material: **[Santoprene] [Manufacturer's standard] <Insert material>**.
 - 1) Color: **[Black] [Brown] [Beige] [Tan] [Gray] [White] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
- E. Wall-to-Wall **<Insert drawing designation>**:
1. Design Criteria:
 - a. Nominal Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - b. Minimum Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - c. Maximum Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - d. Movement Capability: **[As indicated on Drawings] [As scheduled] [-25 percent/+75 percent] <Insert percentage>**.

- e. Type of Movement: **[As indicated on Drawings] [As scheduled] [Thermal] [Seismic]**.
 - f. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than **[that indicated] [that of adjacent construction] [1 hour] [1-1/2 hours] [2 hours] [3 hours] [4 hours] <Insert rating>**.
2. Type: **[Cover plate] [Glide plate] [Snap-on cover] [Clip-in cover] [Elastomeric seal] [Dual elastomeric seal] [Accordion] [Flat seal]**.
- a. Metal: Aluminum.
 - 1) Finish: **[Mill] [Clear anodic, Class I] [Clear anodic, Class II] [Color anodic, Class I] [Color anodic, Class II] [Manufacturer's standard] <Insert finish>**.
 - b. Metal: Stainless steel.
 - 1) Finish: **[No. 2B] [No. 4] [Manufacturer's standard] <Insert finish>**.
 - c. Metal: **[Bronze] [Brass]**.
 - 1) Finish: **[Mill] [Manufacturer's standard] <Insert finish>**.
 - d. Seal Material: **[Santoprene] [PVC] [Manufacturer's standard] <Insert material>**.
 - 1) Color: **[Black] [Brown] [Beige] [Tan] [Gray] [White] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
- F. Wall Corner **<Insert drawing designation>**:
- 1. Design Criteria:
 - a. Nominal Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - b. Minimum Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - c. Maximum Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - d. Movement Capability: **[As indicated on Drawings] [As scheduled] [-25 percent/+75 percent] <Insert percentage>**.
 - e. Type of Movement: **[As indicated on Drawings] [As scheduled] [Thermal] [Seismic]**.
 - f. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than **[that indicated] [that of adjacent construction] [1 hour] [1-1/2 hours] [2 hours] [3 hours] [4 hours] <Insert rating>**.

2. Type: **[Cover plate] [Glide plate] [Snap-on cover] [Clip-in cover] [Elastomeric seal] [Dual elastomeric seal] [Accordion] [Flat seal]**.
 - a. Metal: Aluminum.
 - 1) Finish: **[Mill] [Clear anodic, Class I] [Clear anodic, Class II] [Color anodic, Class I] [Color anodic, Class II] [Manufacturer's standard] <Insert finish>**.
 - b. Metal: Stainless steel.
 - 1) Finish: **[No. 2B] [No. 4] [Manufacturer's standard] <Insert finish>**.
 - c. Metal: **[Bronze] [Brass]**.
 - 1) Finish: **[Mill] [Manufacturer's standard] <Insert finish>**.
 - d. Seal Material: **[Santoprene] [PVC] [Manufacturer's standard] <Insert material>**.
 - 1) Color: **[Black] [Brown] [Beige] [Tan] [Gray] [White] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
- G. Wall-to-Ceiling **<Insert drawing designation>**:
 1. Design Criteria:
 - a. Nominal Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - b. Minimum Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - c. Maximum Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - d. Movement Capability: **[As indicated on Drawings] [As scheduled] [-25 percent/+75 percent] <Insert percentage>**.
 - e. Type of Movement: **[As indicated on Drawings] [As scheduled] [Thermal] [Seismic]**.
 - f. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than **[that indicated] [that of adjacent construction] [1 hour] [1-1/2 hours] [2 hours] [3 hours] [4 hours] <Insert rating>**.
 2. Type: **[Cover plate] [Glide plate] [Snap-on cover] [Clip-in cover] [Elastomeric seal] [Dual elastomeric seal] [Accordion] [Flat seal]**.
 - a. Metal: Aluminum.
 - 1) Finish: **[Mill] [Clear anodic, Class I] [Clear anodic, Class II] [Color anodic, Class I] [Color anodic, Class II] [Manufacturer's standard] <Insert finish>**.

- b. Metal: Stainless steel.
 - 1) Finish: **[No. 2B]** **[No. 4]** **[Manufacturer's standard]** **<Insert finish>**.
 - c. Metal: **[Bronze]** **[Brass]**.
 - 1) Finish: **[Mill]** **[Manufacturer's standard]** **<Insert finish>**.
 - d. Seal Material: **[Santoprene]** **[PVC]** **[Manufacturer's standard]** **<Insert material>**.
 - 1) Color: **[Black]** **[Brown]** **[Beige]** **[Tan]** **[Gray]** **[White]** **[As selected by DEN Project Manager from manufacturer's full range]** **<Insert color>**.
- H. Ceiling-to-Ceiling **<Insert Drawing Designation>**:
- 1. Design Criteria:
 - a. Nominal Joint Width: **[As indicated on Drawings]** **[As scheduled]** **<Insert width>**.
 - b. Minimum Joint Width: **[As indicated on Drawings]** **[As scheduled]** **<Insert width>**.
 - c. Maximum Joint Width: **[As indicated on Drawings]** **[As scheduled]** **<Insert width>**.
 - d. Movement Capability: **[As indicated on Drawings]** **[As scheduled]** **[-25 percent/+75 percent]** **<Insert percentage>**.
 - e. Type of Movement: **[As indicated on Drawings]** **[As scheduled]** **[Thermal]** **[Seismic]**.
 - f. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than **[that indicated]** **[that of adjacent construction]** **[1 hour]** **[1-1/2 hours]** **[2 hours]** **[3 hours]** **[4 hours]** **<Insert rating>**.
 - 2. Type: **[Cover plate]** **[Glide plate]** **[Snap-on cover]** **[Clip-in cover]** **[Elastomeric seal]** **[Dual elastomeric seal]** **[Accordion]** **[Flat seal]**.
 - a. Metal: Aluminum.
 - 1) Finish: **[Mill]** **[Clear anodic, Class I]** **[Clear anodic, Class II]** **[Color anodic, Class I]** **[Color anodic, Class II]** **[Manufacturer's standard]** **<Insert finish>**.
 - b. Metal: Stainless steel.
 - 1) Finish: **[No. 2B]** **[No. 4]** **[Manufacturer's standard]** **<Insert finish>**.
 - c. Metal: **[Bronze]** **[Brass]**.
 - 1) Finish: **[Mill]** **[Manufacturer's standard]** **<Insert finish>**.

- d. Seal Material: **[Santoprene] [PVC] [Manufacturer's standard] <Insert material>**.
- 1) Color: **[Black] [Brown] [Beige] [Tan] [Gray] [White] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.

2.4 EXTERIOR WALL EXPANSION CONTROL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Architectural Art Mfg., Inc.; Division of Pittcon Industries.
2. Balco, Inc.
3. Chase Construction Products; Division of Chase Corporation.
4. Construction Specialties, Inc.
5. D. S. Brown Company (The).
6. EMSEAL Corporation.
7. Erie Metal Specialties, Inc.
8. JointMaster/InPro Corporation.
9. LymTal International, Inc.
10. Michael Rizza Company, LLC.
11. MM Systems Corporation.
12. Nystrom, Inc.
13. RJ Watson, Inc.
14. Schul International Company, Inc.
15. Tremco Incorporated.
16. Watson Bowman Acme Corp.; a BASF Construction Chemicals business.
17. Williams Products, Inc.
18. **<Insert manufacturer's name>**.
19. or approved equal.

- B. Source Limitations: Obtain expansion control systems from single source from single manufacturer.

- C. Wall-to-Wall **<Insert drawing designation>**:

1. Design Criteria:
 - a. Nominal Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - b. Minimum Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - c. Maximum Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - d. Movement Capability: **[As indicated on Drawings] [As scheduled] [-25 percent/+75 percent] <Insert percentage>**.
 - e. Type of Movement: **[As indicated on Drawings] [As scheduled] [Thermal] [Seismic]**.

- f. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than **[that indicated] [that of adjacent construction] [1 hour] [1-1/2 hours] [2 hours] [3 hours] [4 hours] <Insert rating>**.
2. Type: Cover plate.
 - a. Metal: Aluminum.
 - 1) Finish: **[Mill] [Clear anodic, Class I] [Clear anodic, Class II] [Color anodic, Class I] [Color anodic, Class II] [Manufacturer's standard] <Insert finish>**.
 - b. Metal: Stainless steel.
 - 1) Finish: **[No. 2B] [No. 4] [Manufacturer's standard] <Insert finish>**.
 - c. Metal: **[Bronze] [Brass]**.
 - 1) Finish: **[Mill] [Manufacturer's standard] <Insert finish>**.
 3. Type: Flat seal.
 - a. Metal: **[Aluminum] [Stainless steel]**.
 - b. Seal Material: **[Santoprene] [Neoprene] [Manufacturer's standard]**.
 - 1) Color: **[Black] [Brown] [Beige] [Tan] [Gray] [White] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 - c. Pantograph Mechanism: Manufacturer's standard pantographic wind-load support mechanism with stainless-steel fasteners.
 4. Type: Preformed cellular foam.
 - a. Foam Material: **[Manufacturer's standard] [Non-extruded, low-density, crosslinked, nitrogen-blown, ethylene-vinyl-acetate copolymer] [Polyurethane]**.
 - 1) Color: **[Manufacturer's standard] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
- D. Wall Corner **<Insert drawing designation>**:
1. Design Criteria:
 - a. Nominal Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - b. Minimum Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - c. Maximum Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.

- d. Movement Capability: **[As indicated on Drawings] [As scheduled] [-25 percent/+75 percent] <Insert percentage>**.
 - e. Type of Movement: **[As indicated on Drawings] [As scheduled] [Thermal] [Seismic]**.
 - f. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than **[that indicated] [that of adjacent construction] [1 hour] [1-1/2 hours] [2 hours] [3 hours] [4 hours] <Insert rating>**.
2. Type: Cover plate.
 - a. Metal: Aluminum.
 - 1) Finish: **[Mill] [Clear anodic, Class I] [Clear anodic, Class II] [Color anodic, Class I] [Color anodic, Class II] [Manufacturer's standard] <Insert finish>**.
 - b. Metal: Stainless steel.
 - 1) Finish: **[No. 2B] [No. 4] [Manufacturer's standard] <Insert finish>**.
 - c. Metal: **[Bronze] [Brass]**.
 - 1) Finish: **[Mill] [Manufacturer's standard] <Insert finish>**.
 3. Type: Flat seal.
 - a. Metal: **[Aluminum] [Stainless steel]**.
 - b. Seal Material: **[Santoprene] [Neoprene] [Manufacturer's standard]**.
 - 1) Color: **[Black] [Brown] [Beige] [Tan] [Gray] [White] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 - c. Pantograph Mechanism: Manufacturer's standard pantographic wind-load support mechanism with stainless-steel fasteners.
 4. Type: Preformed cellular foam.
 - a. Foam Material: **[Manufacturer's standard] [Non-extruded, low-density, crosslinked, nitrogen-blown, ethylene-vinyl-acetate copolymer] [Polyurethane]**.
 - 1) Color: **[Manufacturer's standard] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
- E. Wall-to-Soffit **<Insert drawing designation>**:
1. Design Criteria:
 - a. Nominal Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.

- b. Minimum Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - c. Maximum Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - d. Movement Capability: **[As indicated on Drawings] [As scheduled] [-25 percent/+75 percent] <Insert percentage>**.
 - e. Type of Movement: **[As indicated on Drawings] [As scheduled] [Thermal] [Seismic]**.
 - f. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than **[that indicated] [that of adjacent construction] [1 hour] [1-1/2 hours] [2 hours] [3 hours] [4 hours] <Insert rating>**.
2. Type: Cover plate.
- a. Metal: Aluminum.
 - 1) Finish: **[Mill] [Clear anodic, Class I] [Clear anodic, Class II] [Color anodic, Class I] [Color anodic, Class II] [Manufacturer's standard] <Insert finish>**.
 - b. Metal: Stainless steel.
 - 1) Finish: **[No. 2B] [No. 4] [Manufacturer's standard] <Insert finish>**.
 - c. Metal: **[Bronze] [Brass]**.
 - 1) Finish: **[Mill] [Manufacturer's standard] <Insert finish>**.
3. Type: Flat seal.
- a. Metal: **[Aluminum] [Stainless steel]**.
 - b. Seal Material: **[Santoprene] [Neoprene] [Manufacturer's standard]**.
 - 1) Color: **[Black] [Brown] [Beige] [Tan] [Gray] [White] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
4. Type: Preformed cellular foam.
- a. Foam Material: **[Manufacturer's standard] [Non-extruded, low-density, crosslinked, nitrogen-blown, ethylene-vinyl-acetate copolymer] [Polyurethane]**.
 - 1) Color: **[Manufacturer's standard] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
- F. Soffit-to-Soffit **<Insert drawing designation>**:
1. Design Criteria:

- a. Nominal Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - b. Minimum Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - c. Maximum Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - d. Movement Capability: **[As indicated on Drawings] [As scheduled] [-25 percent/+75 percent] <Insert percentage>**.
 - e. Type of Movement: **[As indicated on Drawings] [As scheduled] [Thermal] [Seismic]**.
 - f. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than **[that indicated] [that of adjacent construction] [1 hour] [1-1/2 hours] [2 hours] [3 hours] [4 hours] <Insert rating>**.
2. Type: Cover plate.
- a. Metal: Aluminum.
 - 1) Finish: **[Mill] [Clear anodic, Class I] [Clear anodic, Class II] [Color anodic, Class I] [Color anodic, Class II] [Manufacturer's standard] <Insert finish>**.
 - b. Metal: Stainless steel.
 - 1) Finish: **[No. 2B] [No. 4] [Manufacturer's standard] <Insert finish>**.
 - c. Metal: **[Bronze] [Brass]**.
 - 1) Finish: **[Mill] [Manufacturer's standard] <Insert finish>**.
3. Type: Flat seal.
- a. Metal: **[Aluminum] [Stainless steel]**.
 - b. Seal Material: **[Santoprene] [Neoprene] [Manufacturer's standard]**.
 - 1) Color: **[Black] [Brown] [Beige] [Tan] [Gray] [White] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
4. Type: Preformed cellular foam.
- a. Foam Material: **[Manufacturer's standard] [Non-extruded, low-density, crosslinked, nitrogen-blown, ethylene-vinyl-acetate copolymer] [Polyurethane]**.
 - 1) Color: **[Manufacturer's standard] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.

2.5 PARKING AND OPEN-AIR STRUCTURE EXPANSION CONTROL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Architectural Art Mfg., Inc.; Division of Pittcon Industries.
2. Balco, Inc.
3. Chase Construction Products; Division of Chase Corporation.
4. Construction Specialties, Inc.
5. D. S. Brown Company (The).
6. EMSEAL Corporation.
7. Erie Metal Specialties, Inc.
8. JointMaster/InPro Corporation.
9. LymTal International, Inc.
10. Michael Rizza Company, LLC.
11. MM Systems Corporation.
12. Nystrom, Inc.
13. RJ Watson, Inc.
14. Schul International Company, Inc.
15. Tremco Incorporated.
16. Watson Bowman Acme Corp.; a BASF Construction Chemicals business.
17. Williams Products, Inc.
18. **<Insert manufacturer's name>**.
19. or approved equal.

B. Source Limitations: Obtain expansion control systems from single source from single manufacturer.

C. Slab-to-Slab **<Insert drawing designation>**:

1. Design Criteria:
 - a. Nominal Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - b. Minimum Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - c. Maximum Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - d. Movement Capability: **[As indicated on Drawings] [As scheduled] [-25 percent/+75 percent] <Insert percentage>**.
 - e. Type of Movement: **[As indicated on Drawings] [As scheduled] [Thermal] [Seismic]**.
 - f. Load Capacity:
 - 1) Uniform Load: **[150 lb/sq. ft. (732 kg/sq. m)] <Insert load>**.
 - 2) Concentrated Load: **[2000 lb (907 kg)] <Insert load>**.
 - 3) Maximum Deflection: **[0.5 inch (13 mm)] <Insert deflection>**.
 - g. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than **[that indicated] [that of adjacent**

- construction] [1 hour] [1-1/2 hours] [2 hours] [3 hours] [4 hours] <Insert rating>.**
2. Type: Metal plate.
 - a. Metal: Aluminum.
 - 1) Finish: **[Mill] [Manufacturer's standard] <Insert finish>.**
 - b. Metal: Stainless steel.
 - 1) Finish: **[No. 2B] [No. 4] [Manufacturer's standard] <Insert finish>.**
 - c. Attachment Method: **[Mechanical anchors] [Cast in].**
 3. Type: Sealant T-joint.
 - a. Material: Premolded polyurethane.
 - 1) Color: **[Black] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.**
 4. Type: **[Strip seal] [Split-slab membrane].**
 - a. Metal: Aluminum.
 - 1) Finish: **[Mill] [Manufacturer's standard] <Insert finish>.**
 - b. Metal: Stainless steel.
 - 1) Finish: **[No. 2B] [No. 4] [Manufacturer's standard] <Insert finish>.**
 - c. Seal Material: **[Santoprene] [Neoprene] [Silicone] [EPDM] [PVC] [Manufacturer's standard].**
 - 1) Color: **[Black] [Brown] [Beige] [Tan] [Gray] [White] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.**
 - d. Attachment Method: **[Mechanical anchors] [Cast in].**
 5. Type: **[Rubber pad] [Compression seal] [Winged seal] [Epoxy-bonded seal].**
 - a. Seal Material: **[Santoprene] [Neoprene] [Silicone] [EPDM] [PVC] [Manufacturer's standard].**
 - 1) Color: **[Black] [Brown] [Beige] [Tan] [Gray] [White] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.**
 6. Type: Preformed cellular foam.

- a. Foam Material: **[Manufacturer's standard] [Non-extruded, low-density, crosslinked, nitrogen-blown, ethylene-vinyl-acetate copolymer] [Polyurethane]**.
 - 1) Color: **[Manufacturer's standard] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
- D. Slab-to-Wall **<Insert drawing designation>**:
1. Design Criteria:
 - a. Nominal Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - b. Minimum Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - c. Maximum Joint Width: **[As indicated on Drawings] [As scheduled] <Insert width>**.
 - d. Movement Capability: **[As indicated on Drawings] [As scheduled] [-25 percent/+75 percent] <Insert percentage>**.
 - e. Type of Movement: **[As indicated on Drawings] [As scheduled] [Thermal] [Seismic]**.
 - f. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than **[that indicated] [that of adjacent construction] [1 hour] [1-1/2 hours] [2 hours] [3 hours] [4 hours] <Insert rating>**.
 2. Type: Metal plate.
 - a. Metal: Aluminum.
 - 1) Finish: **[Mill] [Manufacturer's standard] <Insert finish>**.
 - b. Metal: Stainless steel.
 - 1) Finish: **[No. 2B] [No. 4] [Manufacturer's standard] <Insert finish>**.
 - c. Attachment Method: **[Mechanical anchors] [Cast in]**.
 3. Type: Sealant T-joint.
 - a. Material: Premolded polyurethane.
 - 1) Color: **[Black] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 4. Type: **[Strip seal] [Split-slab membrane]**.
 - a. Metal: Aluminum.
 - 1) Finish: **[Mill] [Manufacturer's standard] <Insert finish>**.
 - b. Metal: Stainless steel.

- 1) Finish: **[No. 2B] [No. 4] [Manufacturer's standard] <Insert finish>**.
- c. Seal Material: **[Santoprene] [Neoprene] [Silicone] [EPDM] [PVC] [Manufacturer's standard]**.
 - 1) Color: **[Black] [Brown] [Beige] [Tan] [Gray] [White] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
- d. Attachment Method: **[Mechanical anchors] [Cast in]**.
5. Type: **[Rubber pad] [Compression seal] [Winged seal] [Epoxy-bonded seal]**.
 - a. Seal Material: **[Santoprene] [Neoprene] [Silicone] [EPDM] [PVC] [Manufacturer's standard]**.
 - 1) Color: **[Black] [Brown] [Beige] [Tan] [Gray] [White] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
6. Type: Preformed cellular foam.
 - a. Foam Material: **[Manufacturer's standard] [Non-extruded, low-density, crosslinked, nitrogen-blown, ethylene-vinyl-acetate copolymer] [Polyurethane]**.
 - 1) Color: **[Manufacturer's standard] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.

2.6 ACCESSORIES

- A. Moisture Barriers: Manufacturer's standard moisture barrier consisting of a continuous, waterproof membrane within joint and attached to substrate on sides of joint below the primary cover.
 1. Drain-Tube Assemblies: Equip moisture barrier with drain tubes and seals to direct collected moisture **[to drain] [to exterior-wall expansion control system] [as indicated on Drawings] <Insert requirement>**.

2.7 MATERIALS

- A. Aluminum: **ASTM B 221** (ASTM B 221M), Alloy 6063-T5 for extrusions; **ASTM B 209** (ASTM B 209M), Alloy 6061-T6 for sheet and plate.
 1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
- B. Stainless Steel: ASTM A 240/A 240M or ASTM A 666, Type 304 for plates, sheet, and strips.

1. Remove tool and die marks and stretch lines or blend into finish.
- C. Brass: ASTM B 36/B 36M, UNS Alloy C26000 for half hard sheet and coil.
- D. Bronze: ASTM B 455, Alloy C38500 for extrusions; Alloy C23000 red brass for plates.
- E. Elastomeric Seals: ASTM E 1783; preformed elastomeric membranes or extrusions to be installed in metal frames.
- F. Compression Seals: ASTM E 1612; preformed elastomeric extrusions having an internal baffle system and designed to function under compression.
- G. Cellular Foam Seals: Extruded, compressible foam designed to function under compression.
- H. Elastomeric Concrete: Modified epoxy or polyurethane extended into a prepackaged aggregate blend, specifically designed for bonding to concrete substrates.
- I. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to meet performance criteria for required fire-resistance rating.
- J. Moisture Barrier: Flexible elastomeric material, **[PVC, minimum 30 mils thick]** **[EPDM, minimum 45 mils thick]** **[Santoprene]**.
- K. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
- L. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.8 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 ALUMINUM FINISHES

- A. Mill finish.

- B. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
- C. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.
 - 1. Color: [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] <Insert color>.
 - 2. Color: [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**].

2.10 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 3. Directional Satin Finish: No. 4.
- C. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces where expansion control systems will be installed for installation tolerances and other conditions affecting performance of work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to expansion control system manufacturer's written instructions.
- B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion control systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion control systems.
- C. Cast-In Frames: Coordinate and furnish frames to be cast into concrete.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing expansion control systems and materials unless more stringent requirements are indicated.
- B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion control systems.
1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
 2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation. Notify DEN Project Manager where discrepancies occur that will affect proper expansion control system installation and performance.
 3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
 4. Repair or grout blockout as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
 5. Install frames in continuous contact with adjacent surfaces.
 - a. Shimming is not permitted.
 6. Locate anchors at interval recommended by manufacturer, but not less than **3 inches** (75 mm) from each end and not more than **24 inches** (600 mm) o.c.
- C. Seals in Metal Frames: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
1. Provide in continuous lengths for straight sections.
 2. Seal transitions according to manufacturer's written instructions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
 3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
- D. Compression Seals: Apply adhesive or lubricant adhesive as recommended by manufacturer to both **[frame interfaces]** **[sides of slabs]** before installing compression seals.
- E. Foam Seals: Install with adhesive recommended by manufacturer.
- F. Epoxy-Bonded Seals: Pressurize seal for time period and to pressure recommended by manufacturer. Do not overpressurize.
- G. Terminate exposed ends of expansion control systems with field- or factory-fabricated termination devices.
- H. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion control system materials and associated work so complete assemblies comply with assembly performance requirements.

1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.

- I. Moisture Barrier: Provide [**at all exterior joints and**]where indicated on Drawings. Provide drainage fittings[**at a maximum of 50 feet (15.2 m) or**] where indicated on Drawings.

3.4 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion control systems. Reinstall cover plates or seals prior to Substantial Completion of the Work.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 079500

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes hollow-metal work.
- B. Related Requirements:
 - 1. Section 081119 "Stainless-Steel Doors and Frames" for hollow-metal doors and frames manufactured from stainless steel.
 - 2. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate shop drawings, fabrication, and delivery of welded frames with project schedule and installation of wall systems and other systems.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [at time and location as determined by DEN Project Manager] <Insert location>**.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, **[fire-resistance ratings,] [temperature-rise ratings,]** and finishes.
2. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Local/Regional Materials: Indicate location of manufacturing facility including name, address, and distance between manufacturing facility and the project site. Provide manufacturer's documentation indicating location where the base materials were extracted, mined, quarried, harvested, etc., and the distance between this location and the project site. Also include material costs, excluding cost of installation.
3. Adhesives, Primers, Coatings and Sealants: Manufacturers' product data and material safety data sheets (MSDS) for adhesives, primers, coatings and sealants used on the interior of the building including printed statement of VOC content in g/L.

C. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification:

1. For each type of exposed finish required, prepared on Samples of not less than **3 by 5 inches** (75 by 127 mm).
2. For "Doors" and "Frames" subparagraphs below, prepare Samples approximately **[12 by 12 inches (305 by 305 mm)] [8 by 10 inches (203 by 254 mm)] <Insert dimension>** to demonstrate compliance with requirements for quality of materials and construction:

- a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
 - b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.
- F. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.7 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.
- B. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.
- C. Warranty: Submit copy of product warranties.

1.8 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ceco Door Products; an Assa Abloy Group company.
 2. Colorado Doorways
 3. Gateway
 4. NCS Manufacturing Co.
 5. Southwestern Hollow Metal.
 6. Steelcraft; an Ingersoll-Rand company.
 7. **<Insert manufacturer>**
 8. or approved equal.
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings[**and temperature-rise limits**] indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
- B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. [**At locations indicated in the Door and Frame Schedule**] **<Insert locations>**.
1. Physical Performance: Level B according to SDI A250.4.
 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.

- b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: **[Uncoated,]** cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
 - d. Edge Construction:**[Model 1, Full Flush] [Model 2, Seamless]**.
 - e. Core: **[Vertical steel stiffeners]**.
 - 1) Fire Door Cores: As required and approved to provide fire-protection and temperature-rise ratings indicated.
 3. Frames:
 - a. Materials: **[Uncoated]** steel sheet, minimum thickness of 0.053 inch (1.3 mm).
 - b. Construction: **[Face welded] [Full profile welded]**.
 4. Exposed Finish: **[Prime]** .
- C. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3. **[At locations indicated in the Door and Frame Schedule] <Insert locations>**.
 1. Physical Performance: Level A according to SDI A250.4.
 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: **[Uncoated,]** cold-rolled steel sheet, minimum thickness of 0.053 inch (1.3 mm).
 - d. Edge Construction:**[Model 1, Full Flush] [Model 2, Seamless]**
 - e. Core: **[Vertical steel stiffeners]**.
 - 1) Fire Door Cores: As required and approved to provide fire-protection and temperature-rise ratings indicated.
 3. Frames:
 - a. Materials: **[Uncoated,]** steel sheet, minimum thickness of 0.053 inch (1.3 mm).
 - b. Construction: **[Face welded] [Full profile welded]**.
 4. Exposed Finish: **[Prime]**.
- D. Maximum-Duty Doors and Frames: SDI A250.8, Level 4. **[At locations indicated in the Door and Frame Schedule] <Insert locations>**.
 1. Physical Performance: Level A according to SDI A250.4.
 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm.)
 - c. Face: **[Uncoated,]** cold-rolled steel sheet, minimum thickness of 0.067 inch (1.7 mm).

- d. Edge Construction:[**Model 1, Full Flush**] [**Model 2, Seamless**].
 - e. Core: [**Vertical steel stiffeners**].
3. Frames:
- a. Materials: [**Uncoated**] steel sheet, minimum thickness of **0.067 inch** (1.7 mm).
 - b. Construction: [**Face welded**] [**Full profile welded**].
4. Exposed Finish: [**Prime**] .

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3. [**At locations indicated in the Door and Frame Schedule**] <Insert locations>.
- 1. Physical Performance: Level A according to SDI A250.4.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: **1-3/4 inches** (44.5 mm.)
 - c. Face: Metallic-coated steel sheet, minimum thickness of **0.053 inch** (1.3 mm), with minimum **A40** (ZF120) coating.
 - d. Edge Construction:[**Model 1, Full Flush**] [**Model 2, Seamless**] .
 - 1) Retain either "Core" Subparagraph below. Unless otherwise specified, SDI A250.8 permits manufacturers to choose core types.
 - e. Core: Provide thermal-resistance-rated, steel-reinforced cores for exterior doors.
 - 1) Steel-reinforced core: 0.026-inch (0.7-mm-) thick, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart, spot-welded to face sheets at a maximum of 5 inches (127 mm) o.c. Spaces filled snugly between stiffeners with polystyrene insulation.
 - 2) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than [**4.0 deg F x h x sq. ft./Btu** (**0.704 K x sq. m/W**)] <Insert R-value> when tested according to ASTM C 1363.
 - 3) Polystyrene Board: ASTM C 578, Type 1, with thermal-resistance value (R-value) of not less than 6.0 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
 - 4) Fire Door Cores: As required and approved to provide fire-protection and temperature-rise ratings indicated.

3. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of **0.053 inch** (1.3 mm), with minimum **A40** (ZF120) coating.
 - b. Construction: **[Full profile welded]**.
4. Exposed Finish: **[Prime]** .

C. Maximum-Duty Doors and Frames: SDI A250.8, Level 4. **[At locations indicated in the Door and Frame Schedule] <Insert locations>**.

1. Physical Performance: Level A according to SDI A250.4.
2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: **1-3/4 inches** (44.5 mm.)
 - c. Face: Metallic-coated steel sheet, minimum thickness of **0.067 inch** (1.7 mm), with minimum **A40** (ZF120) coating.
 - d. Edge Construction:**[Model 1, Full Flush] [Model 2, Seamless]**.
 - e. Core: Provide thermal-resistance-rated, steel-reinforced cores for exterior doors.
 - 1) Steel-reinforced core: 0.026-inch (0.7-mm-) thick, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart, spot-welded to face sheets at a maximum of 5 inches (127 mm) o.c. Spaces filled snugly between stiffeners with polystyrene insulation.
 - 2) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than **[4.0 deg F x h x sq. ft./Btu (0.704 K x sq. m/W)] <Insert R-value>** when tested according to ASTM C 1363.
 - 3) Polystyrene Board: ASTM C 578, Type 1, with thermal-resistance value (R-value) of not less than 6.0 deg F x h x sq. ft/Btu when tested according to ASTM C 1363.
 - 4) Fire Door Cores: As required and approved to provide fire-protection and temperature-rise ratings indicated.
3. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of **0.067 inch** (1.7 mm), with minimum **A40** (ZF120) coating.
 - b. Construction: **[Full profile welded]**.
4. Exposed Finish: **[Prime]** .

2.5 HOLLOW-METAL PANELS

- A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

2.6 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than **0.042 inch** (1.0 mm) thick, with corrugated or perforated straps not less than **2 inches** (51 mm) wide by **10 inches** (254 mm) long; or wire anchors not less than **0.177 inch** (4.5 mm) thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than **0.042 inch** (1.0 mm) thick.
3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum **3/8-inch** (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, minimum thickness of **0.042 inch** (1.0 mm), and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than **2-inch** (51-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.7 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25] <Insert number>** percent.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- E. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), **04Z** (12G) coating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- G. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

1. Power-actuated fasteners shall be used only with prior approval by DEN Project Manager.
- H. Grout: ASTM C 476, except with a maximum slump of **4 inches** (102 mm), as measured according to ASTM C 143/C 143M.
- I. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- J. Glazing: Comply with requirements in Section 088000 "Glazing."
- K. Bituminous Coating: Cold-applied asphalt mastic, compounded for **15-mil** (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.8 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Tolerances: Fabricate hollow metalwork to tolerances indicated in SDI 117.
- C. Hollow-Metal Doors:
 1. Steel-Stiffened Door Cores: Provide minimum thickness **0.026 inch** (0.66 mm), steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than **6 inches** (152 mm) apart. Spot weld to face sheets no more than **5 inches** (127 mm) o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
 2. Fire Door Cores: As required to provide fire-protection[**and temperature-rise**] ratings indicated.
 3. Vertical Edges for Single-Acting Doors: [**Bevel edges 1/8 inch in 2 inches** (3.2 mm in 51 mm)] .
 4. Top Edge Closures: Close top edges of doors with [**inverted closures**] [**flush closures**] [**inverted closures, except provide flush closures at exterior doors**] of same material as face sheets.
 5. Bottom Edge Closures: Close bottom edges of doors[**where required for attachment of weather stripping**] with end closures or channels of same material as face sheets.
 6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 7. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend

minimum **3/4 inch** (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

- D. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. **[Sidelight] [and] [Transom Bar]** Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than **16 inches** (406 mm) from top and bottom of frame. Space anchors not more than **32 inches** (813 mm) o.c., to match coursing, and as follows:
 - 1) Two anchors per jamb up to **60 inches** (1524 mm) high.
 - 2) Three anchors per jamb from **60 to 90 inches** (1524 to 2286 mm) high.
 - 3) Four anchors per jamb from **90 to 120 inches** (2286 to 3048 mm) high.
 - 4) Four anchors per jamb plus one additional anchor per jamb for each **24 inches** (610 mm) or fraction thereof above **120 inches** (3048 mm) high.
 - b. Stud-Wall Type: Locate anchors not more than **18 inches** (457 mm) from top and bottom of frame. Space anchors not more than **32 inches** (813 mm) o.c. and as follows:
 - 1) Three anchors per jamb up to **60 inches** (1524 mm) high.
 - 2) Four anchors per jamb from **60 to 90 inches** (1524 to 2286 mm) high.
 - 3) Five anchors per jamb from **90 to 96 inches** (2286 to 2438 mm) high.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each **24 inches** (610 mm) or fraction thereof above **96 inches** (2438 mm) high.
 - c. Postinstalled Expansion Type: Locate anchors not more than **6 inches** (152 mm) from top and bottom of frame. Space anchors not more than **26 inches** (660 mm) o.c.
 6. Head Anchors: Two anchors per head for frames more than **42 inches** (1067 mm) wide and mounted in metal-stud partitions.
 7. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.

- b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- 8. Terminated Stops: Terminate stops [**6 inches (152 mm)**] **<Insert dimension>** above finish floor with a [**45**] [**90**]-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.
- E. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- G. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with [**butted**] [**or**] [**mitered**] hairline joints.
 - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 - 4. Provide loose stops and moldings on inside of hollow-metal work.
 - 5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.9 STEEL FINISHES

- A. Prime Finish for Interior Units: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
- B. Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, complying with SDI A250.3.
 - 1. Color and Gloss: [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] **<Insert color and gloss>**.

- C. Zinc-Rich Primer for Exterior Units: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.
1. Use primer with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Available Products: Subject to compliance with requirements, provide one of the following:
 - a. Benjamin Moore & Co.; Epoxy Zinc-Rich Primer CM18/19
 - b. Carboline Company; Carbozinc 621.
 - c. ICI Devboe Coatings; Catha-Coat 313.
 - d. International Coatings Ltd.; Interzinc 315 Epoxy Zinc-Rich Primer.
 - e. PPG Architectural Finishes, Inc.; Aquapon Zinc-Rich Primer 97-670.
 - f. Sherwin-Williams Co.; Corothane I GalvaPac Zinc Primer
 - g. Tnemec Company, Inc.; Tneme-Zinc 90-97.
 - h. or approved equal.

2.10 ACCESSORIES

- A. Louvers: Provide louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles formed of 0.020-inch (0.5-mm-) thick, cold-rolled steel sheet set into 0.032-inch (0.8-mm-) thick steel frame.
1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.
 2. Lightproof Louver: Stationary louvers constructed with baffles to prevent light from passing from one side to the other.
 3. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by same qualified testing and inspecting agency that established fire-resistance rating of door assembly.
- B. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- C. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 1) Powder-actuated fasteners shall be used only with prior approval by DEN Project Manager

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
8. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus **1/16 inch** (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus **1/16 inch** (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus **1/16 inch** (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus **1/16 inch** (1.6 mm), measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: **1/8 inch** (3.2 mm) plus or minus **1/32 inch** (0.8 mm).
 - b. Between Edges of Pairs of Doors: **1/8 inch** (3.2 mm) to **1/4 inch** (6.3 mm) plus or minus **1/32 inch** (0.8 mm).
 - c. At Bottom of Door: [**3/4 inch** (19.1 mm)] [**5/8 inch** (15.8 mm)] plus or minus **1/32 inch** (0.8 mm).
 - d. Between Door Face and Stop: **1/16 inch** (1.6 mm) to **1/8 inch** (3.2 mm) plus or minus **1/32 inch** (0.8 mm).
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than **9 inches** (230 mm) o.c. and not more than **2 inches** (51 mm) o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and

- replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
 - C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
 - D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
 - E. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.
 - F. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 081113

SECTION 081119 - STAINLESS-STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Stainless-steel, hollow-metal doors[**and panels**].
- 2. Stainless-steel, hollow-metal frames.

- B. Related Sections:

- 1. Section 042000 "Unit Masonry" for building anchors into and grouting stainless-steel frames in masonry construction.
- 2. Section 099113 "Exterior Painting" for field painting of factory-primed, stainless-steel doors and frames.
- 3. Section 099123 "Interior Painting" for field painting of factory-primed, stainless-steel doors and frames.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, [**fire-resistance rating,**] [**temperature-rise ratings,**] and finishes.

- 1. Include data substantiating that materials comply with requirements.

- B. Shop Drawings: Include the following:

- 1. Elevations of each door design.
- 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
- 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
- 4. Locations of reinforcement and preparations for hardware.
- 5. Details of each different wall opening condition.

6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Samples for Verification:

1. Finishes: For each type of exposed finish required, prepared on Samples of not less than **3 by 5 inches** (75 by 125 mm).
2. Doors: Include section of vertical-edge, top, and bottom construction; core construction; **[glazing]**; and hinge and other applied hardware reinforcement.
3. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

D. Schedule: Provide a schedule of stainless-steel, hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with a door hardware schedule.

1.4 INFORMATIONAL SUBMITTALS

- A. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of stainless-steel, hollow-metal door and frame assembly.

1.5 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain stainless-steel, hollow-metal work from single source from single manufacturer.
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 2. Temperature-Rise Limit: **[Where indicated] [At vertical exit enclosures and exit passageways]**, provide doors that have a maximum transmitted

temperature end point of not more than **450 deg F** (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

- C. Smoke- and Draft-Control Door Assemblies: **[Where indicated] [At corridors, smoke barriers, and smoke partitions]**, provide assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
 - 1. Air Leakage Rate: Maximum air leakage of **0.3 cfm/sq. ft.** (3 cu. m per minute/sq. m) at the tested pressure differential of **0.3-inch wg** (75 Pa) of water.
- D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies that are listed and labeled, by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite. Install in compliance with NFPA 80.
- E. Mockups: Build mockups of each type of door assembly to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Stainless steel frames.
 - 2. Stainless steel doors.
- F. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
- B. Shipping Spreaders: Deliver welded frames with two removable spreader bars across bottom of frames, tack welded or mechanically attached to jambs and mullions.
- C. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum **4-inch-** (100-mm-) high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.
 - 1. If wrappers on doors become wet, remove cartons immediately. Provide minimum **1/4-inch** (6-mm) space between each stacked door to permit air circulation.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.9 COORDINATION

- A. Coordinate installation of anchorages for stainless-steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 STAINLESS-STEEL DOORS AND FRAMES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ambico Limited.
 2. Ceco Door Products; an ASSA ABLOY Group company.
 3. CURRIES Company; an ASSA ABLOY Group company.
 4. Dawson Doors.
 5. Fleming Steel Doors & Frames Products Ltd.; an ASSA ABLOY Group company.
 6. Forms+Surfaces.
 7. Gensteel Doors, Incorporated.
 8. Habersham Metal Products Company.
 9. Krieger Specialty Products Company.
 10. LaForce, Inc.
 11. Next Door Company.
 12. Security Metal Products Corporation.
 13. Stainless Doors, Incorporated.
 14. Steelcraft; an Ingersoll-Rand company.
 15. **<Insert manufacturer's name>**.
 16. or approved equal.

2.2 STAINLESS-STEEL DOORS

- A. Description: Stainless-steel doors, not less than **1-3/4 inches** (44 mm) thick, of **[seamed] [seamless]**, hollow-metal construction. Construct doors with smooth, flush surfaces without visible joints or seams on faces.
1. Face Sheets: Fabricate from **[0.050-inch- (1.27-mm-)] [0.062-inch- (1.59-mm-)] [0.078-inch- (1.98-mm-)]** thick, stainless-steel sheet.
 2. Core Construction: Fabricate doors with core indicated.

- a. Welded Steel-Stiffened Core: [0.031-inch- (0.79-mm-) **thick, stainless-steel**] [0.030-inch- (0.76-mm-) **nominal thickness uncoated steel**] [0.034-inch- (0.86-mm-) **nominal thickness metallic-coated steel**] vertical stiffeners extending full-door height, spaced not more than 6 inches (152 mm) apart, spot welded to face sheets a maximum of 5 inches (127 mm) o.c. Fill spaces between stiffeners with mineral-fiber insulation.
 - b. Laminated Core: [**Honeycomb of resin-impregnated kraft paper with maximum 1-inch (25.4-mm) cells**] [or] [**foam-plastic insulation**] fastened to face sheets with waterproof adhesive.
 - 1) Foam-Plastic Insulated Doors: Thermal-resistance value (R-value) of not less than [4.0 deg F x h x sq. ft./Btu (0.704 K x sq. m/W)] [6.0 deg F x h x sq. ft./Btu (1.057 K x sq. m/W)] [12.3 deg F x h x sq. ft./Btu (2.166 K x sq. m/W)] <Insert R-value> when tested according to ASTM C 1363.
 - a) Locations: [**Exterior doors**] [and] [**interior doors where indicated**].
 - c. Laminated Steel-Stiffened Core: [0.031-inch- (0.79-mm-) **thick, stainless-steel**] [0.030-inch- (0.76-mm-) **nominal thickness uncoated steel**] [0.034-inch- (0.86-mm-) **nominal thickness metallic-coated steel**] vertical stiffeners extending full-door height, spaced not more than 6 inches (152 mm) apart, fastened to face sheets with waterproof adhesive. Fill spaces between stiffeners with mineral-fiber insulation.
 - d. Fire-Rated Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
3. Vertical Edges for Single-Acting Doors: Beveled 1/8 inch in 2 inches (3 mm in 50 mm).
 4. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch (54-mm) radius.
 5. Moldings for Glazed Lites in Doors: 0.038-inch- (0.95-mm-) thick stainless steel.
 6. Loose Stops for Glazed Lites in Doors: 0.038-inch- (0.95-mm-) thick stainless steel.
 7. Top and Bottom Channels: Closed with continuous channels, [0.062-inch- (1.59-mm-) **thick stainless steel**] [0.060-inch- (1.52-mm-) **nominal thickness uncoated steel**] [0.064-inch- (1.63-mm-) **nominal thickness metallic-coated steel**].
 - a. Spot welded to both face sheets.
 - b. Securely fastened using adhesive.
 8. Hardware Reinforcement: Fabricate according to ANSI/NAAMM-HMMA 866 with reinforcing plates from [**stainless**] [**uncoated**] [**metallic-coated**] steel.
 9. Electrical Hardware Enclosures: Provide enclosures and junction boxes within doors for electrically operated door hardware, interconnected with UL-approved, 1/2-inch- (12.7-mm-) diameter conduit and connectors.
 - a. Where indicated for installation of wiring, provide access plates to junction

boxes, fabricate from same material and thickness as face sheet and fasten with at least four security fasteners spaced not more than 6 inches (152 mm) o.c.

B. Performance: Level A, ANSI A250.4.

C. Materials:

1. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, [Type 304] [Type 316] [Type 304 or 316 as indicated] <Insert type>.
2. Steel Sheet: ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, Commercial Steel (CS), Type B.
3. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
4. Foam-Plastic Insulation: Manufacturer's standard [polystyrene] [urethane] board insulation with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within door.
5. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers.

D. Stainless-Steel Finishes:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - c. Directional Satin Finish: No. 4.
 - d. Dull Satin Finish: No. 6.
 - e. Mirrorlike Reflective, Nondirectional Polish: No. 8.
3. Bright, Cold-Rolled, Unpolished Finish: No. 2B.[**Factory primed for field finish.**]

2.3 STAINLESS-STEEL PANELS

- A. Provide stainless-steel panels of same construction, materials, and finish as specified for adjoining stainless-steel doors.

2.4 STAINLESS-STEEL FRAMES

- A. Description: Fabricate stainless-steel frames of construction indicated, with faces of corners mitered and contact edges closed tight.

1. Doorframes: [**Machine mitered, faces only welded**] [**Saw mitered and full**

(continuously) welded [**Machine mitered and full welded**] [**Knock down**]
[**Slip on**] [**As indicated**].

- a. Weld frames according to HMMA 820.
2. [**Sidelight**] [**Transom**] [**and**] [**Borrowed-Light**] Frames: [**Machine mitered, faces only welded**] [**Saw mitered and full (continuously) welded**] [**Machine mitered and full welded**].
3. Doorframes for Openings **48 Inches** (1219 mm) Wide or Less: Fabricate from [**0.062-inch-** (1.59-mm-)] [**0.078-inch-** (1.98-mm-)] [**0.109-inch-** (2.78-mm-)] thick, stainless-steel sheet.
4. Doorframes for Openings More Than **48 Inches** (1219 mm) Wide: Fabricate from [**0.078-inch-** (1.98-mm-)] [**0.109-inch-** (2.78-mm-)] thick, stainless-steel sheet.
5. Borrowed-Light Frames: Fabricate from [**0.062-inch-** (1.59-mm-)] [**0.078-inch-** (1.98-mm-)] [**0.109-inch-** (2.78-mm-)] thick, stainless-steel sheet.
6. [**Sidelight**] [**and**] [**Transom**] Frames: Fabricate from stainless-steel sheet of same thickness as adjacent doorframe.
7. Glazing[**and Panel**] Stops: Formed integral with stainless-steel frames, minimum **5/8 inch** (16 mm) high, unless otherwise indicated.
8. Loose Stops for Glazed Lites[**and Panels**]: **0.038-inch-** (0.95-mm-) thick stainless steel.
9. Hardware Reinforcement: Fabricate according to ANSI/NAAMM-HMMA 866 with reinforcing plates from [**stainless**] [**uncoated**] [**metallic-coated**] steel.
10. Head Reinforcement: **0.109-inch-** (2.78-mm-) thick, stainless-steel channel or angle stiffener for openings widths more than **48 inches** (1219 mm).
11. Jamb Anchors:
 - a. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than [**0.062-inch-** (1.59-mm-) **thick stainless steel**] [**0.060-inch-** (1.52-mm-) **nominal thickness uncoated steel**] [**0.064-inch-** (1.63-mm-) **nominal thickness metallic-coated steel**] with corrugated or perforated straps not less than **2 inches** (50 mm) wide by **10 inches** (250 mm) long; or wire anchors not less than **0.156 inch** (4.0 mm) thick.
 - b. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than [**0.050-inch-** (1.27-mm-) **thick stainless steel**] [**0.048-inch-** (1.21-mm-) **nominal thickness uncoated steel**] [**0.052-inch-** (1.32-mm-) **nominal thickness metallic-coated steel**].
 - c. Compression Type for Slip-on Frames: Fabricate adjustable compression anchors from [**stainless**] [**uncoated**] [**metallic-coated**] steel.
 - d. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum **3/8-inch-** (9.5-mm-) diameter, [**stainless-steel**] [**uncoated steel**] [**metallic-coated steel**] bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
12. Floor Anchors: Not less than [**0.078-inch-** (1.98-mm-) **thick stainless steel**] [**0.075-inch-** (1.90-mm-) **nominal thickness uncoated steel**] [**0.079-inch-** (2.01-mm-) **nominal thickness metallic-coated steel**], and as follows:
 - a. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive

- fasteners.
- b. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than **2-inch** (50-mm) height adjustment. Terminate bottom of frames at finish floor surface.
13. Ceiling Struts: Minimum **3/8-inch-thick by 2-inch-** (9.5-mm-thick by 50-mm-) wide from **[stainless] [uncoated] [metallic-coated]** steel.
14. Plaster Guards: Not less than **[0.019-inch-** (0.48-mm-) **thick stainless steel] [0.018-inch-** (0.46-mm-) **nominal thickness uncoated steel] [0.022-inch-** (0.56-mm-) **nominal thickness metallic-coated steel]**.
- B. Performance: Level A, ANSI A250.4.
- C. Materials:
1. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, **[Type 304] [Type 316] [Type 304 or 316 as indicated] <Insert type>**.
 2. Steel Sheet: ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, Commercial Steel (CS), Type B.
 3. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum **G60** (Z180) or **A60** (ZF180) metallic coating.
 4. Frame Anchors: Stainless-steel sheet. Same type as door face.
 5. Frame Anchors: **[Steel sheet] [Metallic-coated steel sheet]**, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
 6. Inserts, Bolts, and Anchor Fasteners: Stainless-steel components complying with **ASTM F 593 and ASTM F 594, Alloy Group 1 or 2** (ASTM F 738M and ASTM F 836M, Alloy Group 1 or 4) for bolts and nuts.
 7. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
- D. Finishes:
1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - c. Directional Satin Finish: No. 4.
 - d. Dull Satin Finish: No. 6.
 - e. Mirrorlike Reflective, Nondirectional Polish: No. 8.
 3. Bright, Cold-Rolled, Unpolished Finish: No. 2B.**[Factory primed for field finish.]**

2.5 ACCESSORIES

- A. Glazing: Comply with requirements in Section 088000 "Glazing."
- B. Grout: Comply with ASTM C 476, with a slump of not more than **4 inches** (102 mm) as measured according to ASTM C 143/C 143M.
- C. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for **15-mil** (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- D. Mineral Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers.

2.6 FABRICATION

- A. Stainless-Steel Door Fabrication: Stainless-steel doors to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal.
 - 1. Seamed Edge Construction: Both vertical door edges joined by visible, continuous interlocking seam (lock seam) full height of door.
 - 2. Seamed Edge Construction: Both vertical door edges joined by visible seam that is projection, spot, or tack welded on inside edges of door at minimum **6 inches** (152 mm) o.c.
 - 3. Seamless Edge Construction: Door face sheets joined at vertical edges by continuous weld extending full height of door; with edges ground and polished, providing smooth, flush surfaces with no visible seams.
 - 4. Exterior Doors: Close top edges flush and seal joints against water penetration. Provide weep-hole openings in bottom of exterior doors to permit moisture to escape.
 - 5. Stops and Moldings: Factory cut openings in doors. Provide stops and moldings around glazed lites. Form corners of stops and moldings with butted or mitered hairline joints.
 - a. Glazed Lites: Provide fixed stops and moldings welded on secure side of door.
 - b. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.
 - 6. Hardware Preparation: Factory prepare stainless-steel doors to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in [**Section 087100 "Door Hardware."**] [**Section 087111 "Door Hardware (Descriptive Specification)."**]
 - a. Reinforce doors to receive nontemplated mortised and surface-mounted door hardware.

7. Locate hardware as indicated, or if not indicated, according to HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."
 8. Tolerances: Fabricate doors to tolerances indicated in ANSI/NAAMM-HMMA 866.
- B. Stainless-Steel Frame Fabrication: Fabricate stainless-steel frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
1. Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated from same thickness metal as frames.
 2. **[Mullions] [Rails] [and] [Transom Bars]**: Provide closed tubular members with no visible face seams or joints. Fasten members at crossings and to jambs by butt welding according to joint designs in HMMA 820.
 - a. Provide false head member to receive lower ceiling where frames extend to finish ceilings of different heights.
 3. Provide countersunk, flat-, or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than **18 inches** (457 mm) from top and bottom of frame. Space anchors not more than **32 inches** (813 mm) o.c. and as follows:
 - 1) Two anchors per jamb up to **60 inches** (1524 mm) in height.
 - 2) Three anchors per jamb from **60 to 90 inches** (1524 to 2286 mm) in height.
 - 3) Four anchors per jamb from **90 to 96 inches** (2286 to 2438 mm) in height.
 - 4) Four anchors per jamb plus one additional anchor per jamb for each **24 inches** (610 mm) or fraction thereof more than **96 inches** (2438 mm) in height.
 - b. Stud-Wall Type: Locate anchors not more than **18 inches** (457 mm) from top and bottom of frame. Space anchors not more than **32 inches** (813 mm) o.c. and as follows:
 - 1) Three anchors per jamb up to **60 inches** (1524 mm) in height.
 - 2) Four anchors per jamb from **60 to 90 inches** (1524 to 2286 mm) in height.

- 3) Five anchors per jamb from **90 to 96 inches** (2286 to 2438 mm) in height.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each **24 inches** (610 mm) or fraction thereof more than **96 inches** (2438 mm) in height.
 - 5) Two anchors per head for frames more than **42 inches** (1066 mm) wide and mounted in metal-stud partitions.
- c. Compression Type: Not less than two anchors in each jamb.
 - d. Postinstalled Expansion Type: Locate anchors not more than **6 inches** (152 mm) from top and bottom of frame. Space anchors not more than **26 inches** (660 mm) o.c.
6. Head Reinforcement: For frames more than **48 inches** (1219 mm) wide, provide continuous head reinforcement for full width of opening, welded to back of frame at head.
 7. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.
 - a. Single-Doorframes: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Doorframes: Drill stop in head jamb to receive two door silencers.
 8. Stops and Moldings: Provide stops and moldings around [**glazed lites**] [**and**] [**solid panels**] where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
 - a. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of door or frame.
 - b. Multiple Glazed Lites: Provide fixed and removable stops and moldings such that each lite is capable of being removed independently.
 - c. Coordinate rabbet width between fixed and removable stops with type of glazing[**or panel**] and type of installation indicated.
 - d. Terminated Stops: Where indicated for interior doorframes, terminate stops **6 inches** (152 mm) above finish floor with a [**45**] [**90**]-degree angle cut, and close open end of stop with stainless-steel sheet closure. Cover opening in extension of frame with welded-stainless-steel filler plate, with welds ground smooth and flush with frame.
 9. Hardware Preparation: Factory prepare stainless-steel frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in [**Section 087100 "Door Hardware."**] [**Section 087111 "Door Hardware (Descriptive Specification)."**]
 - a. Reinforce frames to receive nontemplated mortised and surface-mounted door hardware.
 - b. Locate hardware as indicated, or if not indicated, according to HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."

10. Plaster Guards: Weld guards to frame at back of hardware mortises and mounting holes in frames to be grouted.
11. Tolerances: Fabricate frames to tolerances indicated in ANSI/NAAMM-HMMA 866.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stainless-steel doors and frames.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of stainless-steel, door-frame connections before frame installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation and with installation spreaders in place, adjust and securely brace stainless-steel doorframes for squareness, alignment, twist, and plumb to the following tolerances:
 1. Squareness: Plus or minus **1/16 inch** (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 2. Alignment: Plus or minus **1/16 inch** (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 3. Twist: Plus or minus **1/16 inch** (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 4. Plumbness: Plus or minus **1/16 inch** (1.6 mm), measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install stainless-steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with ANSI/NAAMM-HMMA 866 and manufacturer's written instructions.
- B. Stainless-Steel Frames: Install stainless-steel frames of size and profile indicated.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable glazing stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Apply corrosion-resistant coating to backs of grout-filled frames.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors, if so indicated and approved on Shop Drawings.
3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
4. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
5. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
6. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members.
7. Grouted Frames: Solidly fill space between frames and substrate with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
8. Installation Tolerances: Adjust stainless-steel frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus **1/16 inch** (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus **1/16 inch** (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus **1/16 inch** (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus **1/16 inch** (1.6 mm), measured at jambs at floor.

- C. Stainless-Steel Doors: Fit non-fire-rated doors accurately in frames with the following clearances:
1. Non-Fire-Rated Doors:
 - a. Jambs and Head: **1/8 inch** (3 mm) plus or minus **1/16 inch** (1.6 mm).
 - b. Between Edges of Pairs of Doors: **1/8 inch** (3 mm) plus or minus **1/16 inch** (1.6 mm).
 - c. Between Bottom of Door and Top of Threshold: Maximum **3/8 inch** (9.5 mm).
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum **3/4 inch** (19 mm).
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 3. Smoke-Control Doors: Install doors according to NFPA 105.
- D. Glazing: Install glazing in sidelights, transoms, and borrowed lights to comply with installation requirements in Section 088000 "Glazing."
1. Secure stops with countersunk, flat-, or oval-head machine screws spaced uniformly not more than **9 inches** (230 mm) o.c., and not more than **2 inches** (50 mm) o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work including stainless-steel doors or frames that are warped, bowed, or otherwise unacceptable.
- B. Clean grout and other bonding material off stainless-steel doors and frames immediately after installation.
- C. Stainless-Steel Touchup: Immediately after erection, smooth any abraded areas of stainless steel and polish to match undamaged finish.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work

described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 081119

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid-core doors[**and transom panels**] with [**wood-veneer**] faces.
2. [**Factory finishing**] flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Sections:

1. [**Section 062023 "Interior Finish Carpentry"**] [**Section 064023 "Interior Architectural Woodwork"**] for wood doorframes[**including fire-rated wood doorframes**].
2. [**Section 064023 "Interior Architectural Woodwork"**] [**Section 064200 "Wood Paneling"**] for requirements for veneers from the same flitches for both flush wood doors and wood paneling.
3. Section 088000 "Glazing" for glass view panels in flush wood doors.
4. [**Section 099113 "Exterior Painting"**] [**Section 099123 "Interior Painting"**] [**and**] [**Section 099300 "Staining and Transparent Finishing"**] for field finishing doors.
5. Section 134900 "Radiation Protection" for lead-lined flush wood doors.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of door indicated. Include details of core and edge construction[, **louvers,**] and trim for openings.[**Include factory-finishing specifications.**]

1. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Certificates for [**Credit MR 6**] [**Credit MR 7**]: Chain-of-custody certificates

- indicating that flush wood doors comply with forest certification requirements.[**Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body.**] Include statement indicating cost for each certified wood product.
2. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that product contains no urea formaldehyde.
 3. Laboratory Test Reports for Credit IEQ 4: For **[adhesives] [composite wood products] [and] [paints and coatings]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
1. Indicate dimensions and locations of mortises and holes for hardware.
 2. Indicate dimensions and locations of cutouts.
 3. Indicate requirements for veneer matching.
 4. Indicate doors to be factory finished and finish requirements.
 5. Indicate fire-protection ratings for fire-rated doors.
- D. Samples for Initial Selection: For **[factory-finished doors]**.
- E. Samples for Verification:
1. Factory finishes applied to actual door face materials, approximately **8 by 10 inches** (200 by 250 mm), for each material and finish. **[For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.]**
 2. Plastic laminate, **6 inches** (150 mm) square, for each color, texture, and pattern selected.
 3. Corner sections of doors, approximately **8 by 10 inches** (200 by 250 mm), with door faces and edges representing actual materials to be used.
 - a. Provide samples for each species of veneer and solid lumber required.
 - b. Provide samples for each color, texture, and pattern of plastic laminate required.
 - c. Finish veneer-faced door samples with same materials proposed for factory-finished doors.
 4. Louver blade and frame sections, **6 inches** (150 mm) long, for each material and finish specified.
 5. Frames for light openings, **6 inches** (150 mm) long, for each material, type, and finish required.
- 1.4 INFORMATIONAL SUBMITTALS
- A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Source Limitations: Obtain flush wood doors[**and wood paneling**] from single manufacturer.
- C. Quality Standard: In addition to requirements specified, comply with **[AWI's "Architectural Woodwork Quality Standards Illustrated."]** **[WDMA I.S.1-A, "Architectural Wood Flush Doors."]** **[WI's "Manual of Millwork."]**
 - 1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.
 - 2. Provide WI-Certified Compliance Certificate indicating that doors comply with requirements of grades specified.
 - 3. Provide WI-Certified Compliance Certificate for installation.
- D. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at **[positive pressure]** **[as close to neutral pressure as possible]** according to **[NFPA 252]** **[UBC Standard 7-2]** **[or]** **[UL 10B]** **[UL 10C]**.
 - 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 - 2. Temperature-Rise Limit: **[Where indicated]** **[At vertical exit enclosures and exit passageways]**, provide doors that have a maximum transmitted temperature end point of not more than **450 deg F** (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
- E. Preinstallation Conference: Conduct conference at **[Project site]** **[time and location as determined by DEN Project Manager]** **<Insert location>**.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in **[plastic bags or cardboard cartons]** **[cardboard cartons and wrap bundles of doors in plastic sheeting]**.

- C. Mark each door on[**top and**] bottom rail with opening number used on Shop Drawings.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between **60 and 90 deg F** (16 and 32 deg C) and relative humidity between **[25 and 55] [17 and 50] <Insert humidity range>** percent during the remainder of the construction period.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than **1/4 inch** (6.4 mm) in a **42-by-84-inch** (1067-by-2134-mm) section.
 - b. Telegraphing of core construction in face veneers exceeding **0.01 inch in a 3-inch** (0.25 mm in a 76.2-mm) span.
 - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.
- B. CONSTRUCTION WASTE MANAGEMENT
 - 1. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Algoma Hardwoods, Inc.

2. Ampco, Inc.
3. Buell Door Company Inc.
4. Chappell Door Co.
5. Eagle Plywood & Door Manufacturing, Inc .
6. Eggers Industries.
7. Graham; an Assa A bloy Group company.
8. Haley Brothers, Inc.
9. Ideal Architectural Doors & Plywood.
10. Ipik Door Company.
11. Lambton Doors.
12. Marlite.
13. Marshfield Door Systems, Inc.
14. Mohawk Flush Doors, Inc.; a Masonite company.
15. Oshkosh Architectural Door Company.
16. Poncraft Door Company.
17. Vancouver Door Company.
18. VT Industries Inc.
19. <Insert manufacturer>
20. or approved equal.

2.2 DOOR CONSTRUCTION, GENERAL

- A. Certified Wood: Fabricate doors with [**cores**] [**veneers**] [**not less than 70 percent of wood products**] [**all wood products**] produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- B. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that do not contain urea formaldehyde.
- C. Low-Emitting Materials: Fabricate doors with [**adhesives**] [**and**] [**composite wood products**] that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. WDMA I.S.1-A Performance Grade: [**Extra Heavy Duty**] [**Heavy Duty**] [**Standard Duty**] [**As indicated**].
- E. WDMA I.S.1-A Performance Grade:
 1. Heavy Duty unless otherwise indicated.
 2. Extra Heavy Duty: [**Classrooms**] [**public toilets**] [**janitor's closets**] [**assembly spaces**] [**exits**] [**patient rooms**] <Insert locations> [**and where indicated**].
- F. Particleboard-Core Doors:
 1. Particleboard: ANSI A208.1, [**Grade LD-1**] [**or**] [**Grade LD-2**] [, made with **binder containing no urea-formaldehyde resin**].

2. Particleboard: Straw-based particleboard complying with ANSI A208.1, Grade LD-2 or M-2, except for density.
 3. Blocking: Provide wood blocking in particleboard-core doors [**as needed to eliminate through-bolting hardware.**] [**as follows:**]
 - a. 5-inch (125-mm) top-rail blocking, in doors indicated to have closers.
 - b. 5-inch (125-mm) bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
 - c. 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.
 4. Provide doors with [**glued-wood-stave**] [**structural-composite-lumber**] [**either glued-wood-stave or structural-composite-lumber**] cores instead of particleboard cores for doors indicated to receive exit devices.
- G. Structural-Composite-Lumber-Core Doors:
1. Structural Composite Lumber: WDMA I.S.10.
 - a. Screw Withdrawal, Face: 700 lbf (3100 N).
 - b. Screw Withdrawal, Edge: 400 lbf (1780 N).
- H. Fire-Protection-Rated Doors: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
1. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
 2. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. [**Provide stiles with concealed intumescent seals.**] Comply with specified requirements for exposed edges.
 3. Pairs: Provide formed-steel edges and astragals[**with intumescent seals**].
 - a. Finish steel edges and astragals with baked enamel[**same color as doors**].
 - b. Finish steel edges and astragals to match door hardware (locksets or exit devices).
- I. Mineral-Core Doors:
1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
 2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated [**as needed to eliminate through-bolting hardware.**] [**as follows:**]
 - a. 5-inch (125-mm) top-rail blocking.
 - b. 5-inch (125-mm) bottom-rail blocking, in doors indicated to have protection plates.
 - c. 5-inch (125-mm) midrail blocking, in doors indicated to have armor plates.

- d. [4-1/2-by-10-inch (114-by-250-mm) **lock blocks**] [5-inch (125-mm) **midrail blocking**], in doors indicated to have exit devices.
3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

2.3 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors <Insert drawing designation>:

1. Grade: [**Premium, with Grade AA faces**] [**Premium, with Grade A faces**]
2. Species: [**Red oak**] <Insert species>.
3. Cut: [**Rift cut**].
4. Match between Veneer Leaves: [**Slip**] match.
5. Assembly of Veneer Leaves on Door Faces: [**Running**] match.
6. Pair and Set Match: Provide for doors hung in same opening[**or separated only by mullions**].
7. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by [10 feet (3 m)] [20 feet (6 m)] <Insert distance> or more.
8. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
9. Transom Match: [**Continuous match**] [**End match**] [**As indicated**].
10. Blueprint Match: Where indicated, provide doors with faces produced from same flitches as adjacent wood paneling and arranged to provide blueprint match with wood paneling. Comply with requirements in [**Section 064023 "Interior Architectural Woodwork."**] [**Section 064200 "Wood Paneling."**]
11. Exposed Vertical[and Top] Edges: [**Same species as faces or a compatible species**]
12. Core: [**Particleboard**] [**Glued wood stave**] [**Structural composite lumber**] [**Either glued wood stave or structural composite lumber**] [**Either glued or nonglued wood stave or structural composite lumber**].
13. Construction: [**Five**] [**Five or seven**] plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering.[**Faces are bonded to core using a hot press.**]
14. Construction: Seven plies, either bonded or nonbonded construction.
15. WDMA I.S.1-A Performance Grade: [**Extra Heavy Duty**] [**Heavy Duty**] [**Standard Duty**] [**As indicated**].

2.4 LOUVERS AND LIGHT FRAMES

- A. Wood Louvers: Door manufacturer's standard solid-wood louvers unless otherwise indicated.
 1. Wood Species: [**Same species as door faces**].
- B. Metal Louvers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Louvers Inc.
 - b. Anemostat; a Mestek company.
 - c. Hiawatha Incorporated.
 - d. L & L Louvers, Inc.
 - e. LL Building Products, Inc.; a division of GAF Materials Corporation.
 - f. Louvers & Dampers, Inc.; a Mestek company.
 - g. McGill Architectural Products.
 - h. **<Insert manufacturer>**
 - i. or approved equal.
2. Blade Type: **[Vision-proof, inverted V]** .
3. Metal and Finish: Hot-dip galvanized steel, **0.040 inch** (1.0 mm) thick, **[with baked-enamel- or powder-coated finish]**.
4. Metal and Finish: Extruded aluminum with Class II, clear anodic finish, AA-M12C22A31.
5. Metal and Finish: Extruded aluminum with **[light bronze] [medium bronze] [dark bronze] [black]**, Class II, color anodic finish, AA-M12C22A32/A34.

C. Louvers for Fire-Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire-protection rating of 1-1/2 hours and less.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Louvers Inc.
 - b. Anemostat; a Mestek company.
 - c. Hiawatha Incorporated.
 - d. L & L Louvers, Inc.
 - e. LL Building Products, Inc.; a division of GAF Materials Corporation.
 - f. Louvers & Dampers, Inc.; a Mestek company.
 - g. McGill Architectural Products.
 - h. **<Insert manufacturer>**
 - i. or approved equal.
2. Metal and Finish: Hot-dip galvanized steel, **0.040 inch** (1.0 mm) thick, **[with baked-enamel- or powder-coated finish]**.

D. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of **0.048-inch-** (1.2-mm-) thick, cold-rolled steel sheet; **[with baked-enamel- or powder-coated finish]**; and approved for use in doors of fire-protection rating indicated.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with requirements in NFPA 80 for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, doorframe Shop Drawings, DHI A115-W series standards, and hardware templates.
 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.
 1. Fabricate door and transom panels with full-width, solid-lumber[, **rabbeted,**] meeting rails. Provide factory-installed spring bolts for concealed attachment into jambs of metal doorframes.
- D. Openings: Cut and trim openings through doors in factory.
 1. Light Openings: Trim openings with moldings of material and profile indicated.
 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
 3. Louvers: Factory install louvers in prepared openings.

2.6 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on[**top and**] bottom edges, edges of cutouts, and mortises.
- B. Finish doors at factory.
- C. Use only paints and coatings that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Transparent Finish:
 1. Grade: [**Premium**].
 2. Finish: AWI [**conversion varnish**] [or] [**catalyzed polyurethane**] <Insert finish **designation**> system.
 3. Finish: WDMA [**TR-4 conversion varnish**] [or] [**TR-6 catalyzed polyurethane**] <Insert finish **designation**>.

4. Finish: WI System [**4 clear conversion varnish**] [**5 catalyzed polyurethane**] [**or**] [**8 UV-curable coating**] <Insert finish designation>.
5. Staining: [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] [**None required**].
6. Effect: [**Open-grain finish**] [**Filled finish**] [**Semifilled finish, produced by applying an additional finish coat to partially fill the wood pores**].
7. Sheen: [**Satin**] [**Semigloss**].

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed doorframes before hanging doors.
 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware" and Section 087111 "Door Hardware (Descriptive Specification)."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 1. Clearances: Provide **1/8 inch** (3.2 mm) at heads, jambs, and between pairs of doors. Provide **1/8 inch** (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide **1/4 inch** (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.
 - a. Comply with NFPA 80 for fire-rated doors.
 2. Bevel non-fire-rated doors **1/8 inch in 2 inches** (3-1/2 degrees) at lock and hinge edges.
 3. Bevel fire-rated doors **1/8 inch in 2 inches** (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.

- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 081416

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Access doors and frames for walls and ceilings.
 - 2. Floor access doors and frames.
- B. Related Requirements:
 - 1. Section 077200 "Roof Accessories" for roof hatches.
 - 2. Section 083113.53 "Security Access Doors and Frames" for access doors and frames for security applications.
 - 3. Section 233300 "Air Duct Accessories" for heating and air-conditioning duct access doors.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ALLOWANCES

- A. Access doors and frames are part of an access door and frame allowance.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details[, **fire ratings**,] materials, individual components and profiles, and finishes.
 - 2. Include data substantiating that materials comply with requirements.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Detail fabrication and installation of access doors and frames for each type of substrate.

- C. Samples: For each door face material, at least **3 by 5 inches** (75 by 125 mm) in size, in specified finish.
- D. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

1.5 QUALITY ASSURANCE

- A. General: Furnish each access door assembly manufactured as an integral unit, complete with all parts, and ready for installation.
- B. Single Source Responsibility: Obtain access doors for entire project from one source from a single manufacturer.
- C. Fire Resistance Ratings: Wherever a fire resistance classification is required, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in Underwriters Laboratories, Inc.'s "Building Materials Directory" for rating required.
- D. Provide UL label on each fire rated access door.
- E. Size Variations: Obtain DEN Project Manager's acceptance of manufacturer's standard size units, which may vary slightly from sizes indicated.
- F. Coordination: Furnish inserts and anchoring devices that must be built into other work for installation of access doors. Coordinate delivery with other work to avoid delay.

1.6 PROJECT CONDITIONS

- A. Verification: Obtain specific locations and sizes for required access doors from trades requiring access to concealed equipment, and indicate on submittal schedule.
- B. Special Size Access Doors: Use where required or requested; indicate on schedule.

1.7 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics

according to the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
2. NFPA 288 for fire-rated access door assemblies installed horizontally.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Access Panel Solutions.
2. Acudor Products, Inc.
3. Alfab, Inc.
4. Babcock-Davis.
5. Cendrex Inc.
6. Elmdor/Stoneman Manufacturing Co.; Div. of Acorn Engineering Co.
7. Jensen Industries; Div. of Broan-Nutone, LLC.
8. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
9. Karp Associates, Inc.
10. Larsen's Manufacturing Company.
11. Maxam Metal Products Limited.
12. Metropolitan Door Industries Corp.
13. MIFAB, Inc.
14. Milcor Inc.
15. Nystrom, Inc.
16. Williams Bros. Corporation of America (The).
17. **<Insert manufacturer's name>**.
18. or approved equal.

B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

C. For projects with multiple access doors, consider providing a schedule, or distinguish between units by giving each a number designation and creating an additional set of requirements for each variation.

D. Flush Access Doors with Exposed Flanges **<Insert drawing designation>**:

1. Fabricate units of continuous welded steel construction unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.
2. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
3. Locations: **[Wall] [Ceiling] [Wall and ceiling] <Insert location or substrate>**.
4. Door Size: **<Insert door size>**.
5. Uncoated Steel Sheet for Door: Minimum **[Nominal 0.060 inch (1.52 mm), 16 gage] <Insert thickness>**.

- a. Finish: **[Factory prime] [Factory finish]**.
 6. Metallic-Coated Steel Sheet for Door: Minimum **[Nominal 0.064 inch (1.63 mm), 16 gage] <Insert thickness>**.
 - a. Finish: **[Factory prime] [Factory finish]**.
 7. Stainless-Steel Sheet for Door: Minimum **[Nominal 0.062 inch (1.59 mm), @16 gage] <Insert thickness>**.
 - a. Finish: **[No. 4] [No. 2b]**.
 8. Frame Material: **[Same material, thickness, and finish as door] <Insert material, thickness, finish>**.
 - a. Fabricate frame with exposed flange nominal 1 inch wide around perimeter of frame for units installed in the following construction:
 - 1) Exposed masonry.
 - 2) Exposed concrete.
 - 3) Drywall finish.
 - 4) Ceramic tile finish.
 - b. For gypsum drywall or gypsum veneer plaster, furnish perforated frames with drywall bead.
 - c. For installation in masonry construction, furnish frames with adjustable metal masonry anchors.
 9. Hinges: **[Manufacturer's standard] <Insert hinge type> <concealed spring hinges or concealed continuous piano hinge set to open 175 degrees>**
 - a. For 2'-0" X 2'-0" or larger doors provide continuous piano hinge or minimum three (3) hinges.
 10. Hardware: Furnish flush, screwdriver operated cam locks of number required to hold door in flush, smooth plane when closed.
 - a. Provide one cylinder lock with automatic dust shutter. Type of cylinder is specified in Division 08 section "Door Hardware", master key.
- E. Flush Access Doors with Concealed Flanges **<Insert drawing designation>**:
1. Fabricate units of continuous welded steel construction unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.
 2. Assembly Description: Fabricate door to fit flush to frame. Provide frame with **[gypsum board] [plaster]** beads for concealed flange installation.
 3. Locations: **[Wall] [Ceiling] [Wall and ceiling] <Insert location or substrate>**.
 4. Door Size: **<Insert door size>**.

5. Uncoated Steel Sheet for Door: [Nominal 0.060 inch (1.52 mm), 16 gage] <Insert thickness>.
 - a. Finish: [Factory prime] [Factory finish].
 6. Metallic-Coated Steel Sheet for Door: [Nominal 0.064 inch (1.63 mm), 16 gage] <Insert thickness>.
 - a. Finish: [Factory prime] [Factory finish].
 7. Stainless-Steel Sheet for Door: [Nominal 0.062 inch (1.59 mm), 16 gage] <Insert thickness>.
 - a. Finish: [No. 4] [No. 2b].
 8. Frame Material: [Same material and thickness as door] <Insert material, thickness, finish>.
 9. Hinges: [Manufacturer's standard] <Insert hinge type>.
 10. Hardware: Furnish flush, screwdriver operated cam locks of number required to hold door in flush, smooth plane when closed.
 - a. Provide one cylinder lock with automatic dust shutter. Type of cylinder is specified in Division 08 section "Door Hardware", master key.
- F. Recessed Access Doors <Insert drawing designation>:
1. Fabricate units of continuous welded steel construction unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.
 2. Assembly Description: Fabricate door in the form of a pan recessed [1/2 inch (13 mm)] [5/8 inch (16 mm)] [1 inch (25 mm)] for [gypsum board] [plaster] [acoustical tile] <Insert material> infill. Provide frame with [gypsum board bead for concealed flange] [plaster bead for concealed flange] [no bead for acoustical tile] installation.
 3. Locations: [Wall] [Ceiling] [Wall and ceiling] <Insert location or substrate>.
 4. Door Size: <Insert door size>.
 5. Uncoated Steel Sheet for Door: [Nominal 0.060 inch (1.52 mm), 16 gage] <Insert thickness>.
 - a. Finish: [Factory prime] [Factory finish].
 6. Metallic-Coated Steel Sheet for Door: [Nominal 0.064 inch (1.63 mm), 16 gage] <Insert thickness>.
 - a. Finish: [Factory prime] [Factory finish].
 7. Stainless-Steel Sheet for Door: [Nominal 0.062 inch (1.59 mm), 16 gage] <Insert thickness>.

- a. Finish: **[No. 4] [No. 2b]**.
 8. Frame Material: **[Same material and thickness as door] <Insert material, thickness, finish>**.
 9. Hinges: **[Manufacturer's standard] <Insert hinge type>**.
 10. Hardware: Furnish flush, screwdriver operated cam locks of number required to hold door in flush, smooth plane when closed.
 - a. Provide one cylinder lock with automatic dust shutter. Type of cylinder is specified in Division 08 section "Door Hardware", master key.
- G. Exterior Flush Access Doors **<Insert drawing designation>**:
1. Fabricate units of continuous welded steel construction unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.
 2. Assembly Description: Fabricate door to be weatherproof and fit flush to frame. Provide manufacturer's standard **2-inch- (50-mm-)** thick fiberglass insulation and extruded door gaskets. Provide manufacturer's standard-width frame for surface mounting, proportional to door size.
 3. Locations: **[Wall] <Insert location or substrate>**.
 4. Door Size: **<Insert door size>**.
 5. Metallic-Coated Steel Sheet for Door: **[Nominal 0.064 inch (1.63 mm), 16 gage] <Insert thickness>**.
 - a. Finish: **[Factory prime] [Factory finish]**.
 6. Stainless-Steel Sheet for Door: **[Nominal 0.062 inch (1.59 mm), 16 gage] <Insert thickness>**.
 - a. Finish: **[No. 4] [No. 2b]**.
 7. Frame Material: **[Same material, thickness, and finish as door] <Insert material, thickness, finish>**.
 8. Hinges: **[Manufacturer's standard] <Insert hinge type>**.
 9. Hardware: Furnish flush, screwdriver operated cam locks of number required to hold door in flush, smooth plane when closed.
 - a. Provide one cylinder lock with automatic dust shutter. Type of cylinder is specified in Division 08 section "Door Hardware", master key.
- H. Fire-Rated, Flush Access Doors with Exposed Flanges **<Insert drawing designation>**:
1. Fabricate units of continuous welded steel construction unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.

2. Assembly Description: Fabricate door to fit flush to frame, [**with a core of mineral-fiber insulation enclosed in sheet metal**] [**uninsulated**]. Provide self-latching door with automatic closer and interior latch release. Provide manufacturer's standard-width exposed flange, proportional to door size.
 3. Locations: [**Wall**] [**Ceiling**] [**Wall and ceiling**] <Insert location or substrate>.
 4. Fire-Resistance Rating: Not less than [**that indicated**] [**that of adjacent construction**] [**45 minutes**] [**1 hour**] [**1-1/2 hours**] [**2 hours**] [**3 hours**] <Insert requirement>.
 5. Temperature-Rise Rating: [**450 deg F (250 deg C) at the end of 30 minutes**] [**250 deg F (139 deg C) at the end of 30 minutes**].
 6. Uncoated Steel Sheet for Door: [**Nominal 0.036 inch (0.91 mm), 20 gage**] <Insert thickness>.
 - a. Finish: [**Factory prime**] [**Factory finish**].
 7. Metallic-Coated Steel Sheet for Door: [**Nominal 0.040 inch (1.02 mm), 20 gage**] <Insert thickness>.
 - a. Finish: [**Factory prime**] [**Factory finish**].
 8. Stainless-Steel Sheet for Door: [**Nominal 0.038 inch (0.95 mm), 20 gage**] <Insert thickness>.
 - a. Finish: [**No. 4**] [**No. 2b**].
 9. Frame Material: [**Same material, thickness, and finish as door**] <Insert material, thickness, finish>.
 10. Hinges: [**Manufacturer's standard**] <Insert hinge type>.
 11. Hardware: Furnish flush, screwdriver operated cam locks of number required to hold door in flush, smooth plane when closed.
 - a. Provide one cylinder lock with automatic dust shutter. Type of cylinder is specified in Division 08 section "Door Hardware", master key.
- I. Fire-Rated, Flush Access Doors with Concealed Flanges <Insert drawing designation>:
1. Fabricate units of continuous welded steel construction unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.
 2. Assembly Description: Fabricate door to fit flush to frame, [**with a core of mineral-fiber insulation enclosed in sheet metal**] [**uninsulated**]. Provide self-latching door with automatic closer and interior latch release. Provide frame with [**gypsum board**] [**plaster**] beads for concealed flange installation.
 3. Locations: [**Wall**] [**Ceiling**] [**Wall and ceiling**] <Insert location or substrate>.
 4. Fire-Resistance Rating: Not less than [**that indicated**] [**that of adjacent construction**] [**45 minutes**] [**1 hour**] [**1-1/2 hours**] [**2 hours**] [**3 hours**] <Insert requirement>.

5. Temperature-Rise Rating: [450 deg F (250 deg C) at the end of 30 minutes] [250 deg F (139 deg C) at the end of 30 minutes].
 6. Uncoated Steel Sheet for Door: [Nominal 0.036 inch (0.91 mm), 20 gage] <Insert thickness>.
 - a. Finish: [Factory prime] [Factory finish].
 7. Metallic-Coated Steel Sheet for Door: [Nominal 0.040 inch (1.02 mm), 20 gage] <Insert thickness>.
 - a. Finish: [Factory prime] [Factory finish].
 8. Stainless-Steel Sheet for Door: [Nominal 0.038 inch (0.95 mm), 20 gage] <Insert thickness>.
 - a. Finish: [No. 4] [No. 2b].
 9. Frame Material: [Same material, thickness, and finish as door] <Insert material, thickness, finish>.
 10. Hinges: [Manufacturer's standard] <Insert hinge type>.
 11. Hardware: Furnish flush, screwdriver operated cam locks of number required to hold door in flush, smooth plane when closed.
 - a. Provide one cylinder lock with automatic dust shutter. Type of cylinder is specified in Division 08 section "Door Hardware", master key.
- J. Retain "Latch" or "Lock" Subparagraph below. Locks provide greater security than latches.
1. Latch: [Cam latch] <Insert latch> operated [by screwdriver] [as shown on Drawings] [as indicated in schedule] <Insert operator> [with interior release].
 2. Lock: [Cylinder] [As shown on Drawings] [As indicated in schedule] <Insert lock>.
 - a. Lock Preparation: Prepare door panel to accept cylinder specified in [Section 087100 "Door Hardware."] [Section 087111 "Door Hardware (Descriptive Specification)."]

2.3 FLOOR ACCESS DOORS AND FRAMES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Acudor Products, Inc.
 2. Babcock-Davis.
 3. Bilco Company (The).
 4. Cendrex Inc.
 5. Dur-Red Products.

6. Halliday Products.
 7. Jensen Industries; Div. of Broan-Nutone, LLC.
 8. Karp Associates, Inc.
 9. Maxam Metal Products Limited.
 10. Metropolitan Door Industries Corp.
 11. MIFAB, Inc.
 12. Milcor Inc.
 13. Nystrom, Inc.
 14. U.S.F. Fabrication.
 15. Williams Bros. Corporation of America (The).
 16. <Insert manufacturer's name>.
 17. or approved equal.
- B. Floor Doors, General: Equip each door with adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with red vinyl grip that allows for one-handed closure, and recessed lift handle.
- C. Steel Angle-Frame Floor Door: **[Single]** **[Double]**-leaf opening. **[Prime-painted structural]** **[Galvanized structural]** **[Stainless]**-steel frame with **[3/16- or 1/4-inch- (4.8- or 6.4-mm-)]** **[3/16-inch- (4.8-mm-)]** **[1/4-inch- (6.4-mm-)]** thick, diamond-pattern, **[prime-painted structural]** **[galvanized structural]** **[stainless]**-steel tread plate door; nonwatertight; loading capacity to support **[150-lbf/sq. ft. (7.2-kN/sq. m) pedestrian live]** **[300-lbf/sq. ft. (14.4-kN/sq. m) pedestrian live]** **[AASHTO H20 concentrated wheel]** load.
1. Fire-Resistance Rating: Not less than **[that indicated]** **[that of adjacent construction]** **[45 minutes]** **[1 hour]** **[1-1/2 hours]** **[2 hours]** **[3 hours]** <Insert requirement>.
 - a. Finish: Yellow with wording "FIRE DOOR - DO NOT STORE MATERIALS ON SURFACE."
- D. Watertight Steel Gutter-Frame Floor Door: **[Single]** **[Double]**-leaf opening. **[Prime-painted structural]** **[Galvanized structural]** **[Stainless]**-steel channel frame forming gutter with **NPS 1-1/2 (DN 40)** drainage coupling and **[3/16- or 1/4-inch- (4.8- or 6.4-mm-)]** **[3/16-inch- (4.8-mm-)]** **[1/4-inch- (6.4-mm-)]** thick, diamond-pattern, **[prime-painted structural]** **[galvanized structural]** **[stainless]**-steel tread plate door; watertight; loading capacity to support **[150-lbf/sq. ft. (7.2-kN/sq. m) pedestrian live]** **[300-lbf/sq. ft. (14.4-kN/sq. m) pedestrian live]** **[AASHTO H20 concentrated wheel]** load.
1. Fire-Resistance Rating: Not less than **[that indicated]** **[that of adjacent construction]** **[45 minutes]** **[1 hour]** **[1-1/2 hours]** **[2 hours]** **[3 hours]** <Insert requirement>.
 - a. Finish: Yellow with wording "FIRE DOOR - DO NOT STORE MATERIALS ON SURFACE."
- E. Hardware: Provide the following:

1. Hinges: Heavy-duty, [**zinc-coated steel**] [**stainless-steel**] [**brass**] butt hinges with stainless-steel pins.
2. Latch: Stainless-steel slam latch.
3. Lock: [**Staple for a padlock**] [**Recessed hasp**] [**Keyed deadbolt lock**] [**Hasp and staple**].
4. Hardware Material: [**Manufacturer's standard**] [**Stainless steel, including latch and lifting mechanism assemblies, hold-open arms, and all brackets, hinges, pins, and fasteners**].

F. Insulation: [**Fiberglass**] [**Urethane**] with liner pan.

G. Safety Accessories: Safety [**chains**] [**net**] [**railing**].

2.4 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

C. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum **G60** (Z180) or **A60** (ZF180) metallic coating.

E. Rolled-Stainless-Steel Floor Plate: ASTM A 793, manufacturer's standard finish.

F. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, [**Type 304**] [**Type 316**]. Remove tool and die marks and stretch lines or blend into finish.

G. Frame Anchors: Same type as door face.

H. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.5 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.

1. For concealed flanges with drywall bead, provide edge trim for **[gypsum board]** **[and]** **[gypsum base]** securely attached to perimeter of frames.
 2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded metal lath and exposed casing bead welded to perimeter of frames.
 3. Provide mounting holes in frames for attachment of units to metal or wood framing.
 4. Provide mounting holes in frame for attachment of masonry anchors.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.
1. For recessed doors with plaster infill, provide self-furring expanded metal lath attached to door panel.
- E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
1. For cylinder locks, furnish two keys per lock and key all locks alike.
 2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

2.6 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Steel and Metallic-Coated-Steel Finishes:
1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
 2. Factory Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry-film thickness of **1 mil** (0.025 mm) for topcoat.
- E. Stainless-Steel Finishes:
1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

- a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - c. Directional Satin Finish: No. 4.
3. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement will be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the lump sum contract price.

END OF SECTION 083113

SECTION 083113.53 - SECURITY ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes security access doors and frames for walls and ceilings.
- B. Related Requirements:
 - 1. Section 077200 "Roof Accessories" for roof hatches.
 - 2. Section 083113 "Access Doors and Frames" for access doors and frames for nonsecurity applications.
 - 3. Section 233300 "Air Duct Accessories" for heating and air-conditioning duct access doors.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ALLOWANCES

- A. Security access doors and frames are part of a security access door and frame allowance.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details[, **fire ratings**,] materials, individual components and profiles, and finishes.
 - 2. Include data substantiating that materials comply with requirements.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Detail fabrication and installation of access doors and frames for each type of substrate.

- C. Samples: For each door face material, at least **3 by 5 inches** (75 by 125 mm) in size, in specified finish.
- D. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

1.5 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. General: Furnish each access door assembly manufactured as an integral unit, complete with all parts, and ready for installation.
- B. Single Source Responsibility: Obtain access doors for entire project from one source from a single manufacturer.
- C. Fire Resistance Ratings: Wherever a fire resistance classification is required, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in Underwriters Laboratories, Inc.'s "Building Materials Directory" for rating required.
- D. Provide UL label on each fire rated access door.
- E. Size Variations: Obtain DEN Project Manager's acceptance of manufacturer's standard size units, which may vary slightly from sizes indicated.
- F. Coordination: Furnish inserts and anchoring devices that must be built into other work for installation of access doors. Coordinate delivery with other work to avoid delay.

1.7 PROJECT CONDITIONS

- A. Verification: Obtain specific locations and sizes for required access doors from trades requiring access to concealed equipment, and indicate on submittal schedule.
- B. Special Size Access Doors: Use where required or requested; indicate on schedule.

1.8 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics according to the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.

2.2 SECURITY ACCESS DOORS AND FRAMES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acudor Products, Inc.
2. Babcock-Davis.
3. Cendrex Inc.
4. Elmdor/Stoneman Manufacturing Co.; Div. of Acorn Engineering Co.
5. Jensen Industries; Div. of Broan-Nutone, LLC.
6. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
7. Karp Associates, Inc.
8. Larsen's Manufacturing Company.
9. Maxam Metal Products Limited.
10. Metropolitan Door Industries Corp.
11. MIFAB, Inc.
12. Nystrom, Inc.
13. Williams Bros. Corporation of America (The).
14. **<Insert manufacturer's name>**.
15. or approved equal.

- B. Medium-Security Flush Access Doors with Exposed Flanges **<Insert drawing designation>**:

1. Fabricate units of continuous welded steel construction unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.
2. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
3. Locations: **[Wall] [Ceiling] [Wall and ceiling] <Insert location or substrate>**.
4. Door Size: **<Insert door size>**.
5. Uncoated Steel Sheet for Door: **[Nominal 0.105 inch (2.66 mm), 12 gage] [Nominal 0.075 inch (1.90 mm), 14 gage]**.
 - a. Finish: Factory prime.

6. Metallic-Coated Steel Sheet for Door: **[Nominal 0.108 inch (2.74 mm), 12 gage]**
[Nominal 0.079 inch (2.01 mm), 14 gage].
 - a. Finish: Factory prime.
 7. Stainless-Steel Sheet for Door: **[Nominal 0.109 inch (2.78 mm), 12 gage]**
[Nominal 0.078 inch (1.98 mm), 14 gage].
 - a. Finish: No. 4.
 8. Frame Material: **[Same material, thickness, and finish as door]** **[Minimum 3/16-by-1-1/2-by-1-1/2-inch (4.7-by-38-by-38-mm) angle welded with joints ground smooth; factory prime]** **<Insert material, thickness, finish>**.
 - a. Fabricate frame with exposed flange nominal 1 inch wide around perimeter of frame for units installed in the following construction:
 - 1) Exposed masonry.
 - 2) Exposed concrete.
 - 3) Drywall finish.
 - 4) Ceramic tile finish.
 - b. For gypsum drywall or gypsum veneer plaster, furnish perforated frames with drywall bead.
 - c. For installation in masonry construction, furnish frames with adjustable metal masonry anchors.
 9. Hinges: **[Manufacturer's standard security hinge]** **<Insert hinge type>**.
 10. Hardware: Furnish flush cam locks of number required to hold door in flush, smooth plane when closed.
 - a. Provide one cylinder lock with automatic dust shutter. Type of cylinder is specified in Division 08 section "Door Hardware", master key.
- C. Medium-Security Flush Access Doors with Concealed Flanges **<Insert drawing designation>**:
1. Fabricate units of continuous welded steel construction unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.
 2. Assembly Description: Fabricate door to fit flush to frame. Provide frame with **[gypsum board]** **[plaster]** beads for concealed flange installation.
 3. Locations: **[Wall]** **[Ceiling]** **[Wall and ceiling]** **<Insert location or substrate>**.
 4. Door Size: **<Insert door size>**.
 5. Uncoated Steel Sheet for Door: **[Nominal 0.105 inch (2.66 mm), 12 gage]**
[Nominal 0.075 inch (1.90 mm), 14 gage].
 - a. Finish: Factory prime.

6. Metallic-Coated Steel Sheet for Door: **[Nominal 0.108 inch (2.74 mm), 12 gage]**
[Nominal 0.079 inch (2.01 mm), 14 gage].
 - a. Finish: Factory prime.
 7. Stainless-Steel Sheet for Door: **[Nominal 0.109 inch (2.78 mm), 12 gage]**
[Nominal 0.078 inch (1.98 mm), 14 gage].
 - a. Finish: No. 4.
 8. Frame Material: **[Same material, thickness, and finish as door] <Insert material, thickness, finish>**.
 9. Hinges: **[Manufacturer's standard security hinge] <Insert hinge type>**.
 10. Hardware: Furnish flush cam locks of number required to hold door in flush, smooth plane when closed.
 - a. Provide one cylinder lock with automatic dust shutter. Type of cylinder is specified in Division 08 section "Door Hardware", master key.
- D. High-Security Flush Access Doors **<Insert drawing designation>**:
1. Fabricate units of continuous welded steel construction unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.
 2. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
 3. Locations: **[Wall] [Ceiling] [Wall and ceiling] <Insert location or substrate>**.
 4. Door Size: **<Insert door size>**.
 5. Uncoated Steel Sheet for Door: Nominal **0.134 inch (3.42 mm)**, 10 gage.
 - a. Finish: Factory prime.
 6. Metallic-Coated Steel Sheet for Door: Nominal **0.138 inch (3.50 mm)**, 10 gage.
 - a. Finish: Factory prime.
 7. Stainless-Steel Sheet for Door: Nominal **0.141 inch (3.57 mm)**, 10 gage.
 - a. Finish: No. 4.
 8. Frame Material: **[Same material, thickness, and finish as door] [Minimum 3/16-by-2-by-2-by-3-inch (4.7-by-50-by-50-by-76-mm) angle welded with joints ground smooth; factory prime] <Insert material, thickness, finish>**.
 9. Hinges: **[Manufacturer's standard security hinge] <Insert hinge type>**.
 10. Hardware: Furnish flush, cam locks of number required to hold door in flush, smooth plane when closed.
 - a. Provide one cylinder lock with automatic dust shutter. Type of cylinder is specified in Division 08 section "Door Hardware", master key.
- E. Maximum-Security Flush Access Doors **<Insert drawing designation>**:

1. Fabricate units of continuous welded steel construction unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.
 2. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
 3. Locations: **[Wall] [Ceiling] [Wall and ceiling]** <Insert location or substrate>.
 4. Door Size: <Insert door size>.
 5. Uncoated Steel Sheet for Door: Nominal **0.180 inch** (4.55 mm), 7 gage.
 - a. Finish: Factory prime.
 6. Metallic-Coated Steel Sheet for Door: Nominal **0.183 inch** (4.65 mm), 7 gage.
 - a. Finish: Factory prime.
 7. Frame: Minimum **3/16-by-2-by-2-by-3-inch** (4.7-by-50-by-50-by-76-mm) angle welded with joints ground smooth.
 8. Hinges: Heavy-duty steel welded to door and frame.
 9. Hardware: Furnish flush cam locks of number required to hold door in flush, smooth plane when closed.
 - a. Provide one cylinder lock with automatic dust shutter. Type of cylinder is specified in Division 08 section "Door Hardware", master key.
- F. Fire-Rated, Medium-Security, Flush Access Doors <Insert drawing designation>:
1. Fabricate units of continuous welded steel construction unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.
 2. Assembly Description: Fabricate door to fit flush to frame, **[with a core of mineral-fiber insulation enclosed in sheet metal] [uninsulated]**. Provide manufacturer's standard-width exposed flange, proportional to door size.
 3. Locations: **[Wall] [Ceiling] [Wall and ceiling]** <Insert location or substrate>.
 4. Fire-Resistance Rating: Not less than **[that indicated] [that of adjacent construction] [45 minutes] [1 hour] [1-1/2 hours] [2 hours] [3 hours]** <Insert requirement>.
 5. Temperature-Rise Rating: Maximum **[450 deg F (250 deg C) at the end of 30 minutes] [250 deg F (139 deg C) at the end of 30 minutes]**.
 6. Door Size: <Insert door size>.
 7. Uncoated Steel Sheet for Door: **[Nominal 0.105 inch (2.66 mm), 12 gage] [Nominal 0.075 inch (1.90 mm), 14 gage]**.
 - a. Finish: Factory prime.
 8. Metallic-Coated Steel Sheet for Door: **[Nominal 0.108 inch (2.74 mm), 12 gage] [Nominal 0.079 inch (2.01 mm), 14 gage]**.
 - a. Finish: Factory prime.

9. Stainless-Steel Sheet for Door: [**Nominal 0.109 inch** (2.78 mm), **12 gage**] [**Nominal 0.078 inch** (1.98 mm), **14 gage**].
 - a. Finish: No. 4.
10. Frame Material: [**Same material, thickness, and finish as door**] [**Minimum 3/16-by-1-1/2-by-1-1/2-inch** (4.7-by-38-by-38-mm) **angle welded with joints ground smooth; factory prime**] <Insert material, thickness, finish>.
11. Hinges: [**Manufacturer's standard security hinge**] <Insert hinge type>.
12. Hardware: Furnish flush cam locks of number required to hold door in flush, smooth plane when closed.
 - a. Provide one cylinder lock with automatic dust shutter. Type of cylinder is specified in Division 08 section "Door Hardware", master key.

G. Hardware:

1. Latch: [**Cam latch**] <Insert latch> operated [**by hex-head wrench**] [**by pinned-hex-head wrench**] [**by flush key**] [**by paracentric key**] [**by ring turn**] [**as shown on Drawings**] [**as indicated in schedule**] <Insert operator> [**with interior release**].
2. Lock: [**Cylinder**] [**As shown on Drawings**] [**As indicated in schedule**] <Insert lock>.
3. Lock Preparation: Prepare door panel to accept cylinder specified in [**Section 087100 "Door Hardware."**] [**Section 087111 "Door Hardware (Descriptive Specification)."**] [**Section 087163 "Detention Door Hardware."**]

2.3 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum **G60** (Z180) or **A60** (ZF180) metallic coating.
- D. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, [**Type 304**] [**Type 316**]. Remove tool and die marks and stretch lines or blend into finish.
- E. Frame Anchors: Same type as door face.
- F. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.4 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 - 1. For concealed flanges with drywall bead, provide edge trim for **[gypsum board]** **[and]** **[gypsum base]** securely attached to perimeter of frames.
 - 2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded metal lath and exposed casing bead welded to perimeter of frames.
 - 3. Provide mounting holes in frames for attachment of units to metal or wood framing.
 - 4. Provide mounting holes in frame for attachment of masonry anchors.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 - 1. For cylinder lock, furnish two keys per lock and key all locks alike.

2.5 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Steel and Metallic-Coated-Steel Finishes:
 - 1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
 - 2. Factory Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry-film thickness of **1 mil** (0.025 mm) for topcoat.
- E. Stainless-Steel Finishes:

1. Surface Preparation: Remove tool and die marks and stretch lines or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - c. Directional Satin Finish: No. 4.
3. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement will be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the lump sum contract price.

SECTION 083213 - SLIDING ALUMINUM-FRAMED GLASS DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes sliding aluminum-framed glass doors for exterior locations.
- B. Related Sections:
 - 1. Section 084113 "Aluminum-Framed Entrances and Storefronts" for coordinating finish among aluminum fenestration units on the building exterior.
 - 2. Section 085113 "Aluminum Windows" for related aluminum-framed transom and sidelite windows and mullions and for coordinating finish among aluminum fenestration units on the building exterior.
 - 3. Section 087100 "Door Hardware" for hardware not specified in this Section.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide sliding aluminum-framed glass doors capable of complying with performance requirements indicated, based on testing manufacturer's sliding doors that are representative of those specified, and that are of minimum test size indicated below:
 - 1. Size required by AAMA/WDMA/CSA 101/I.S.2/A440 for **optional performance grade**.
 - 2. Size indicated [**on Drawings**] [**in a schedule**].
 - 3. **<Insert size>**.
- B. Structural Performance: Provide sliding aluminum-framed glass doors capable of withstanding the effects of the following loads, based on testing units representative of those indicated for Project that pass AAMA/WDMA/CSA 101/I.S.2/A440, Uniform Load Structural Test:
 - 1. Design Wind Loads: Determine design wind loads under conditions indicated according to [**ASCE/SEI 7**] **<Insert requirement>**.

- a. Basic Wind Speed: 115 mph (51 m/s) with gust factor of 1.3. .
 - b. Importance Factor: 1.15 .
 - c. Exposure Category: **C** .
 - d. **<Insert factor>**.
2. Deflection Limits: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or **3/4 inch (19 mm)**, whichever is less, at design pressure based on testing performed according to AAMA/WDMA/CSA 101/I.S.2/A440, Uniform Load Deflection Test, or structural computations.
- C. Windborne-Debris Resistance: Provide sliding aluminum-framed glass doors capable of resisting impact from windborne debris, based on the pass/fail criteria as determined from testing sliding aluminum-frames glass doors identical to those specified, according to **[ASTM E 1886 and testing information in ASTM E 1996] [or] [AAMA 506] <Insert test method>** and requirements of authorities having jurisdiction.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): Minus 30 deg F (minus 35 de. C) to **120 deg F (67 deg C)**, **ambient; 180 deg F (100 deg C)** max, material surfaces.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions.
1. Include data substantiating that materials comply with requirements.
- B. Product certificates signed by the aluminum sliding glass door manufacturer certifying that door units comply with specified performance requirements.
- C. Shop Drawings: For sliding aluminum-framed glass doors. Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, and the following:
1. Mullion details for fenestration combinations including reinforcement and stiffeners.
 2. Joinery details.
 3. Expansion provisions.
 4. Flashing and drainage details.
 5. Weather-stripping details.
 6. Thermal-break details.
 7. Glazing details.
 8. Accessories.

- D. Samples for Initial Selection: For each type of sliding aluminum-framed glass door indicated.
1. Include similar Samples of hardware and accessories involving color selection.
- E. Samples for Verification: For sliding aluminum-framed glass doors and components required, prepared on Samples of size indicated below:
1. Main Framing Member: **12-inch- (300-mm-)** long section with[**weather stripping,**] glazing bead and factory-applied color finish.
 2. Hardware: Full-size units with factory-applied finish.
 3. **<Insert component>: <Insert description>.**
 4. The DEN Project Manager reserves the right to require additional samples that show fabrication techniques and workmanship, and design of hardware and accessories.
- F. Delegated-Design Submittal: For sliding aluminum-framed glass doors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation and used to determine the following:
1. Structural test pressures and design pressures from wind loads indicated.
 2. Deflection limitations of glass framing systems.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified [**Installer**] [**manufacturer**] [**professional engineer**] [**and**] [**testing agency**].
- B. Product Test Reports: Based on evaluation of comprehensive tests performed[**within the last four years**] by a qualified testing agency, for each class, grade, and size of sliding aluminum-framed glass door.[**Test results based on use of downsized test doors will not be accepted.**]
- C. Field quality-control reports.
- D. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For[**finishes,**] weather stripping, operable panels, and operating hardware to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating sliding aluminum-framed glass doors that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.
1. Provide only AAMA "Quality Certified" aluminum sliding glass doors with an attached label.
- B. Installer Qualifications: An installer acceptable to sliding door manufacturer for installation of units required for this Project.
1. Installer's responsibilities include providing professional engineering services needed to assume engineering responsibility including preparation of data for sliding aluminum-framed glass doors, including Shop Drawings and Designated-Design Submittal, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- C. Source Limitations: Obtain sliding aluminum-framed glass doors from single source from single manufacturer.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of sliding aluminum-framed glass doors. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
- E. Product Options: Drawings indicate size, profiles, and dimensional requirements of sliding aluminum-framed glass doors and are based on the specific system indicated. Refer to Section 016000 "Product Requirements." Do not modify size and dimensional requirements.
1. Do not modify intended aesthetic effects, as judged solely by DEN Project Manager, except with DEN Project Manager's approval. If modifications are proposed, submit comprehensive explanatory data to DEN Project Manager for review.
- F. Fenestration Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440, "Standard/Specification for Windows, Doors, and Unit Skylights," for minimum standards of performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
1. Provide [**AAMA**] [**WDMA**]-certified, sliding aluminum-framed glass doors with an attached label.

- G. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201.
1. Subject to compliance with requirements, permanently mark safety glass with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction.
- H. Glazing Publications: Comply with published recommendations of glass manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.
- I. Single Source Responsibility: The "Exterior skin installer" is to provide the structural calculations, coordination, fabrication, installation and warranty for all work associated with the exterior skin, which includes the following: Section 074213.12, "Formed Metal Wall Panels", Section 074213.16 "Metal Plate Wall Panels", Section 074213.19 "Insulated Metal Wall Panels", Section 074213.23 "Metal Composite Material Wall Panels", Section 084113, "Glazed Aluminum Curtain Walls", Section 084213 "Aluminum-Framed Entrances", Section 084413 "Glazed Aluminum Curtain Walls", Section 085113 "Aluminum Windows", Section 089116 "Operable Wall Louvers" Section 089119 "Fixed Louvers", Section 089516 "Wall Vents", and the following:
1. All cold-formed metal framing or metal fabrications associated with the above. Cold-formed metal framing to be of the size and spacing indicated on the drawings, except gauge shall be as needed as determined by the structural calculations required, but in no case less than 14 gauge. Metal fabrications shall be of the size indicated on the drawings, except thickness shall be as determined by the structural calculations required. Provide additional fabrications as needed. All of this work to be in accordance with requirements of Section 054000, "Cold-Formed Metal Framing" and Section 055000 "Metal Fabrications".
 2. All expansion joints in the exterior side of the above exterior wall, per Section 079500 "Expansion Control".
 3. All joint sealers installed within the above described work including joints between adjacent work, per Section 079200 "Joint Sealants".
 4. All glazing installed within the above described work per Section 088000, "Glazing".
 5. All painting, finishes, or coatings associated with the above described work.
 6. All firestopping associated with exterior skin and roof or floor structure per Section 078413 "Penetration Firestopping."
- J. Design Criteria: The drawings are based on a specific type and model of sliding glass door by a single manufacturer. An equivalent type of sliding glass door by an alternative manufacturer may be accepted provided deviations in dimensions and profiles are minor and do not materially detract from the design concept or intended performances as judged solely and approved by the DEN Project Manager.
- K. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockup for type(s) of sliding aluminum-framed glass door(s) indicated, in location(s) shown on Drawings.

- L. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of sliding aluminum-framed glass door openings by field measurements before fabrication.

1. Coordinate fabrication schedule with construction progress to avoid delay. Where necessary, proceed with fabrication without field measurements, and coordinate fabrication tolerances to ensure proper fit of sliding glass door units.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sliding aluminum-framed glass doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Failure to meet performance requirements.
- b. Structural failures including excessive deflection.
- c. Water leakage or air infiltration.
- d. Faulty operation of movable sash and hardware.
- e. Deterioration of metals, metal finishes, weatherstripping and other materials beyond normal weathering.
- f. Faulty operation of movable panels or hardware or other components.
- g. Deterioration of insulating glass[**and laminated glass**] as defined in Section 088000 "Glazing."
- h. **<Insert failure modes>**.

2. Warranty Period:

- a. Sliding Door: Minimum [**three (3)**] [**five (5)**] **<Insert number>** years from date of Substantial Completion.
- b. Glazing: Minimum [**10**] [**20**] **<Insert number>** years from date of Substantial Completion.
- c. Metal Finish: Minimum [**Five**] [**10**] [**15**] **<Insert number>** years from date of Substantial Completion.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. [Arcadia Architectural Products, Inc.](#)
2. [EFCO Corporation.](#)
3. [Fleetwood Aluminum Products, Inc.](#)
4. [Graham Architectural Products.](#)
5. [Hydro Aluminum North America.](#)
6. [Kawneer North America; an Alcoa company.](#)
7. [Milgard Windows.](#)
8. [MI Windows and Doors, Inc.](#)
9. [Peterson Architectural Products.](#)
10. [Plaza Door Co., Inc.](#)
11. [Thermal Windows, Inc.](#)
12. [TRACO.](#)
13. **<Insert manufacturer's name>.**
14. or approved equal.

2.2 MATERIALS

A. Aluminum Extrusions: Provide alloy and temper recommended by sliding aluminum-framed glass door manufacturer for strength, corrosion resistance, and application of required finish. Comply with AAMA/WDMA/CSA 101/I.S.2/A440.

B. Fasteners: Provide fasteners of aluminum, nonmagnetic stainless steel, or other materials warranted by manufacturer to be noncorrosive for SC 3 severe service conditions and compatible with members, trim, hardware, anchors, and other components of sliding aluminum-framed glass doors. Comply with AAMA/WDMA/CSA 101/I.S.2/A440.

1. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.

C. Anchors, Clips, and Accessories: Provide anchors, clips, and accessories of aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron for sliding aluminum-framed glass doors, complying with ASTM B 456 or ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

D. Reinforcing Members: Provide aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel reinforcing members that are noncorrosive for SC 3 severe service conditions and that comply with AAMA/WDMA/CSA 101/I.S.2/A440; provide sufficient strength to withstand design pressure indicated.

- E. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action, and completely concealed when sliding aluminum-framed glass door is closed.
1. Weather-Stripping Material: Closed-cell elastomeric, preformed gaskets complying with ASTM C 509.
 2. Weather-Stripping Material: Dense elastomeric gaskets complying with ASTM C 864.
 3. Weather-Stripping Material: Manufacturer's standard system and materials complying with AAMA/WDMA/CSA 101/I.S.2/A440.
- F. Sliding-Type Weather Stripping: Provide woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric. Comply with AAMA 701.
1. Weather Seals: Provide weather stripping with integral barrier fin or fins of semirigid, polypropylene sheet or polypropylene-coated material. Comply with AAMA 702.
- G. Sealant: For sealants required within fabricated sliding doors, provide sliding aluminum-framed glass door manufacturer's standard, permanently elastic, nonshrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement.

2.3 SLIDING DOOR <Insert drawing designation>

- A. AAMA/WDMA/CSA Performance Requirements: Provide sliding aluminum-framed glass doors of performance indicated that comply with AAMA/WDMA/CSA 101/I.S.2/A440[**unless more stringent performance requirements are indicated**].
1. Performance Class and Grade: HC[40] [45] [50] <Insert grade>.
 2. Performance Class and Grade: AW[40] [45] [50] <Insert grade>.
 3. Performance Class and Grade: As indicated.
 4. Performance Class: [HC] [AW].
- B. Condensation Resistance: Provide sliding aluminum-framed glass doors with a minimum [**CRF when tested according to AAMA 1503**] [**CR determined according to NFRC 500**] of [45] [52] <Insert value>.
- C. Thermal Transmittance: Provide sliding aluminum-framed glass doors with a maximum whole fenestration product U-factor indicated, when [**tested according to AAMA 1503**] [**determined according to ASTM E 1423**] [**determined according to NFRC 100**].
1. U-Factor: [0.35] [0.40] [0.65] <Insert value appropriate to system of measure> Btu/sq. ft. x h x deg F (W/sq. m x K).
- D. Solar Heat-Gain Coefficient (SHGC): Provide sliding aluminum-framed glass doors with a whole-fenestration product SHGC maximum of [0.40] [0.55] <Insert value>, determined according to NFRC 200.

- E. Acoustical Performance: Provide sliding aluminum-framed glass doors with an **[STC]** **[OITC]** rating of **[29]** **[34]** **<Insert value>** when tested according to and determined by **[ASTM E 90 and ASTM E 413]** **[ASTM E 1425 and ASTM E 1332]**, respectively.
- F. Air Leakage Resistance: Maximum rate not more than indicated when tested according to AAMA/WDMA/CSA 101/I.S.2/A440, Air Leakage Resistance Test.
1. Maximum Rate: **0.3 cfm/sq. ft. (1.5 L/s x sq. m)** of area at an inward test pressure of **1.6 lbf/sq. ft. (75 Pa)**.
 2. Maximum Rate: **0.3 cfm/sq. ft. (1.5 L/s x sq. m)** of area at an inward test pressure of **6.2 lbf/sq. ft. (300 Pa)**.
 3. Maximum Rate: **<Insert rate and test pressure>**.
- G. Water Penetration Resistance: No water leakage as defined in the AAMA/WDMA/CSA referenced test methods at a water test pressure equaling that indicated, when tested according to AAMA/WDMA/CSA 101/I.S.2/A440, Water Penetration Resistance Test.
1. Test Pressure: 15 percent of positive design pressure, but not less than **2.9 lbf/sq. ft. (140 Pa)** or more than **12 lbf/sq. ft. (580 Pa)**.
 2. Test Pressure: 20 percent of positive design pressure, but not more than **12 lbf/sq. ft. (580 Pa)**.
 3. Test Pressure: **<Insert percent and pressure>**.
- H. Forced-Entry Resistance: Comply with Performance Grade **[10]** **<Insert performance grade>** requirements when tested according to ASTM F 842.
- I. Life-Cycle Testing: Tested according to and complying with AAMA/WDMA/CSA 101/I.S.2/A440.
- J. Operating Force and Auxiliary (Durability) Tests: Tested according to and complying with AAMA/WDMA/CSA 101/I.S.2/A440.

2.4 GLAZING

- A. Glass and Glazing System: Comply with Section 088000 "Glazing" for safety glass, insulating-glass units, laminated glass, and glazing requirements applicable to glazed sliding aluminum-framed glass doors.
- B. Glass **<Insert drawing designation>**: Comply with Section 088000 "Glazing" for requirements applicable to safety glazing, insulating-glass units, and laminated glass units.
1. Clear, insulating-glass units.
 2. Clear, insulating-glass units, with low-E coating pyrolytic on second surface or sputtered on second or third surface.
 3. Clear, insulating-glass units, argon gas filled, with low-E coating pyrolytic on second surface or sputtered on second or third surface.
 4. Clear, insulating-glass units; outer lite consisting of laminated glass unit with PVB interlayer for windborne-debris resistance.

5. Clear, insulating-glass units, with low-E coating pyrolytic on second surface or sputtered on second or third surface; outer lite consisting of laminated glass unit with PVB interlayer for windborne-debris resistance.
6. Monolithic laminated glass unit, with PVB interlayer, complying with windborne-debris resistance.
7. **<Insert glass type, description, and performance requirements>.**

- C. Glazing System: **[Manufacturer's standard factory-glazing system that produces weathertight seal.] [Manufacturer's standard factory-glazing system that produces weathertight seal and complies with requirements for windborne-debris resistance.] [Manufacturer's standard factory-glazing system as indicated in Section 088000 "Glazing."]** **<Insert glazing requirements.>**

2.5 HARDWARE

- A. General: Provide manufacturer's standard hardware, fabricated from a corrosion-resistant material compatible with aluminum complying with AAMA 907 and designed to smoothly operate, tightly close, and securely lock sliding aluminum-framed glass doors. Do not use aluminum in frictional contact with other metals. Where exposed, provide **[solid bronze] [extruded, cast, or wrought aluminum] [die-cast zinc with special coating finish] [or] [nonmagnetic stainless steel]**.
1. Hardware Finish: **[Manufacturer's standard] [Match aluminum appearance] <Insert finish>.**
- B. Roller Assemblies: Provide movable panels with adjustable-height roller assemblies, complying with AAMA 906, consisting of self-lubricating, dual tandem **[nylon] [steel] [stainless-steel] [manufacturer's standard nylon or steel]** ball-bearing rollers; with two roller assemblies per panel.
- C. Threshold and Sill Cap/Track: Provide extruded-aluminum threshold and track of thickness, dimensions, and profile indicated; designed to comply with performance requirements indicated **[and to drain to the exterior]**; with manufacturer's standard finish.
1. Low-Profile Floor Track: ADA-ABA compliant.
- D. Door Pulls: Provide manufacturer's standard extruded-aluminum pull grips.
- E. Lock: Install manufacturer's keyed cylinder lock and **[multipoint]**locking device on each movable panel, lockable from the inside **[only] [and outside]**. Adjust locking device to allow unobstructed movement of the panel across adjacent panel in the direction indicated.
1. Keying System: **[All cylinders keyed alike] [Keyed to match other building entrances] <Insert instructions>.**

2.6 FABRICATION

- A. Fabricate sliding aluminum-framed glass doors in sizes indicated. Include a complete system for assembling components and anchoring doors.
- B. Assembly: Assemble components into complete weathertight units with flush, rigid, hairline joints. Mill, cope, butt, and miter necessary joints; secure by mechanical devices or by other means to ensure permanently watertight joints. Provide at least 2 corrosion resistant, pre lubricated, or self lubricating rollers for each sliding panel, of sufficient capacity to assure easy, quiet, and smooth operation.
- C. Fabricate sliding aluminum-framed glass doors that are reglazable without dismantling panel framing.
- D. Thermally Improved Construction: Fabricate sliding aluminum-framed glass doors with an integral, concealed, low-conductance thermal barrier; locate between exterior materials and door members exposed on interior side, and in a manner that eliminates direct metal-to-metal contact.
 - 1. Provide thermal-break construction that has been in use for not less than three years and has been tested to demonstrate resistance to thermal conductance and condensation and to show adequate strength and security of glass retention.
 - 2. Provide thermal barriers tested according to AAMA 505; determine the allowable design shear flow per the appendix in AAMA 505.
 - 3. Provide hardware with low conductivity, or provide nonmetallic material for hardware bridging thermal breaks at frame.
- E. Weather Stripping: Provide operable panels with a double row of sliding weather stripping in horizontal rails and [~~single-~~] [~~or~~] [~~double-~~]row weather stripping in meeting or jamb stiles. Provide compression-type weather stripping at the perimeter of each movable panel where sliding-type weather stripping is not appropriate.
 - 1. Provide weather stripping locked into extruded grooves in door panels or frames.
- F. Weep Holes: Provide weep holes and internal drainage passages to conduct infiltrating water to exterior.
- G. Factory-Glazed Fabrication: Glaze sliding aluminum-framed glass doors in the factory where practical and possible for applications indicated. Comply with requirements in Section 088000 "Glazing" and with AAMA/WDMA/CSA 101/I.S.2/A440.
- H. Glazing Stops: Provide snap-on glazing stops coordinated with Section 088000 "Glazing" and with glazing system indicated. Provide glazing stops to match panel frames.

2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
- B. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.
 - 1. Color: [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] <Insert color>.
 - 2. Color: [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**].
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils** (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.
- D. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with [**AAMA 2604**] [**AAMA 2605**] and containing not less than [**50**] [**70**] percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.
- E. High-Performance Organic Finish: [**Three**] [**Four**]-coat fluoropolymer finish complying with AAMA 2605 and containing not less than [**50**] [**70**] percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - 1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
 - 2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches (76 mm) of opening.
 - 3. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
- B. Verify rough opening dimensions, levelness of threshold substrate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight sliding aluminum-framed glass door installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing doors, hardware, accessories, and other components.
- B. Install sliding aluminum-framed glass doors level, plumb, square, true to line, without distortion, warp or rack of frames and panels, or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing, vapor retarders, air barriers, water/weather barriers, and other adjacent construction.
- C. Set sill members in bed of sealant or with gaskets, as indicated, to provide weathertight construction.
- D. Install sliding aluminum-framed glass doors and components to drain condensation, water penetrating joints, and moisture migrating within doors to the exterior.
- E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials according to ASTM E 2112, Section 5.12 "Dissimilar Materials."

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: **[Owner will engage] [Engage]** a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 - 1. Testing Methodology: Testing of sliding aluminum-framed glass doors for air penetration resistance and water resistance will be performed according to AAMA 502, **[Test Method A] [Test Method B]**, by applying same test pressures required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440.
 - 2. Testing Extent: **[Three] [Three mockup] <Insert number or description>** sliding aluminum-framed glass doors as selected by DEN Project Manager and a qualified independent testing and inspecting agency. Sliding doors shall be tested immediately after installation.
- C. Sliding aluminum-framed glass door will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports according to AAMA 502. Testing agency will interpret test results and state in each report whether tested work complies with or deviates from requirements.

3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Lubricate hardware and moving parts.
- B. Adjust operating panels and screens to provide a tight fit at contact points and weather stripping for smooth operation, without binding, and a weathertight closure.
- C. Adjust hardware for proper alignment, smooth operation, and proper latching without unnecessary force or excessive clearance.
- D. Clean aluminum surfaces immediately after installing sliding doors. Comply with manufacturer's written recommendations for final cleaning and maintenance. Avoid damaging protective coatings and finishes. Remove nonpermanent labels, and clean surfaces.
- E. Clean glass immediately after installing sliding aluminum-framed glass doors. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels and clean surfaces.
- F. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- G. Protect sliding door surfaces from contact with contaminating substances resulting from construction operations. During construction, monitor sliding door surfaces adjacent to and below exterior concrete and masonry surfaces for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do

contact sliding door surfaces, remove contaminants immediately according to manufacturer's written instructions.

- H. Refinish or replace sliding aluminum-framed glass doors with damaged finishes.
- I. Replace damaged components.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 083213

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Service doors[**with integral pass doors**].
2. Insulated service doors[**with integral pass doors**].
3. Counter doors.
4. Fire-rated service doors[**with integral pass doors**].
5. Fire-rated, insulated service doors[**with integral pass doors**].
6. Fire-rated counter doors.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.
2. **[Section 099113 "Exterior Painting"] [and] [Section 099123 "Interior Painting"]** for finish painting of factory-primed doors.
3. Section 111200 "Parking Control Equipment" for parking control equipment interlocked to overhead coiling doors.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design overhead coiling doors, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance, Exterior Doors: Exterior overhead coiling doors shall withstand the wind loads, the effects of gravity loads, and loads and stresses within limits and under conditions indicated according to **[SEI/ASCE 7] <Insert requirement>**.
1. Wind Loads: **[As indicated on Drawings] [Uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa), acting inward and outward] <Insert loads>**.
 - a. Basic Wind Speed: **115 mph (51 m/s)** with gust factor of **[1.3] <Insert**

- value>.**
- b. Importance Factor: **[1.3] <Insert factor>.**
 - c. Exposure Category: **[D].**
2. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
- C. Operability under Wind Load: Design overhead coiling doors to remain operable under **[design] [uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa)] <Insert load>** wind load, acting inward and outward.
- D. Windborne-Debris-Impact-Resistance Performance: Provide **[glazed] [and] [impact-protective]** overhead coiling doors that pass missile-impact and cyclic-pressure tests when tested according to **[ASTM E 1886 and ASTM E 1996] <Insert requirement>.**
1. Large Missile Test: For overhead coiling doors located within **30 feet (9.144 m)** of grade.
 2. Small Missile Test: For overhead coiling doors located more than **30 feet (9.144 m)** above grade.
- E. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to **[SEI/ASCE 7] <Insert requirement>.**
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[**and the emergency-egress-door component will be fully operational after the seismic event**]."
 2. Seismic Component Importance Factor: **[1.5] [1.0].**
- F. Operation Cycles: Provide overhead coiling door components and operators capable of operating for not less than number of cycles indicated for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
- 1.4 ACTION SUBMITTALS
- A. Product Data: For each type and size of overhead coiling door and accessory. Include the following:
1. Construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
 2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
 3. For fire-rated doors, description of fire-release system including testing and resetting instructions.
 4. Include data substantiating that materials comply with requirements.

- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Show locations of replaceable fusible links.
 3. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
1. Include similar Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
1. Curtain Slats: **12 inches** (305 mm) long[, **including vision window secured to slat**].
 2. Bottom Bar: **6 inches** (150 mm) long[**with sensor edge**].
 3. Guides: **6 inches** (150 mm) long.
 4. Brackets: **6 inches** (150 mm) square.
 5. Hood: **6 inches** (150 mm) square.
 6. Laminate-Clad Counter Panel Product: **6 inches** (150 mm) square; for each type, color, pattern, and surface finish; laminated to core.
- E. Delegated-Design Submittal: For overhead coiling doors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of seismic restraints.
 2. Summary of forces and loads on walls and jambs.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Seismic Qualification Certificates: For overhead coiling doors, accessories, and components, from manufacturer.
- C. Oversize Construction Certification: For door assemblies required to be fire-rated and that exceed size limitations of labeled assemblies.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For overhead coiling doors to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with

other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
 - 1. Obtain operators and controls from overhead coiling door manufacturer.
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to **[NFPA 252]** **[UBC Standard 7-2]** **[or]** **[UL 10B]**.
 - 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 - 2. Temperature-Rise Limit: **[Where indicated]** **[At vertical exit enclosures and exit passageways]**, provide doors that have a maximum transmitted temperature end point of not more than **450 deg F** (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
 - 3. Smoke Control: **[Where indicated]** **[In corridors and smoke barriers]**, provide doors that are listed and labeled with the letter "S" on the fire-rating label by a qualified testing agency for smoke- and draft-control based on testing according to **[UBC Standard 7-2]** **[UL 1784]**; with maximum air-leakage rate of **3.0 cfm/sq. ft.** (0.01524 cu. m/s x sq. m) of door opening at **0.10 inch wg** (24.9 Pa) for both ambient and elevated temperature tests.
- D. Sound-Control Doors: Assemblies that have been fabricated and tested to control the passage of sound and have minimum certified STC rating according to ASTM E 413.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Regulatory Requirements: Comply with applicable provisions in **[the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines]** **[and]** **[ICC/ANSI A117.1]**.

1.8 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of **0.028 inch** (0.71 mm) and as required to meet requirements.
 2. Stainless-Steel Door Curtain Slats: ASTM A 666, Type 304; sheet thickness of **0.025 inch** (0.64 mm) and as required to meet requirements.
 3. Aluminum Door Curtain Slats: **ASTM B 209** (ASTM B 209M) sheet or **ASTM B 221** (ASTM B 221M) extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; thickness of **0.050 inch** (1.27 mm) and as required to meet requirements.
 4. Vision-Panel Glazing: Manufacturer's standard clear glazing, fabricated from transparent acrylic sheet or fire-protection rated glass as required for type of door; set in glazing channel secured to curtain slats.
 5. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within slat faces.
 6. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.
 7. Plastic Interior Curtain-Slat Facing: Extruded PVC plastic with maximum flame-spread index of **[25] [75] [200]** and smoke-developed index of 450, according to ASTM E 84.
 8. Gasket Seal: Provide insulated slats with manufacturer's standard interior-to-exterior thermal break or with continuous gaskets between slats.
- B. Endlocks[**and Windlocks**] for Service Doors: Malleable-iron casings galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Provide locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.
- C. Endlocks for Counter Doors: Manufacturer's standard locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.
- D. Bottom Bar for Service Doors: Consisting of two angles, each not less than **1-1/2 by 1-1/2 by 1/8 inch** (38 by 38 by 3 mm) thick; fabricated from manufacturer's standard hot-dip galvanized steel, stainless steel, or aluminum extrusions to match curtain slats and finish.

- E. Bottom Bar for Counter Doors: Manufacturer's standard continuous channel or tubular shape, fabricated from manufacturer's standard hot-dip galvanized steel, stainless steel, or aluminum extrusions to match curtain slats and finish.
- F. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
- G. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain[, **and a continuous bar for holding windlocks**].
 - 1. Removable Posts and Jamb Guides for Counter Doors: Manufacturer's standard.
- H. Pass Door(s): Door and frame assembly constructed integrally with the coiling-door assembly[**and bearing the same fire rating**]. Complying with egress and accessibility requirements of authorities having jurisdiction.
 - 1. Door Frame and Integral Jamb Guide: Fabricate of angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading.
 - 2. Hinged Frame: Hinged pass door and frame that swings out of the way, as a unit, to allow use of the full coiling-door opening width. One jamb of the pass-door frame is hinged and the other jamb includes a guide for the lower, narrower part of the coiling-door curtain.
 - 3. Rigid Frame: Rigid pass door and frame that are built into the rigid lower part of the door curtain and that raise with the curtain.
 - 4. Locking Hardware:
 - a. **[Lockset] [Exit Hardware]: [As specified in Section 087100 "Door Hardware."] [As selected by DEN Project Manager from manufacturer's full range.] <Insert requirement.>**
 - b. Lock Cylinders: Provide cylinders **[specified in Section 087100 "Door Hardware"] [standard with manufacturer] [and keyed to building keying system]**.
 - c. Keys: **[Two] [Three] <Insert number>** for each cylinder.
 - 5. Thresholds: Equip pass doors with integral thresholds that comply with egress and accessibility requirements of authorities having jurisdiction.

2.2 HOOD

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that

projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal **0.028-inch-** (0.71-mm-) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.
2. Stainless Steel: **0.025-inch-** (0.64-mm-) thick stainless-steel sheet, Type 304, complying with ASTM A 666.
3. Aluminum: **0.040-inch-** (1.02-mm-) thick aluminum sheet complying with **ASTM B 209** (ASTM B 209M), of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.
4. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.
5. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

2.3 COUNTER DOORS

- A. Integral Frame, Hood, and Fascia for Counter Door: Welded sheet metal assembly of the following sheet metal:
1. Galvanized Steel: Nominal [**0.064-inch-** (1.63-mm-)] **<Insert thickness>** thick, hot-dip galvanized steel sheet with **G90** (Z275) zinc coating, complying with ASTM A 653/A 653M.
 2. Stainless Steel: [**0.062-inch-** (1.59-mm-)] **<Insert thickness>** thick stainless-steel sheet, Type 304, complying with ASTM A 666.
- B. Integral Metal Sill for Counter Door: Fabricate sills as integral part of frame assembly of Type 304 stainless steel in manufacturer's standard thickness with **[No. 4] <Insert finish>** finish.
- C. Fire-Rated, Laminate Counter: Fire-door manufacturer's high-pressure decorative laminate-covered countertop, UL or ITS tested and labeled for 1-1/2-hour fire rating for approved use with fire-door assembly.

2.4 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
1. Lock Cylinders: Provide cylinders [**specified in Section 087100 "Door Hardware"**] [**standard with manufacturer**] [**and keyed to building keying system**].
 2. Keys: Provide [**two**] [**three**] **<Insert number>** for each cylinder.
- C. Chain Lock Keeper: Suitable for padlock.

- D. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.5 CURTAIN ACCESSORIES

- A. Smoke Seals: Equip each fire-rated door with smoke-seal perimeter gaskets for smoke and draft control as required for door listing and labeling by a qualified testing agency.
- B. Weatherseals: Equip each exterior door with weather-stripping gaskets fitted to entire perimeter of door for a weathertight installation, unless otherwise indicated.
 - 1. At door head, use **1/8-inch-** (3-mm-) thick, replaceable, continuous sheet secured to inside of hood.
 - 2. At doorjamb, use replaceable, adjustable, continuous, flexible, **1/8-inch-** (3-mm-) thick seals of flexible vinyl, rubber, or neoprene.
- C. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.
 - 1. Provide pull-down straps or pole hooks for doors more than **84 inches** (2130 mm) high.
- D. Automatic-Closing Device for Fire-Rated Doors: Equip each fire-rated door with an automatic-closing device that is inoperative during normal door operations and that has a governor unit complying with NFPA 80 and an easily tested and reset release mechanism designed to be activated by the following:
 - 1. Replaceable fusible links with temperature rise and melting point of [**165 deg F (74 deg C)**] <Insert temperature> interconnected and mounted on both sides of door opening.
 - 2. Manufacturer's standard UL-labeled smoke detector and door-holder-release devices.
 - 3. Manufacturer's standard UL-labeled heat detector and door-holder-release devices.
 - 4. Building fire-detection and -alarm systems and manufacturer's standard door-holder-release devices.

2.6 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than **0.03 in./ft.** (2.5 mm/m) of span under full load.

- C. Spring Balance: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.7 MANUAL DOOR OPERATORS

- A. Equip door with manufacturer's recommended manual door operator unless another type of door operator is indicated.
- B. Push-up Door Operation: Design counterbalance mechanism so required lift or pull for door operation does not exceed **[25 lbf (111 N)] <Insert force>**.
- C. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum **[25 lbf (111 N)] [30 lbf (133 N)] <Insert force>** force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.
- D. Crank Operator: Consisting of crank and crank gearbox, steel crank drive shaft, and gear-reduction unit, of type indicated. Size gears to require not more than **[25 lbf (111 N)] [30 lbf (133 N)] <Insert force>** force to turn crank. Fabricate gearbox to be oil tight and to completely enclose operating mechanism. Provide manufacturer's standard crank-locking device.

2.8 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door[**and operation-cycles requirement**] specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
 - 1. Comply with NFPA 70.
 - 2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24 V, ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door Operator Location(s): Operator location indicated for each door.
 - 1. Top-of-Hood Mounted: Operator is mounted to the right or left door head plate

- with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.
2. Front-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on coil side of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.
 3. Wall Mounted: Operator is mounted to the inside front wall on the left or right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.
 4. Bench Mounted: Operator is mounted to the right or left door head plate and connected to the door drive shaft with drive chain and sprockets. Side room is required for this type of mounting.
 5. Through-Wall Mounted: Operator is mounted on other side of wall from coil side of door.
- D. Electric Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 110513 "Common Motor Requirements for Equipment" unless otherwise indicated.
1. Electrical Characteristics:
 - a. Phase: [**Single phase**] [**Polyphase**].
 - b. Volts: [**115**] [**208**] [**230**] [**460**] <Insert value> V.
 - c. Hertz: 60.
 2. Motor Type and Controller: Reversible motor and controller (disconnect switch) for motor exposure indicated.
 3. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than **8 in./sec.** (203 mm/s) and not more than **12 in./sec.** (305 mm/s), without exceeding nameplate ratings or service factor.
 4. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 5. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
- E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Obstruction Detection Device: Equip motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. [**For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.**] [**For fire-rated doors, activation delays closing.**]
1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.

- a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained pressure on close button.
 2. Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
 - a. Self-Monitoring Type: Four-wire configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.
 - G. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."
 1. Interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
 2. Exterior units, full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.
 - H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed **[25 lbf (111 N)] [30 lbf (133 N)] <Insert force>**.
 - I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
 - J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
 - K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.
 - L. Radio-Control System: Consisting of the following:
 1. Three-channel universal coaxial receiver to open, close, and stop door; **[one] [two] <Insert number>** per operator.
 2. Multifunction remote control.
 3. Remote-antenna mounting kit.
- 2.9 DOOR ASSEMBLY **<Insert drawing designation>**
- A. **[Service] [Insulated Service] [Counter]** Door: Overhead coiling door formed with curtain of interlocking metal slats.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACME Rolling Doors.
 - b. Alpine Overhead Doors, Inc.
 - c. AlumaTek, Inc.
 - d. C.H.I. Overhead Doors.
 - e. City-Gates.
 - f. Cookson Company.
 - g. Cornell Iron Works, Inc.
 - h. Dynamic Closures Corp.
 - i. Lawrence Roll-Up Doors, Inc.
 - j. Mahon Door Corporation.
 - k. McKeon Rolling Steel Door Company, Inc.
 - l. Metro Door.
 - m. Overhead Door Corporation.
 - n. QMI Security Solutions.
 - o. Raynor.
 - p. Southwestern Steel Rolling Door Co.
 - q. Wayne-Dalton Corp.
 - r. Windsor Door.
 - s. **<Insert manufacturer's name>**.
 - t. or approved equal.

- B. Operation Cycles: Not less than **[10,000] [20,000] [50,000] [100,000] <Insert number>**.

 1. Include tamperproof cycle counter.

- C. STC Rating: **[26] <Insert STC rating>**.

- D. Curtain R-Value: **[4.5 deg F x h x sq. ft./Btu (0.792 K x sq. m/W)] [5.0 deg F x h x sq. ft./Btu (0.881 K x sq. m/W)] [6.0 deg F x h x sq. ft./Btu (1.057 K x sq. m/W)] <Insert value>**.

- E. Door Curtain Material: **[Galvanized steel] [Stainless steel] [Aluminum]**.

- F. Door Curtain Slats: **[Curved] [Flat]** profile slats of **[1-1/4-inch (32-mm)] [1-1/2-inch (38-mm)] [1-7/8-inch (48-mm)] [2-5/8-inch (67-mm)] [3-1/4-inch (83-mm)] <Insert dimension>** center-to-center height.
 1. Perforated Slats: Approximately **[1/16-inch (1.6-mm) pinholes] [3/32-inch (2.4-mm) pinholes] [7/8-inch- (22-mm-) wide by 3/8-inch- (10-mm-) high slots] <Insert dimensions>**.
 2. Fenestrated Slats: Approximately **[3- by 5/8-inch (76- by 16-mm)] [4- by 5/8-inch (102- by 16-mm)] [10- by 1-5/8-inch (254- by 41-mm)] <Insert dimensions>** openings spaced approximately **[1-1/2 inches (38 mm)] <Insert dimension>** apart and beginning **12 inches (305 mm)** from jamb guides.
 3. Vision Panels: Approximately **10- by 1-5/8-inch (254- by 41-mm)** openings spaced approximately **2 inches (51 mm)** apart and beginning **12 inches (305 mm)** from end

- guides; in **[two]** **[three]** **<Insert number>** rows of slats at height indicated on Drawings; installed with **[insulated]** vision-panel glazing.
4. Insulated-Slat Interior Facing: **[Metal]** **[Plastic]**.
- G. Curtain Jamb Guides: **[Galvanized steel]** **[Stainless steel]** **[Aluminum]** with exposed finish matching curtain slats. **[Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.]** **[Provide removable post(s) and jamb guides where shown on Drawings.]**
- H. Pass Door(s): **[Hinged]** **[Rigid]** frame with **[lockset]** **[exit hardware]**.
- I. Hood: **[Match curtain material and finish]** **[Galvanized steel]** **[Stainless steel]** **[Aluminum]**.
1. Shape: **[Round]** **[Square]** **[As shown on Drawings]** **<Insert shape>**.
2. Mounting: **[Face of wall]** **[Between jambs]** **[As shown on Drawings]**.
- J. Integral Frame, Hood, and Fascia for Counter Door: **[Galvanized steel]** **[Stainless steel]**.
1. Mounting: **[Face of wall]** **[Between jambs]** **[As shown on Drawings]**.
- K. Sill Configuration for Counter Door: **[No sill]** **[Integral metal sill]**.
- L. Locking Devices: Equip door with **[slide bolt for padlock]** **[locking device assembly]** **[and]** **[chain lock keeper]**.
1. Locking Device Assembly: **[Single-jamb side]** **[Cremone type, both jamb sides]** locking bars, operable from **[inside with thumb turn]** **[outside with cylinder]** **[outside only, with cylinder]** **[inside and outside with cylinders]** **<Insert requirement>**.
- M. Manual Door Operator: **[Push-up operation]** **[Chain-hoist operator]** **[Manufacturer's standard crank operator]** **[Awning-crank operator]** **[Wall-crank operator]**.
1. Provide operator with through-wall shaft operation.
2. Provide operator with manufacturer's standard removable operating arm.
- N. Electric Door Operator:
1. Usage Classification: **[Heavy duty, 60 to 90 cycles per hour]** **[Standard duty, up to 60 cycles per hour]** **[Medium duty, up to 15 cycles per hour]** **[Light duty, up to 10 cycles per hour]** **<Insert classification>**.
2. Operator Location: **[Top of hood]** **[Front of hood]** **[Wall]** **[Bench]** **[Through wall]** **[As shown on Drawings]**.
3. Motor Exposure: **[Interior]** **[Exterior, wet, and humid]**.
4. Emergency Manual Operation: **[Push-up]** **[Chain]** **[Crank]** type.
5. Obstruction-Detection Device: Automatic **[photoelectric sensor]** **[electric sensor edge on bottom bar]** **[pneumatic sensor edge on bottom bar]** **[; self-monitoring type]**.

- a. Sensor Edge Bulb Color: **[Black] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 6. Remote-Control Station: **[Interior] [Exterior] [Where shown on Drawings] <Insert location>**.
 7. Other Equipment: **[Audible and visual signals] [Radio-control system] <Insert device>**.
- O. Door Finish:
1. Aluminum Finish: **[Mill] [Clear anodized] [Light bronze anodized] [Medium bronze anodized] [Dark bronze anodized] [Black anodized] [Anodized color matching DEN Project Manager's sample] [Anodized color as selected by DEN Project Manager from full range of industry colors and color densities] <Insert color>**.
 2. Baked-Enamel or Powder-Coated Finish: **[Color as indicated by manufacturer's designations] [Color matching DEN Project Manager's sample] [Color as selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>**.
 3. Factory Prime Finish: Manufacturer's standard color.
 4. Stainless-Steel Finish: **[No. 2B (bright, cold rolled)] [No. 4 (polished directional satin)] <Insert finish>**.
 5. Interior Curtain-Slat Facing: **[Match finish of exterior curtain-slat face] [PVC plastic] <Insert finish>**.

2.10 FIRE-RATED DOOR ASSEMBLY <Insert drawing designation>

- A. Fire-Rated **[Service] [Insulated Service] [Counter]** Door: Overhead fire-rated coiling door formed with curtain of interlocking metal slats.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACME Rolling Doors.
 - b. Alpine Overhead Doors, Inc.
 - c. AlumaTek, Inc.
 - d. C.H.I. Overhead Doors.
 - e. City-Gates.
 - f. Cookson Company.
 - g. Cornell Iron Works, Inc.
 - h. Lawrence Roll-Up Doors, Inc.
 - i. Mahon Door Corporation.
 - j. McKeon Rolling Steel Door Company, Inc.
 - k. Overhead Door Corporation.
 - l. Raynor.
 - m. Southwestern Steel Rolling Door Co.
 - n. Wayne-Dalton Corp.
 - o. Windsor Door.
 - p. **<Insert manufacturer's name>**.

- q. or approved equal.
- B. Operation Cycles: Not less than [10,000] [20,000] [50,000] [100,000] <Insert number>.
1. Include tamperproof cycle counter.
- C. Fire Rating: [3/4 hour] [1 hour] [1-1/2 hours] [3 hours] [4 hours] [with temperature-rise limit] [and] [with smoke control].
- D. STC Rating: [27] <Insert STC rating>.
- E. Curtain R-Value: [4.5 deg F x h x sq. ft./Btu (0.792 K x sq. m/W)] [5.0 deg F x h x sq. ft./Btu (0.881 K x sq. m/W)] [6.0 deg F x h x sq. ft./Btu (1.057 K x sq. m/W)] <Insert value>.
- F. Door Curtain Material: [Galvanized steel] [Stainless steel].
- G. Door Curtain Slats: [Curved] [Flat] profile slats of [1-1/4-inch (32-mm)] [1-1/2-inch (38-mm)] [1-7/8-inch (48-mm)] [2-5/8-inch (67-mm)] [3-1/4-inch (83-mm)] <Insert dimension> center-to-center height.
1. Vision Panels: Approximately 10- by 1-5/8-inch (254- by 41-mm) openings spaced approximately 2 inches (51 mm) apart and beginning 12 inches (305 mm) from end guides; in [two] [three] <Insert number> rows of slats at height indicated on Drawings; installed with fire-rated vision-panel glazing.
 2. Insulated-Slat Interior Facing: Metal.
- H. Curtain Jamb Guides: [Galvanized steel] [Stainless steel] with exposed finish matching curtain slats.
- I. Pass Door(s): [Hinged] [Rigid] frame with [lockset] [exit hardware].
- J. Hood: [Match curtain material and finish] [Galvanized steel] [Stainless steel].
1. Shape: [Round] [Square] [As shown on Drawings] <Insert shape>.
 2. Mounting: [Face of wall] [Between jambs] [As shown on Drawings].
- K. Integral Frame, Hood, and Fascia for Counter Door: [Galvanized steel] [Stainless steel].
1. Mounting: [Face of wall] [Between jambs] [As shown on Drawings].
- L. Sill Configuration for Fire-Rated Counter Door: [No sill] [Integral metal sill] [Fire-rated, laminate counter].
1. High-Pressure Decorative Laminate: Match color, pattern, and finish [as indicated by manufacturer's designations] [of DEN Project Manager sample] [as selected by DEN Project Manager from manufacturer's full range] <Insert requirement>.

- M. Locking Devices: Equip door with **[slide bolt for padlock] [locking device assembly] [and] [chain lock keeper]**.
1. Locking Device Assembly: **[Single-jamb side] [Cremone type, both jamb sides]** locking bars, operable from **[inside with thumbturn] [outside with cylinder] [outside only, with cylinder] [inside and outside with cylinders]** <Insert requirement>.
- N. Manual Door Operator: **[Push-up operation] [Chain-hoist operator] [Manufacturer's standard crank operator] [Awning-crank operator] [Wall-crank operator]**.
1. Provide operator with through-wall shaft operation.
 2. Provide operator with manufacturer's standard removable operating arm.
- O. Electric Door Operator:
1. Usage Classification: **[Heavy duty, 60 to 90 cycles per hour] [Standard duty, up to 60 cycles per hour] [Medium duty, up to 15 cycles per hour] [Light duty, up to 10 cycles per hour]** <Insert classification>.
 2. Operator Location: **[Top of hood] [Front of hood] [Wall] [Bench] [Through wall] [As shown on Drawings]**.
 3. Motor Exposure: **[Interior] [Exterior, wet, and humid]**.
 4. Emergency Manual Operation: **[Push-up] [Chain] [Crank]** type.
 5. Obstruction Detection Device: Automatic **[photoelectric sensor] [electric sensor edge on bottom bar] [pneumatic sensor edge on bottom bar] [; self-monitoring type]**.
 - a. Sensor Edge Bulb Color: **[Black] [As selected by DEN Project Manager from manufacturer's full range]** <Insert color>.
 6. Remote-Control Station: **[Interior] [Exterior] [Where shown on Drawings]** <Insert location>.
 7. Other Equipment: **[Audible and visual signals] [Radio-control system]** <Insert device>.
- P. Door Finish:
1. Baked-Enamel or Powder-Coated Finish: **[Color as indicated by manufacturer's designations] [Color matching DEN Project Manager's sample] [Color as selected by DEN Project Manager from manufacturer's full range]** <Insert color and gloss>.
 2. Factory Prime Finish: Manufacturer's standard color.
 3. Stainless-Steel Finish: **[No. 2B (bright, cold rolled)] [No. 4 (polished directional satin)]** <Insert finish>.
 4. Interior Curtain-Slat Facing: **[Match finish of exterior curtain-slat face]** <Insert finish>.

2.11 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.12 ALUMINUM FINISHES

- A. Mill Finish: Manufacturer's standard.
- B. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
- C. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.
- D. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.

2.13 STEEL AND GALVANIZED-STEEL FINISHES

- A. Factory Prime Finish: Manufacturer's standard primer, compatible with field-applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.
- B. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

2.14 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 3. Directional Satin Finish: No. 4.
- C. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Fire-Rated Doors: Install according to NFPA 80.
- E. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide weathertight fit around entire perimeter.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.
 - 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 083323

SECTION 083326 - OVERHEAD COILING GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Open-curtain overhead coiling grilles.
 - 2. Closed-curtain overhead coiling grilles.
- B. Related Sections:
 - 1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.
 - 2. Section 099123 "Interior Painting" for finish painting of factory-primed grilles.
 - 3. Section 111200 "Parking Control Equipment" for parking control equipment interlocked to overhead coiling grilles.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design overhead coiling grilles, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Seismic Performance: Overhead coiling grilles shall withstand the effects of earthquake motions determined according to **[SEI/ASCE 7]** <Insert requirement>.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - 2. Seismic Component Importance Factor: **[1.5]** **[1.0]**.
- C. Operation Cycles: Provide overhead coiling grille components and operators capable of operating for not less than number of cycles indicated for each grille. One operation cycle is complete when a grille is opened from the closed position to the fully open position and returned to the closed position.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling grille and accessory. Include the following:
1. Construction details, material descriptions, dimensions of individual components, profiles for curtain components, and finishes.
 2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
 3. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
1. Include similar Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
1. Open-Curtain Grille: **18-inch-** (457-mm-) square assembly with full-size components consisting of rods, spacers, and links as required to illustrate each assembly[, **including glazed inserts**].
 2. Closed-Curtain Grille: **18-inch-** (457-mm-) square assembly with full-size components consisting of ribs and infill as required to illustrate each assembly.
 3. Bottom Bar: **6 inches** (150 mm) long[**with sensor edge**].
 4. Guides: **6 inches** (150 mm) long.
 5. Mounting Frame: **6 inches** (150 mm) long.
 6. Brackets: **6 inches** (150 mm) square.
 7. Hood: **6 inches** (150 mm) square.
- E. Delegated-Design Submittal: For overhead coiling grilles indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of seismic restraints.
 2. Summary of forces and loads on walls and jambs.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

- B. Seismic Qualification Certificates: For overhead coiling grilles, accessories, and components, from manufacturer.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For overhead coiling grilles to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain overhead coiling grilles from single source from single manufacturer.
 - 1. Obtain operators and controls from overhead coiling grille manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Regulatory Requirements: Comply with applicable provisions in **[the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines] [and] [ICC/ANSI A117.1]**.

1.8 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GRILLE CURTAIN MATERIALS AND CONSTRUCTION

- A. Open-Curtain Grilles: Fabricate metal grille curtain as an open network of horizontal rods, spaced at regular intervals, that are interconnected with vertical links, which are formed and spaced as indicated and are free to rotate on the rods.
 - 1. Aluminum Grille Curtain: **ASTM B 221** (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

2. Stainless-Steel Grille Curtain: ASTM A 666, Type 300 series.
 3. Steel Grille Curtain: Hot-dip zinc-coated (galvanized) complying with ASTM A 123/A 123M, or electrogalvanized complying with ASTM 653/A 653M, and phosphatized before fabrication.
 4. Glazing Insert: Manufacturer's standard glazing of clear polycarbonate sheet secured by the curtain links.
- B. Closed-Curtain Grilles: Fabricate curtain as a series of horizontal double-C ribs, spaced at regular intervals that alternate with continuous horizontal infill panels secured by the ribs.
1. Aluminum Horizontal Ribs: [ASTM B 221](#) (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
 2. Glass Panels: Uncoated, clear, heat-treated, fully tempered float glass; complying with ASTM C 1048, Condition A, Type I, Class I, Quality q3, Kind FT; manufacturer's standard panel dimensions and thickness.
 3. Plastic Panels: Fire-retardant polycarbonate sheet manufactured by the extrusion process; UV resistant; manufacturer's standard panel dimensions and thickness.
 4. Aluminum Panels: [ASTM B 209](#) (ASTM B 209M), alloy and temper standard with manufacturer for type of use and finish indicated; manufacturer's standard panel dimensions and thickness; finished to match ribs.
 - a. Perforations: [**Manufacturer's standard pinholes**] <Insert description>.
- C. Endlocks: Continuous end links, chains, or other devices at ends of rods; locking and retaining grille curtain in guides against excessive pressures, maintaining grille curtain alignment, and preventing lateral movement.
- D. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, finished to match grille.
1. Astragal: Equip each grille bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
 2. Provide motor-operated grilles with combination bottom astragal and sensor edge.
- E. Grille Curtain Jamb Guides: Manufacturer's standard shape having curtain groove with return lips or bars to retain curtain. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise; with removable stops on guides to prevent overtravel of curtain.
1. Removable Posts and Jamb Guides: Manufacturer's standard.

2.2 HOODS AND ACCESSORIES

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for

surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal **0.028-inch-** (0.71-mm-) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.
 2. Stainless Steel: **0.025-inch-** (0.64-mm-) thick stainless-steel sheet, Type 304, complying with ASTM A 666.
 3. Aluminum: **0.040-inch-** (1.02-mm-) thick aluminum sheet complying with **ASTM B 209** (ASTM B 209M), of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.
- B. Removable Metal Soffit: Formed or extruded from same metal and with same finish as curtain if hood is mounted above ceiling, unless otherwise indicated.
- C. Mounting Frame: Manufacturer's standard mounting frame designed to support grille; factory fabricated from ASTM A 36/A 36M structural-steel [**tubes**] [**or**] [**shapes**], hot-dip galvanized per ASTM A 123/A 123M; fastened to floor and structure above grille; to be built into wall construction; and complete with anchors, connections, and fasteners.
- D. Push/Pull Handles: Equip each push-up-operated or emergency-operated grille with lifting handles on each side of grille, finished to match grille.
1. Provide pull-down straps or pole hooks for grilles more than **84 inches** (2130 mm) high.

2.3 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
1. Lock Cylinders: Provide cylinders [**specified in Section 087100 "Door Hardware"**] [**standard with manufacturer**] [**and keyed to building keying system**].
 2. Keys: [**Two**] [**Three**] **<Insert number>** for each cylinder.
- C. Chain Lock Keeper: Suitable for padlock.
- D. Safety Interlock Switch: Equip power-operated grilles with safety interlock switch to disengage power supply when grille is locked.

2.4 COUNTERBALANCING MECHANISM

- A. General: Counterbalance grilles by means of manufacturer's standard mechanism with

an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of parts and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.
- C. Spring Balance: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.5 MANUAL GRILLE OPERATORS

- A. Equip grille with manufacturer's recommended manual grille operator unless another type of grille operator is indicated.
- B. Push-up Grille Operation: Design counterbalance mechanism so required lift or pull for grille operation does not exceed [25 lbf (111 N)] <Insert force>.
- C. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum [25 lbf (111 N)] [30 lbf (133 N)] <Insert force> force for grille operation. Provide alloy-steel hand chain with chain holder secured to operator guide.
- D. Crank Operator: Consisting of crank and crank gearbox, steel crank drive shaft, and gear-reduction unit, of type indicated. Size gears to require not more than [25 lbf (111 N)] [30 lbf (133 N)] <Insert force> force to turn crank. Fabricate gearbox to be oil tight and to completely enclose operating mechanism. Provide manufacturer's standard crank-locking device.

2.6 ELECTRIC GRILLE OPERATORS

- A. General: Electric grille operator assembly of size and capacity recommended and provided by grille manufacturer for grille [and operation-cycles requirement] specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking grille, and accessories required for proper operation.

1. Comply with NFPA 70.

2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24 V, ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each grille.
- C. Grille Operator Location(s): Operator location indicated for each grille.
1. Top-of-Hood Mounted: Operator is mounted to the right or left grille head plate with the operator on top of the grille-hood assembly and connected to the grille drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.
 2. Front-of-Hood Mounted: Operator is mounted to the right or left grille head plate with the operator on coil side of the grille-hood assembly and connected to the grille drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.
 3. Wall Mounted: Operator is mounted to the inside front wall on the left or right side of grille and connected to grille drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.
 4. Bench Mounted: Operator is mounted to the right or left grille head plate and connected to the grille drive shaft with drive chain and sprockets. Side room is required for this type of mounting.
 5. Through-Wall Mounted: Operator is mounted on other side of wall from coil-side of grille.
- D. Electric Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 110513 "Common Motor Requirements for Equipment" unless otherwise indicated.
1. Electrical Characteristics:
 - a. Phase: **[Single phase]** **[Polyphase]**.
 - b. Volts: **[115]** **[208]** **[230]** **[460]** **<Insert value>** V.
 - c. Hertz: 60.
 2. Motor Type and Controller: Reversible motor and controller (disconnect switch) for motor exposure indicated.
 3. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate grille in either direction from any position, at a speed not less than **8 in./sec.** (203 mm/s) and not more than **12 in./sec.** (305 mm/s), without exceeding nameplate ratings or service factor.
 4. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 5. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
- E. Limit Switches: Equip each motorized grille with adjustable switches interlocked with motor controls and set to automatically stop grille at fully opened and fully closed

positions.

- F. Obstruction Detection Device: Equip motorized grille with indicated external automatic safety sensor capable of protecting full width of grille opening. Activation of sensor immediately stops and reverses downward grille travel.
1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in grille opening without contact between grille and obstruction.
 - a. Self-Monitoring Type: Designed to interface with grille operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, grille closes only with sustained pressure on close button.
 2. Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
 - a. Self-Monitoring Type: Four-wire configured device designed to interface with grille operator control circuit to detect damage to or disconnection of sensing device.
- G. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."
1. Interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
 2. Exterior units, full-guarded, standard-duty, surface-mounted, weatherproof type; NEMA ICS 6, Type 4 enclosure, key operated.
- H. Emergency Manual Operation: Equip each electrically powered grille with capability for emergency manual operation. Design manual mechanism so required force for grille operation does not exceed [25 lbf (111 N)] [30 lbf (133 N)] <Insert force>.
- I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.
- L. Emergency-Egress Release: Flush, wall-mounted handle mechanism, for ADA-ABA-compliant egress feature, not dependent on electric power. The release allows an unlocked grille to partially open without affecting limit switches to permit

passage, and it automatically resets motor drive upon return of handle to original position.

- M. Self-Opening Mechanism: Automatic release mechanism triggered by [**smoke detector,**] [**emergency push-button station,**] fire alarm or power failure. When activated, the grille self opens by means of a fail-safe operator to the fully open position without the need of power operation or battery backup systems. When the [**emergency push-button is reset, and the**] alarm is cleared and power is restored, the grille will operate normally.

2.7 OPEN-CURTAIN GRILLE ASSEMBLY <Insert drawing designation>

- A. Open-Curtain Grille: Overhead coiling grille with a curtain having a network of horizontal rods that interconnect with vertical links.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACME Rolling Doors.
 - b. Alpine Overhead Doors, Inc.
 - c. AlumaTek, Inc.
 - d. City-Gates.
 - e. Cookson Company.
 - f. Cornell Iron Works, Inc.
 - g. Dynaflair Corporation.
 - h. Dynamic Closures Corp.
 - i. Lawrence Roll-Up Doors, Inc.
 - j. Mahon Door Corporation.
 - k. McKeon Rolling Steel Door Company, Inc.
 - l. Metro Door.
 - m. Overhead Door Corporation.
 - n. Raynor.
 - o. Windsor Door.
 - p. <Insert manufacturer's name>.
 - q. or approved equal.
- B. Operation Cycles: Not less than [**10,000**] [**20,000**] [**50,000**] [**100,000**] <Insert number>.
1. Include tamperproof cycle counter.
- C. Grille Curtain Material: [**Aluminum**] [**Stainless steel**] [**Galvanized steel**].
1. Space rods at approximately [**1-1/2 inches** (38 mm)] [**2 inches** (51 mm)] [**3 inches** (76 mm)] <Insert dimension> o.c.
 2. Space links approximately [**3 inches** (76 mm)] [**6 inches** (152 mm)] [**9 inches** (228 mm)] <Insert dimension> apart in a [**straight in-line**] [**brick (staggered)**] <Insert pattern> pattern.
 3. Glazing Inserts: [**Manufacturer's standard**] <Insert description>.

4. Spacers: **[Metal tubes matching curtain material] [PVC] <Insert description>**.

- D. Curtain Jamb Guides: **[Aluminum] [Stainless steel] [Galvanized steel]** with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise. **[Provide removable post(s) and jamb guides where shown on Drawings.]**

- E. Hood: **[Match curtain material and finish] [Aluminum] [Stainless steel] [Galvanized steel]**.
 1. Shape: **[Round] [Square] [As shown on Drawings] <Insert shape>**.
 2. Mounting: **[Face of wall] [Between jambs] [On mounting frame] [As shown on Drawings]**.

- F. Locking Devices: Equip grille with **[slide bolt for padlock] [locking device assembly] [and] [chain lock keeper]**.
 1. Locking Device Assembly: **[Single-jamb side] [Cremone type, both jamb sides]** locking bars, operable from **[inside with thumb turn] [outside with cylinder] [outside only, with cylinder] [inside and outside with cylinders] <Insert requirement>**.

- G. Manual Grille Operator: **[Push-up operation] [Chain-hoist operator] [Manufacturer's standard crank operator] [Awning-crank operator] [Wall-crank operator]**.
 1. Provide operator with through-wall shaft operation.
 2. Provide operator with manufacturer's standard removable operating arm.

- H. Electric Grille Operator:
 1. Usage Classification: **[Heavy duty, 60 to 90 cycles per hour] [Standard duty, up to 60 cycles per hour] [Medium duty, up to 15 cycles per hour] [Light duty, up to 10 cycles per hour] <Insert classification>**.
 2. Operator Location: **[Top of hood] [Front of hood] [Wall] [Bench] [Through wall] [As shown on Drawings]**.
 3. Motor Exposure: **[Interior] [Exterior, wet, and humid]**.
 4. Emergency Manual Operation: **[Push-up] [Chain] [Crank]** type.
 5. Obstruction-Detection Device: Automatic **[photoelectric sensor] [electric sensor edge on bottom bar] [pneumatic sensor edge on bottom bar] [; self-monitoring type]**.
 - a. Sensor Edge Bulb Color: **[Black] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 6. Remote-Control Station: **[Interior] [Exterior] [Where shown on Drawings] <Insert location>**.
 7. Other Equipment: **[Audible and visual signals] [Emergency-egress release] [Self-opening mechanism] <Insert device>**.

- I. Grille Finish:

1. Aluminum Finish: **[Mill] [Clear anodized] [Light bronze anodized] [Medium bronze anodized] [Dark bronze anodized] [Black anodized] [Anodized color matching DEN Project Manager's sample] [Anodized color as selected by DEN Project Manager from full range of industry colors and color densities] <Insert color>**.
2. Baked-Enamel or Powder-Coated Finish: **[Color as indicated by manufacturer's designations] [Color matching DEN Project Manager's sample] [Color as selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>**.
3. Factory Prime Finish: Manufacturer's standard color.
4. Stainless-Steel Finish: **[No. 2B (bright, cold rolled)] [No. 4 (polished directional satin)] <Insert finish>**.
5. PVC Spacers: **[Color as indicated by manufacturer's designations] [Color as selected by DEN Project Manager from manufacturer's full range] <Insert color>**.

2.8 CLOSED-CURTAIN GRILLE ASSEMBLY <Insert drawing designation>

- A. Closed-Curtain Grille: Overhead coiling grille with a curtain having a series of horizontal ribs alternating with continuous horizontal infill panels secured by the ribs.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AlumaTek, Inc.
 - b. Dynaflair Corporation.
 - c. Dynamic Closures Corp.
 - d. QMI Security Solutions.
 - e. **<Insert manufacturer's name>**.
 - f. or approved equal.
- B. Operation Cycles: Not less than **[10,000] [20,000] [50,000] [100,000] <Insert number>**.
 1. Include tamperproof cycle counter.
- C. Grille Curtain Material: Aluminum ribs with continuous inserts indicated.
 1. Space ribs at approximately **[3 inches (76 mm)] <Insert dimension>** o.c.
 2. Inserts: Glass panels.
 3. Inserts: **[Clear, transparent] [Translucent]** plastic panels.
 4. Inserts: **[Solid] [Perforated]** aluminum panels.
- D. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise. **[Provide removable post(s) and jamb guides where shown on Drawings.]**

- E. Hood: **[Match curtain material and finish] [Aluminum] [Stainless steel] [Galvanized steel]**.
1. Shape: **[Round] [Square] [As shown on Drawings] <Insert shape>**.
 2. Mounting: **[Face of wall] [Between jambs] [On mounting frame] [As shown on Drawings]**.
- F. Locking Devices: Equip grille with **[slide bolt for padlock] [locking device assembly] [and] [chain lock keeper]**.
1. Locking Device Assembly: **[Single-jamb side] [Cremone type, both jamb sides] locking bars, operable from [inside with thumbturn] [outside with cylinder] [outside only, with cylinder] [inside and outside with cylinders] <Insert requirement>**.
- G. Manual Grille Operator: **[Push-up operation] [Chain-hoist operator] [Manufacturer's standard crank operator] [Awning-crank operator] [Wall-crank operator]**.
1. Provide operator with through-wall shaft operation.
 2. Provide operator with manufacturer's standard removable operating arm.
- H. Electric Grille Operator:
1. Usage Classification: **[Heavy duty, 60 to 90 cycles per hour] [Standard duty, up to 60 cycles per hour] [Medium duty, up to 15 cycles per hour] [Light duty, up to 10 cycles per hour] <Insert classification>**.
 2. Operator Location: **[Top of hood] [Front of hood] [Wall] [Bench] [Through wall] [As shown on Drawings]**.
 3. Motor Exposure: **[Interior] [Exterior, wet, and humid]**.
 4. Emergency Manual Operation: **[Push-up] [Chain] [Crank] type**.
 5. Obstruction-Detection Device: Automatic **[photoelectric sensor] [electric sensor edge on bottom bar] [pneumatic sensor edge on bottom bar] [; self-monitoring type]**.
 - a. Sensor Edge Bulb Color: **[Black] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 6. Remote-Control Station: **[Interior] [Exterior] [Where shown on Drawings] <Insert location>**.
 7. Other Equipment: **[Audible and visual signals] [Emergency-egress release] [Self-opening mechanism] <Insert device>**.
- I. Grille Finish:
1. Aluminum Finish: **[Mill] [Clear anodized] [Light bronze anodized] [Medium bronze anodized] [Dark bronze anodized] [Black anodized] [Anodized color matching DEN Project Manager's sample] [Anodized color as selected by DEN Project Manager from full range of industry colors and color densities] <Insert color>**.

2. Baked-Enamel or Powder-Coated Finish: [**Color as indicated by manufacturer's designations**] [**Color matching DEN Project Manager's sample**] [**Color as selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.
3. Factory Prime Finish: Manufacturer's standard color.
4. Stainless-Steel Finish: [**No. 2B (bright, cold rolled)**] [**No. 4 (polished directional satin)**] <Insert finish>.

2.9 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.10 ALUMINUM FINISHES

- A. Mill Finish: Manufacturer's standard.
- B. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
- C. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.
- D. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.

2.11 STEEL AND GALVANIZED-STEEL FINISHES

- A. Factory Prime Finish: Manufacturer's standard primer, compatible with field-applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.
- B. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

2.12 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 3. Directional Satin Finish: No. 4.
- C. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install overhead coiling grilles and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling grilles, hoods, and operators at the mounting locations indicated for each grille.
- C. Accessibility: Install overhead coiling grilles, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Test grille opening when activated by detector, fire-alarm system, emergency-egress release, or self-opening mechanism as required. Reset grille-opening mechanism after successful test.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that grilles operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling grilles.
 - 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 083326

SECTION 083513 - FOLDING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Accordion folding doors.
2. Panel folding doors.
3. Bifold doors.
4. Bifold mirror doors.
5. Fire-rated folding doors.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for support of and blocking for partition tracks, jamb conditions, pocket doors, motor operators, and controls; and for prepunching metal support members.
2. Section 061000 "Rough Carpentry" for support of and blocking for partition tracks, jamb conditions, pocket doors, motor operators, and controls.
3. Section 083113 "Access Doors and Frames" for access panels to controls of fire-rated folding doors.
4. Section 102238 "Operable Panel Partitions" for large-size, acoustically rated[**and fire-rated**], flat panel operable partitions.
5. Section 102226.13 "Accordion Folding Partitions" for large-size, acoustically rated, accordion folding partitions.
6. Section 283100 "Intelligent Life Safety Fire Management System" for fire alarm system requirements.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.[**Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for folding doors.**]

1. Include data substantiating that materials comply with requirements.

- B. Shop Drawings: For folding doors. Include plans, elevations, sections, details, attachments to other work, clearances required for operation, [**electronic operating and control mechanisms,**] [**access requirements,**] [**pockets and pocket doors,**] and accessory items. Show blocking.
 - 1. Fire-Release System: Describe system, including testing and resetting instructions.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Setting Drawings: For anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors that are to be embedded in [**concrete**] [**or**] [**masonry**], and for cutouts required in other work, including support-beam punching template.
- D. Samples for Initial Selection: For units with factory-applied color finishes.
- E. Samples for Verification: For each type of folding door indicated and for each type of exposed finish required, in manufacturer's standard sizes.
- F. Product Schedule: For folding doors. [**Use same designations indicated on Drawings.**]

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: For the following, from manufacturer:
 - 1. Each type of fire-rated folding door.
 - 2. Each type of finish, covering, or facing for [**fire-rated**] folding doors.
- C. Material Test Reports: For each type of finish, covering, or facing indicated.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fire-rated folding doors.
- E. Research/Evaluation Reports: For fire-rated folding doors, from <**Insert applicable model code organization**>.

1.5 CLOSEOUT SUBMITTALS

- A. [**Operation and**] Maintenance Data: For folding doors to include in [**emergency, operation, and**] maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Finishes, coverings, or facings for folding doors, including finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
 - 2. Hardware, track, carriers, seals, [**fire release,**] and other operating components.
 - 3. Electric operator.

- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: **[25] <Insert value>** or less.
 - 2. Smoke-Developed Index: **[50] [450] <Insert value>** or less.
- C. Fire-Rated Folding Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing according to **[NFPA 252] [UBC Standard 7-2] [UL 10B] <Insert test method>**.
 - 1. Oversize Fire-Rated Folding Doors: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
- D. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>**.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install folding doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication

1.8 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 ACCORDION FOLDING DOORS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. [Curtition, Inc.](#)
 2. [FolDoor; Holcomb & Hoke Mfg. Co., Inc.](#)
 3. [Hufcor, Inc.](#)
 4. [KWIK-WALL Company.](#)
 5. [Moderco Inc.](#)
 6. [Modernfold, Inc; a DORMA Group company.](#)
 7. [Panelfold Inc.](#)
 8. **<Insert manufacturer's name>.**
 9. or approved equal.
- B. General: Top-supported, horizontal-sliding, manually operated accordion folding doors, with chain controlling the spacing and extension of pantographic or X-type accordion folding frames. Inner and outer covers are continuous surface facings that attach to and completely cover the folding frames and are pleated as the door is retracted.
- C. Outer Covering: Of type indicated below, complying with indicated surface-burning characteristics; attached to door support frames in a concealed manner at sufficient intervals to prevent sagging and separation and to permit on-site removal and repair, with vertical seams located in valleys and material hemmed at top and bottom.
1. Vinyl reinforced with woven backing weighing not less than [20 oz./linear yd. (567 g/m)] **<Insert weight>.**
 - a. Color, Texture, and Pattern: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color, texture, and pattern>.**
 2. Fabric weighing not less than [16 oz./linear yd. (496 g/m)] **<Insert weight>**, treated to resist stains.
 - a. Color, Texture, and Pattern: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color, texture, and pattern>.**
 3. Manufacturer's standard nonwoven carpet, needle punched with fused fibers to prevent unraveling.+
 - a. Color, Texture, and Pattern: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by**

DEN Project Manager from manufacturer's full range] <Insert color, texture, and pattern>.

- D. Sweep Seals: Manufacturer's standard top and bottom sweep seals on **[both] [one]** side(s).
- E. Carriers: Four-wheel carriers at lead post and two-wheel carriers at intermediate spacing, as necessary for size and weight of partition, to ensure secure, easy, and quiet operation.
1. Doors **96 Inches** (2438 mm) High or Less: Nylon wheels on steel shafts.
 2. Doors More Than **96 Inches** (2438 mm) High: Ball-bearing wheels with nylon tread and steel shafts.
- F. Tracks: Manufacturer's standard metal track made of extruded aluminum or formed steel with factory-applied, corrosion-resistant finish. Limit track deflection, independent of structural supporting system, to no more than 80 percent of bottom clearance. Design and fabricate track to support accordion folding doors and enable their operation without damage to track, folding unit, or adjacent surfaces; complying with the following requirements:
1. Head Trim: Prefinished wood molding for surface-mounted tracks.
 2. Center stop for center-opening partitions.
 3. Galvanized-steel sheet or aluminum subchannel for forming pocket for recessed suspension track.
 4. Metal ceiling contact guard to protect finished ceiling surface from damage by moving top sweep seals; with finish matching other exposed metal.
 5. Curved track sections with ceiling clips to accommodate configuration indicated.
 6. Glide switch to divert door to auxiliary track.
 7. Pivot switch to change track direction.
 8. Cross-track switch to allow one door to cross another.
- G. Hardware: Manufacturer's standard heavy-duty, manually operated metal pulls and latches as follows:
1. Finish: **[Clear-anodized aluminum] [Satin stainless steel] [Dull chromium-finish brass] [Dull chromium-finish steel]**.
 2. Latch: Operable from **[both] [one]** side(s) of closed door **[with coin-slot release on opposite side]**.
 3. Lock: **[Manufacturer's standard key-operated cylinder lock, operable from both sides] [Manufacturer's standard key-operated cylinder lock, operable from one side; privacy lock on other side] [Deadlock to receive cylinder, operable from both sides. Refer to Section 087100 "Door Hardware" for cylinder requirements] [Deadlock to receive cylinder, operable from both sides. Refer to Section 087111 "Door Hardware (Descriptive Specification)" for cylinder requirements] <Insert requirements>.**
 4. Foot bolts on lead post where indicated. Secure to post to avoid interference with seals.

- H. Jamb Molding: Manufacturer's standard wood or metal molding at closing jamb as required for light-tight jamb closure.
- I. Lead Posts and Jamb Posts: Not less than **0.048-inch- (1.2-mm-)** thick **[steel]** **[extruded aluminum]**, formed for rigidity and light seal at supporting construction.
 - 1. Nonferrous jamb strip for single-operating partitions to ensure tight closure by engaging rubber bumper on lead post.
- J. Meeting Post: **[Fixed single jamb for single-stacked doors]** **[Center meeting post for center-opening doors]**.
- K. Stacking: Tiebacks to maintain door in stacked position.
- L. Stacking Configuration: Stack **[single doors at one end of opening]** **[center-opening doors at both ends of opening]** **[doors in pockets with hinged pocket doors]**.
- M. Opening Size: **[As indicated on Drawings]** **<Insert size>**.

2.2 PANEL FOLDING DOORS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - 1. [American Folding Door Company, Inc.](#)
 - 2. [FolDoor; Holcomb & Hoke Mfg. Co., Inc.](#)
 - 3. [Panelfold Inc.](#)
 - 4. [Won-Door Corporation.](#)
 - 5. [Woodfold-Marco Mfg., Inc.](#)
 - 6. **<Insert manufacturer's name>**.
 - 7. or approved equal.
- B. General: Top-supported, horizontal-sliding, manually operated panel folding doors, with panels joined by continuous hinge connectors for the full height of panels.
- C. Core Material and Thickness: Manufacturer's standard.
- D. Panel Width: **[4-inch (100-mm)] [5-inch (125-mm)] [6-inch (150-mm)] [8-inch (200-mm)]** **<Insert dimension>** nominal width.
- E. Panel Facing: Facings that comply with indicated surface-burning characteristics.
 - 1. Vinyl Facing: Vinyl not less than **[7 mils (0.175 mm)]** **<Insert thickness>** thick, factory bonded to core.
 - a. Color and Texture: **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's samples]** **[As selected by DEN Project Manager from manufacturer's full range]** **<Insert color and texture>**.

2. Vinyl Facing with Woven Backing: Vinyl reinforced with woven backing weighing not less than [12 oz./linear yd. (372 g/m)] <Insert weight>, factory bonded to core.
 - a. Color and Texture: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>.**
 3. Plastic-Laminate Facing: Grade VGS, high-pressure plastic laminate complying with NEMA LD 3; adhesive applied under pressure to core.
 - a. Color, Texture, and Pattern: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color, texture, and pattern>.**
 4. Wood-Veneer Facing: <Insert species> wood veneer, laminated to core, with manufacturer's standard [clear] [stained] transparent finish.
 - a. Stain Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.**
- F. Carriers: Four-wheel carriers at lead post and two-wheel carriers at intermediate spacing, as necessary for size and weight of partition, to ensure secure, easy, and quiet operation.
1. Panels 5 Inches (125 mm) Wide or Less: Nylon wheels and axles.
 2. Panels More Than 5 Inches (125 mm) Wide: Ball-bearing wheels with nylon tread and steel shafts.
- G. Tracks: Manufacturer's standard [surface-mounted] [recessed], extruded-aluminum or steel track with factory-applied, corrosion-resistant finish. Limit track deflection, independent of structural supporting system, to no more than 80 percent of bottom clearance. Design and fabricate track to support operation without damage to track, folding unit, or adjacent surfaces; complying with the following requirements:
1. Prefinished ceiling guard/channel for recessed tracks.
 2. Center stop for biparting partitions.
 3. Galvanized-steel sheet or aluminum subchannel for forming pocket for recessed suspension track.
 4. Nonferrous jamb strip for single-operating partitions to ensure tight closure by engaging rubber bumper on lead post.
 5. Curved track sections to accommodate configuration indicated.
 6. Glide switch to divert door to auxiliary track.
 7. Pivot switch to change track direction.
 8. Cross-track switch to allow one door to cross another.
- H. Hinge Connector: Manufacturer's standard extruded-vinyl hinge connector.

1. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] [Match or coordinate with facing color] <Insert color>**.
 - I. Hardware: Manufacturer's standard heavy-duty, manually operated metal pulls and latches as follows:
 1. Finish: **[Clear-anodized aluminum] [Satin stainless steel] [Dull chromium-finish brass] [Dull chromium-finish steel]**.
 2. Latch: Operable from **[both] [one]** side(s) of closed door.
 3. Lock: **[Manufacturer's standard key-operated cylinder lock, operable from both sides] [Manufacturer's standard key-operated cylinder lock, operable from one side; privacy lock on other side] [Deadlock to receive cylinder, operable from both sides. Refer to Section 087100 "Door Hardware" for cylinder requirements] [Deadlock to receive cylinder, operable from both sides. Refer to Section 087111 "Door Hardware (Descriptive Specification)" for cylinder requirements] <Insert requirements>**.
 4. Foot bolts on lead post where indicated. Secure to post to avoid interference with seals.
 - J. Jamb Molding: Manufacturer's standard wood or metal molding at closing jamb as required for light-tight jamb closure.
 1. Wood: Match species and finish of panel facing.
 2. Metal: Manufacturer's standard finish.
 - K. Wood Track Molding: Manufacturer's standard wood molding on each side of surface-mounted track to match species and finish of panel facings. Install with tight, hairline joints with all fasteners concealed.
 - L. Meeting Post: **[Fixed single jamb for single-stacked doors] [Center meeting post for biparting doors]**.
 - M. Stacking: Tiebacks to maintain door in stacked position.
- 2.3 BIFOLD DOORS
- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 1. **Dunbarton Corporation**; Slimfold Products Division.
 2. **<Insert manufacturer's name>**.
 3. or approved equal.
 - B. General: Metal folding doors hinged together in pairs and supported on pivots at jamb, with floor and overhead track and door guide pins.

- C. Metal Panels: Sizes as indicated, formed from nominal **0.024-inch-** (0.6-mm-) thick, cold-rolled steel sheet. Channel form vertical edges and weld cross bracing to panel and channel-formed edges.
1. Surface Profile: [**Fully louvered**] [**Flush**] [**Paneled**] [**Louvered and paneled**] **<Insert profile>**.
 2. Configuration: [**Two**] [**Four**]-panel bifold.
 3. Sheet Metal Texture: [**Smooth**] [**Simulated leather**].
 4. Protective Finish: Hot-dip galvanized coating applied to panels, stiffeners, hinges, and decorative trim.
 5. Baked Finish: Baked-enamel factory finish in [**white**] [**ivory**] [**custom color as selected by DEN Project Manager**] **<Insert color>**.
- D. Hardware: Manufacturer's standard felt pads, screws, and pulls in standard finish. Hinges, pivots, and manufacturer's standard wheels factory installed and as follows:
1. Hinges: 3 self-aligning hinges.
 2. Guides and Pivots: Not less than **5/16-inch-** (7.9-mm-) diameter, adjustable screw-type, weight-bearing, zinc-plated pivot rod held in place by nylon rod clamp assemblies; with not less than **1/4-inch-** (6.4-mm-) diameter, spring-loaded, self-aligning, zinc-plated steel guide rods and top pivot rods held in place by nylon sleeves.
 3. Track: [**Prefinished rolled steel with baked-enamel paint finish**] [**Aluminum extrusion, Alloy 6063-T5, 0.05 inch (1.3 mm) thick, with manufacturer's standard metal finish**].

2.4 BIFOLD MIRROR DOORS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. **Dunbarton Corporation;** Slimfold Products Division.
 2. **<Insert manufacturer's name>**.
 3. or approved equal.
- B. General: Folding doors hinged together in pairs and supported on pivots at jamb, with floor and overhead track and door guide pins.
- C. Steel-Panel Door Construction: Sizes as indicated, flush profile, formed from nominal **0.024-inch-** (0.6-mm-) thick, cold-rolled steel sheet. Channel form vertical edges and weld cross bracing to panel- and channel-formed edges. Attach mirrored glass facing to steel sheet by means of mechanically attached channels at top and bottom and by dual-faced cushion tape.
1. Configuration: [**Two**] [**Four**]-panel bifold.
 2. Protective Finish: Hot-dip galvanized coating applied to panels, stiffeners, hinges, and decorative trim.
 3. Baked Finish: Baked-enamel factory finish in [**white**] [**custom color as selected by DEN Project Manager**] **<Insert color>**.

- D. Metal-Framed Door Construction: **[Aluminum]** **[Steel]** stiles and mechanically fitted rails with screw-attached stiffeners and with mirrored-glass facing attached securely to frames.
1. Panel Style: **[Exposed]** **[Concealed]** frame.
 2. Configuration: **[Two]** **[Four]**-panel bifold.
 3. Baked Finish: Electrostatically applied, baked-enamel factory finish in **[white]** **[custom color as selected by DEN Project Manager]** <Insert color>.
 4. Bright, Reflective Metallic Finish: **[Chrome]** **[Gold]** **[Selected by DEN Project Manager from manufacturer's full range]** <Insert finish>.
- E. Mirror Facing: **[Smooth]** **[Beveled]**-edged, silvered, mirrored, film-backed safety glass complying with 16 CFR 1201 for Category II safety glass; with ASTM C 1036 for Type I (transparent, flat), Class 1 (clear), Quality q2 (mirror) annealed float glass; with the following:
1. Glass Thickness: **[3 mm thick for doors up to 84 inches (2133 mm) in height]** **[4 mm thick for doors with height more than 84 inches (2133 mm)]**.
 2. Edge Protection: Vertical mirror edges protected by **[metal]** **[Mylar]** trim.
 3. Film-Backed Safety Mirrors: Apply film backing with pressure-sensitive adhesive coating over mirror-backing paint as recommended in writing by film-backing manufacturer to produce a surface free of bubbles, blisters, and other imperfections.
- F. Hardware: Manufacturer's standard felt pads, screws, and pulls in standard finish. Hinges, pivots, and manufacturer's standard wheels factory installed and as follows:
1. Hinges: 3 self-aligning hinges.
 2. Guides and Pivots: Manufacturer's standard.
 3. Guides and Pivots: Spring-loaded, zinc-plated steel guides and tops, and adjustable bottom pivot pins with nylon bushings and tips.
 4. Guides and Pivots: Not less than **5/16-inch-** (7.9-mm-) diameter, adjustable screw-type, weight-bearing, zinc-plated pivot rod held in place by nylon rod clamp assemblies; with not less than **1/4-inch-** (6.4-mm-) diameter, spring-loaded, self-aligning, zinc-plated steel guide rods and top pivot rods held in place by nylon sleeves.
- G. Track: **[Prefinished rolled steel with baked-enamel paint finish]** **[Aluminum extrusion, Alloy 6063-T5, 0.05 inch (1.3 mm) thick, with manufacturer's standard metal finish]**.

2.5 FIRE-RATED FOLDING DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [McKeon Rolling Steel Door Company, Inc.](#)
 2. [Won-Door Corporation.](#)
 3. **<Insert manufacturer's name>**.

4. or approved equal.
- B. General: **[Electrically]** **[Gravity-]** operated, automatic- or self-closing, UL- or ITS-listed, **[biparting]** folding fire-rated assembly; top supported from overhead track or dual tracks without floor guides; complete with hardware, seals, track, closing devices, releasing devices, controls, **[pocket doors,]** and accessories necessary for intended operation and complying with the following requirements:
 1. Assembly remains in normal open (stacked) position. Signal from fire-alarm system initiates self-closing operation.
 2. Controls allow manual operation in either conventional or emergency mode. When opened manually during emergency mode, control mechanism automatically closes assembly.
 3. **<Insert requirements>**.
- C. Fire Rating: **[1]** **[1-1/2]** **[3]** **<Insert number>** hour(s).
- D. Panel Construction: **[Formed-steel]** **[Formed stainless-steel]** sheet panels connected by **[formed-steel]** **[formed stainless-steel]** hinges.
- E. Fire Insulation:
 1. Cover interior surface of both series of panels in parallel panel doors with continuous fire-resistive blanket secured to each panel with metal clip system.
 2. Extend fire insulation from bottom edge of panels to tracks and meet at interior centers of fixed jamb and lead post, forming an effective fire barrier.
- F. Perimeter Seals and Closures: Manufacturer's standard vinyl or neoprene vertical seals, horizontal top and bottom seals, and closures identical to products tested for fire rating indicated, and forming an effective smoke and draft seal.
- G. Track and Trolley System: 1 track or 2 parallel steel tracks on **8-inch (200-mm)** centers, with ball-bearing roller trolleys and adjustable steel hanger rods for overhead support; designed for type of operation, size, and weight of fire-rated folding door indicated. Provide a continuous system of track sections and accessories identical to products tested for fire rating indicated, to accommodate configuration and layout indicated for door operation and storage.
- H. Lead Posts: Formed from not less than **0.026-inch (0.66-mm-)** thick **[steel]** **[stainless-steel]** sheet, connected to door panels by specially adapted panels and equipped with manufacturer's standard handle on each side.
- I. Electric Operators and Controls:
 1. Operators: Factory-assembled power-drive unit consisting of motor, **[remote-located]** control panel, limit switches, torque-limiting devices, clutch, reversing magnetic motor operator, leading-edge obstruction detectors, and key-switch control for conventional operation.

- a. Motor: [1/2 hp] <Insert horsepower>, controlled by reversing magnetic starter and equipped with overload protection.
 - b. Limit Switches: To prevent overtravel.
 - c. Roller Chain or Cable: Connected to lead posts by means of vertical stabilizer bar assembly.
 - d. Drive Mechanism: Protected by torque limiter and emergency clutch.
 - e. Travel Speed: 18 inches (450 mm) per second, maximum; 6 inches (150 mm) per second, minimum.
2. In case of fire, closing system is activated by building's fire- and smoke-detection equipment and automatically closes fire-rated folding doors.
 3. Electrical Service: Equip for [120 V, single phase, 60-cycle ac] <Insert service requirements>.
 4. Battery: Electrical current connects through relay to battery charger that continuously charges 12-V dc battery and automatically maintains battery at capacity. Automatic audible signal device sounds off if battery falls below or exceeds proper charge, power loss has occurred, or high-ac line voltage has been experienced.
 5. Leading-Edge Obstruction Detector:
 - a. Equip with pressure-sensitive leading edge that, on contact with an obstruction, causes door to stop and pause before attempting to re-close.
 - b. Disable leading-edge obstruction detector until fire-rated folding door has opened pocket door.
 6. Fire-rated folding doors can be manually opened at any time by pushing against leading edge.
 7. Audible alarm sounds at automatic closing of door.
- J. Accessories:
1. Vision panels.
 2. Exit Hardware: Located on both sides of fire-rated folding door. In emergency mode, slight pressure on hardware causes door to open a minimum of 32 inches (812 mm), pause for 3 seconds, and then automatically close. Furnish hardware that can be field programmable to allow automatic opening distances of up to the entire opening width. In conventional mode, hardware is used to operate door and move it back into storage pocket.
 3. <Insert accessory>.
- K. Finishes:
1. Baked-enamel finish for panels and hinges in colors selected by DEN Project Manager from manufacturer's full range.
 2. Manufacturer's standard finish for handles.
- L. Pocket Door:
1. Solid-core pocket doors with [reverse-action spring] [continuous] hinge; 90-degree minimum swing.

2. Face Finish: [**Match adjacent finishes**] <Insert finishes>.
3. Magnetic Catch: Holding force of no more than 30 lbf (133 N).
4. Maximum Opening Force: 50 lbf (222 N).
5. Bumper on interior side of pocket door as required by fire-rated folding door manufacturer to prevent interference with opening or retracting operation of fire-rated folding door.
6. Coordinate pocket door sizes with fire-rated folding door manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of folding doors.
- B. Verify that headers are level with finished floor to within plus or minus 1/16-inch (1.6-mm) tolerance over the length of opening.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. For folding doors supported by or anchored to permanent construction, advise installers of specific requirements for placement of anchorage devices. Furnish installers of other work with templates and drawings showing locations of anchorage devices and similar items.
- B. In path of fire-rated folding doors, level floor with header to tolerance of plus or minus 1/16 inch (1.6 mm) across opening; grind or fill floor as necessary.

3.3 INSTALLATION

- A. General: Install folding doors complying with manufacturer's written installation instructions. Install track in one piece.
 1. Comply with NFPA 80 for installing fire-rated folding doors.
- B. Standard Floor Clearances: 1/4 to 3/4 inch (6.4 to 19 mm) maximum (above floor finish).
 1. Comply with NFPA 80 for clearances required for fire-rated folding doors.
- C. Coordinate provisions for electrical service, sensing devices, and final connections for fire-rated folding doors.

3.4 ADJUSTING

- A. Adjust units as necessary to ensure smooth, quiet operation without warping or binding. Adjust hardware to function smoothly. Confirm that latches engage accurately and securely without forcing or binding.
 - 1. Fire-Rated Folding Doors: Verify that all operations are functional and comply with requirements of authorities having jurisdiction.
- B. Pocket Doors: Adjust to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly. Confirm that latches and locks engage accurately and securely without forcing or binding.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-rated folding doors.
 - 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 083513

SECTION 083613 - SECTIONAL DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes **[manually] [electrically]** operated sectional doors **[with integral pass doors]**.
- B. Related Sections:
 - 1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.
 - 2. **[Section 099113 "Exterior Painting"] [and] [Section 099123 "Interior Painting"]** for finish painting of factory-primed doors.
 - 3. Section 111200 "Parking Control Equipment" for parking control equipment interlocked to sectional doors.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Sectional doors shall meet performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.
- B. Delegated Design: Design sectional doors, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Structural Performance: Exterior sectional doors shall withstand the effects of gravity loads, and the following loads and stresses within limits and under conditions indicated according to **[ASCE/SEI 7] <Insert requirement>**.
 - 1. Wind Loads: **[As indicated on Drawings] [Uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa), acting inward and outward] <Insert loads>**.
 - a. Basic Wind Speed: **[85 mph (38 m/s)] [90 mph (40 m/s)] [100 mph (44 m/s)] [110 mph (49 m/s)] <Insert value>**.
 - b. Importance Factor: **<Insert factor>**.

- c. Exposure Category: **[A] [B] [C] [D]**.
 2. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components. Deflection of door in horizontal position (open) shall not exceed 1/120 of the door width.
 - D. Air Infiltration: Maximum rate not more than indicated when tested according to **[ASTM E 283] [or] [DASMA 105]**.
 1. Air Infiltration: Maximum rate of **[0.08 cfm/sq. ft. (0.406 L/s per sq. m)] <Insert rate>** at **15 and 25 mph** (24.1 and 40.2 km/h).
 - E. Windborne-Debris-Impact-Resistance Performance: Provide **[glazed]** sectional doors that pass large-missile-impact and cyclic-pressure tests when tested according to **[ASTM E 1886 and ASTM E 1996] [DASMA 115] <Insert requirement>**.
 - F. Seismic Performance: Sectional doors shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7] <Insert requirement>**.
 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 2. Seismic Component Importance Factor: **[1.5] [1.0]**.
 - G. Operation Cycles: Provide sectional door components and operators capable of operating for not less than number of cycles indicated for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
- 1.4 ACTION SUBMITTALS
- A. Product Data: For each type and size of sectional door and accessory. Include the following:
 1. Construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
 2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
 3. Include data substantiating that materials comply with requirements.
 - B. LEED Submittals:
 1. Certificates for **[Credit MR 6] [Credit MR 7]**: Chain-of-custody certificates certifying that flush wood doors comply with forest certification requirements. **[Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.]** Include statement indicating cost for each certified wood product.
 - C. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details,

and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Wiring Diagrams: For power, signal, and control wiring.
- D. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
1. Include similar Samples of accessories involving color selection.
- E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
1. Flat Door Sections: **6 inches** (150 mm) square.
 2. Frame for Paneled Door Sections: **6 inches** (150 mm) long of each width of stile and rail required.
 3. Panel for Raised-Panel Door Sections: **12 inches** (300 mm) square at panel corner, but not smaller than required to show raised-panel profile.
- F. Delegated-Design Submittal: For sectional doors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of seismic restraints.
 2. Summary of forces and loads on walls and jambs.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Seismic Qualification Certificates: For sectional doors, accessories, and components, from manufacturer.
- C. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sectional doors to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Wood Door Manufacturer Qualifications: A qualified manufacturer that is certified for

chain of custody by an FSC-accredited certification body.

- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.
- C. Source Limitations: Obtain sectional doors from single source from single manufacturer.
 - 1. Obtain operators and controls from sectional door manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Standard for Sectional Doors: Fabricate sectional doors to comply with DASMA 102 unless otherwise indicated.
- F. Regulatory Requirements: Comply with applicable provisions in [**the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities"**] [**and**] [**ICC/ANSI A117.1**].

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Faulty operation of hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
 - d. Delamination of exterior or interior facing materials.
 - 2. Warranty Period: Minimum [**two (2)**] [**five (5)**] <Insert number> years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Warranty Period: Minimum [**10**] <Insert number> years from date of Substantial Completion.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419

"Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 STEEL DOOR SECTIONS

- A. Exterior Section Faces and Frames: Fabricate from zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653/A 653M, with indicated zinc coating and thickness.
1. Fabricate section faces from single sheets to provide sections not more than **24 inches** (610 mm) high and of indicated thickness. Roll horizontal meeting edges to a continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove weathertight seal, with a reinforcing flange return.
 2. For insulated doors, provide sections with continuous thermal-break construction, separating the exterior and interior faces of door.
- B. Section Ends and Intermediate Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet not less than **0.064-inch-** (1.63-mm-) nominal coated thickness and welded to door section. Provide intermediate stiles formed from not less than **0.064-inch-** (1.63-mm-) thick galvanized-steel sheet, cut to door section profile, and welded in place. Space stiles not more than **48 inches** (1219 mm) apart.
- C. Reinforce bottom section with a continuous channel or angle conforming to bottom-section profile[**and allowing installation of astragal**].
- D. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place.[**Ensure that reinforcement does not obstruct vision lites.**]
- E. Provide reinforcement for hardware attachment.
- F. Board Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard[**CFC-free**] polystyrene or polyurethane board insulation, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84; or with glass-fiber-board insulation. Secure insulation to exterior face sheet. Enclose insulation completely within steel sections that incorporate the following interior facing material, with no exposed insulation:
1. Interior Facing Material: Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653/A 653M, with indicated thickness.
 2. Interior Facing Material: Manufacturer's standard prefinished hardboard panel, **1/8 inch** (3 mm) thick and complying with ANSI A135.5.
- G. Foamed-in-Place Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard[**CFC-free**] polyurethane insulation, foamed in place to completely fill interior of section and pressure bonded to face sheets to prevent

delamination under wind load, and with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within steel sections that incorporate the following interior facing material, with no exposed insulation:

1. Interior Facing Material: Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653/A 653M, with indicated thickness.
2. Interior Facing Material: Manufacturer's standard prefinished hardboard panel, **1/8 inch** (3 mm) thick and complying with ANSI A135.5.

H. Fabricate sections so finished door assembly is rigid and aligned, with tight hairline joints and free of warp, twist, and deformation.

2.2 WOOD DOOR SECTIONS

A. Paneled Sections: Fabricate stiles and rails of clear, vertical-grain, straight, kiln-dried Douglas fir, West Coast hemlock, or Sitka spruce, not less than **1-3/4 inches** (44 mm) thick. Form meeting rails to provide rabbeted, weathertight-seal joint.

1. Panel Inserts: Tempered hardboard, **1/4 inch** (6 mm) thick, smooth on two sides, complying with ANSI A135.4.
2. Glazed Panel Inserts: 6-mm-thick, clear float glass, complying with ASTM C 1036, Type I, Class 1, Quality Q3, with removable glazing stops of same wood as stiles and rails.

B. Flush Sections: Construct flush wood door sections with top, bottom, and end closures of clear, vertical-grain, straight, kiln-dried Douglas fir, West Coast hemlock, or Sitka spruce. Provide wood blocking to receive hardware, end stiles, and frames for glazing, glued and doweled in place. Form meeting rails to provide rabbeted weathertight-seal joint.

1. Core: Manufacturer's standard polystyrene or polyurethane board insulation[**or honeycomb core**] complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Bond to facing.
2. Facing: **1/8-inch-** (3-mm-) thick, tempered hardboard complying with ANSI A135.4 and smooth on one side.

C. Certified Wood: Fabricate wood door sections with **[not less than 70 percent of] [all]** wood products produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

D. Fabricate sections of mortise-and-tenon construction with waterproof glue and steel dowels, or of rabbeted construction with waterproof glue and steel dowels and pins.

E. Reinforce sections with continuous horizontal and diagonal galvanized-steel members as required to stiffen door and for wind loading.[**Ensure that reinforcement does not obstruct vision lites.**]

- F. Treat wood door members after machining with water-repellent preservative formulation according to WDMA I.S. 4.
- G. Fabricate sections so finished door assembly is rigid and aligned, with tight hairline joints and free of warp, twist, deformation, and delamination.
- H. Factory prime door sections with one coat of exterior primer compatible with field-applied finish, applied at a minimum dry film thickness of **1 mil** (0.025 mm).

2.3 ALUMINUM DOOR SECTIONS

- A. Sections: Construct door sections with stiles and rails formed from extruded-aluminum shapes, complying with **ASTM B 221** (ASTM B 221M), alloy and temper recommended by manufacturer for type of use and finish indicated, with wall thickness not less than **0.065 inch** (1.7 mm) for door section **1-3/4 inches** (44 mm) deep. Fabricate sections with stile and rail dimensions and profiles shown on Drawings. Join stiles and rails by welding or with concealed, **1/4-inch-** (6-mm-) minimum diameter, aluminum or nonmagnetic stainless-steel through bolts, full height of door section. Form meeting rails to provide a weathertight-seal joint.
 - 1. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. [**Ensure that reinforcement does not obstruct vision lites.**]
 - 2. Provide reinforcement for hardware attachment.
- B. Solid Panels: Fabricate of aluminum sheet, complying with **ASTM B 209** (ASTM B 209M), alloy and temper standard with manufacturer for type of use and finish indicated, not less than **0.040 inch** (1.02 mm) thick, set in continuous vinyl channel retained with rigid, snap-in, extruded-vinyl moldings or with rubber or neoprene glazing gasket with aluminum stop.
- C. Full-Vision Sections: Manufacturer's standard, tubular, aluminum-framed section fully glazed with 6-mm-thick, clear acrylic glazing set in vinyl, rubber, or neoprene glazing channel and with removable extruded-vinyl or aluminum stops.

2.4 TRANSLUCENT DOOR SECTIONS

- A. Construct door sections of not less than **0.063-inch-** (1.6-mm-) thick, extruded-aluminum stiles and rails complying with **ASTM B 221** (ASTM B 221M) and with alloy and temper recommended by manufacturer for type of use and finish indicated, to provide door sections at least **1-3/4 inches** (44 mm) deep. Fabricate units with overlapped or interlocked weathertight-seal joints at meeting rails. Reinforce or truss each section as required for strength and rigidity. Provide reinforcement for hardware attachment.
- B. Provide translucent, ribbed, glass-fiber-reinforced plastic panels, secured and sealed watertight to framing, and reinforced to meet performance requirements.

2.5 TRACKS, SUPPORTS, AND ACCESSORIES

- A. Tracks: Manufacturer's standard, galvanized-steel track system of configuration indicated, sized for door size and weight, designed for lift type indicated and clearances shown on Drawings, and complying with ASTM A 653/A 653M for minimum **G60 (Z180)** zinc coating. Provide complete track assembly including brackets, bracing, and reinforcement for rigid support of ball-bearing roller guides for required door type and size. Slot vertical sections of track spaced **2 inches (51 mm)** apart for door-drop safety device. Slope tracks at proper angle from vertical or design tracks to ensure tight closure at jambs when door unit is closed.
- B. Track Reinforcement and Supports: Galvanized-steel track reinforcement and support members, complying with ASTM A 36/A 36M and ASTM A 123/A 123M. Secure, reinforce, and support tracks as required for door size and weight to provide strength and rigidity without sag, sway, and vibration during opening and closing of doors.
1. Vertical Track Assembly: Track with **[continuous reinforcing angle attached to track and attached to wall with jamb brackets] [wall jamb brackets attached to track and attached to wall]**.
 2. Horizontal Track Assembly: Track with continuous reinforcing angle attached to track and supported at points from curve in track to end of track by laterally braced attachments to overhead structural members.
- C. Removable Center Posts: Manufacturer's standard **[carry-away] [roll-away] [swing-up]** type for multiple doors in one opening.
- D. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of sectional door unless otherwise indicated.
- E. Windows: Manufacturer's standard window units of type and size indicated and in arrangement shown. Set glazing in vinyl, rubber, or neoprene glazing channel for metal-framed doors and elastic glazing compound for wood doors, as required. Provide removable stops of same material as door-section frames.
- F. Pass Doors: Manufacturer's standard pass doors where indicated, complete with glazing, operating hardware, and mortise lock. Construct pass doors of same materials, design, and finish as sectional door assembly.
1. Lock Cylinders: Provide cylinders **[specified in Section 087100 "Door Hardware"] [standard with manufacturer] [and keyed to building keying system]**.
 2. Keys: **[Two] [Three] <Insert number>** for each cylinder.

2.6 HARDWARE

- A. General: Provide heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.

- B. Hinges: Heavy-duty, galvanized-steel hinges of not less than **0.079-inch-** (2.01-mm-) nominal coated thickness at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is not possible. Provide double-end hinges where required, for doors over **16 feet** (4.88 m) wide unless otherwise recommended by door manufacturer.
- C. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide **3-inch-** (76-mm-) diameter roller tires for **3-inch-** (76-mm-) wide track and **2-inch-** (51-mm-) diameter roller tires for **2-inch-** (51-mm-) wide track.
- D. Push/Pull Handles: For push-up or emergency-operated doors, provide galvanized-steel lifting handles on each side of door.

2.7 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.
- B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded deadbolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
 - 1. Lock Cylinders: Provide cylinders [**specified in Section 087100 "Door Hardware"**] [**standard with manufacturer**] [**and keyed to building keying system**].
 - 2. Keys: [**Two**] [**Three**] <Insert number> for each cylinder.
- C. Chain Lock Keeper: Suitable for padlock.
- D. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.8 COUNTERBALANCE MECHANISM

- A. Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from steel-spring wire complying with ASTM A 229/A 229M, mounted on torsion shaft made of steel tube or solid steel. Provide springs designed for number of operation cycles indicated.
- B. Weight Counterbalance: Counterbalance mechanism consisting of filled pipe weights that move vertically in a galvanized-steel weight pipe. Connect pipe weights with cable to weight-cable drums mounted on torsion shaft made of steel tube or solid steel.
- C. Cable Drums and Shaft for Doors: Cast-aluminum or gray-iron casting cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised.

Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft. Provide one additional midpoint bracket for shafts up to **16 feet** (4.88 m) long and two additional brackets at one-third points to support shafts more than **16 feet** (4.88 m) long unless closer spacing is recommended by door manufacturer.

- D. Cables: Galvanized-steel lifting cables with cable safety factor of at least **[5] [7]** to 1.
- E. Cable Safety Device: Include a spring-loaded steel or spring-loaded bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either lifting cable breaks.
- F. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
- G. Provide a spring bumper at each horizontal track to cushion door at end of opening operation.

2.9 MANUAL DOOR OPERATORS

- A. Equip door with manufacturer's recommended manual door operator unless another type of door operator is indicated.
- B. Push-up Operation: Lift handles and pull rope for raising and lowering doors, with counterbalance mechanism designed so that required lift or pull for door operation does not exceed **[25 lbf (111 N)] <Insert value>**.
- C. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum **[25-lbf (111-N)] [35-lbf (155-N)] <Insert value>** force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

2.10 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door[**and "operation cycles" requirement**] specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
 - 1. Comply with NFPA 70.
 - 2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

- C. Door-Operator Type: Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification.
1. Trolley: Trolley operator mounted to ceiling above and to rear of door in raised position and directly connected to door with drawbar.
 2. Jackshaft, Center Mounted: Jackshaft operator mounted on the inside front wall above door and connected to torsion shaft with an adjustable coupling or drive chain.
 3. Jackshaft, Side Mounted: Jackshaft operator mounted on the inside front wall on right or left side of door and connected to torsion shaft with an adjustable coupling or drive chain.
- D. Electric Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 110513 "Common Motor Requirements for Equipment" unless otherwise indicated.
1. Electrical Characteristics:
 - a. Phase: **[Single phase] [Polyphase]**.
 - b. Volts: **[115] [208] [230] [460] <Insert value> V.**
 - c. Hertz: 60.
 2. Motor Type and Controller: Reversible motor and controller (disconnect switch) for motor exposure indicated.
 3. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than **8 in./sec. (203 mm/s)** and not more than **12 in./sec. (305 mm/s)**, without exceeding nameplate ratings or service factor.
 4. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 5. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
 6. Use adjustable motor-mounting bases for belt-driven operators.
- E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Obstruction Detection Device: Equip motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
 - a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensor device. When self-monitoring feature is activated, door closes only with sustained pressure on close button.

2. Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
 - a. Self-Monitoring Type: Four-wire configured device designed to interface with door-operator control circuit to detect damage to or disconnection of sensor edge.
 - G. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."
 1. Interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
 2. Exterior units, full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.
 - H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed [25 lbf (111 N)] [35 lbf (155 N)] <Insert value>.
 - I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
 - J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
 - K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.
 - L. Radio-Control System: Consisting of the following:
 1. Three-channel universal coaxial receiver to open, close, and stop door; [one] [two] <Insert number> per operator.
 2. Multifunction remote control.
 3. Remote antenna and mounting kit.
- 2.11 DOOR ASSEMBLY <Insert drawing designation>
- A. [Steel] [Wood] [Aluminum] [Full-Vision Aluminum] [Translucent] Sectional Door: Sectional door formed with hinged sections.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amarr Garage Doors.
 - b. Arm-R-Lite.

- c. C.H.I. Overhead Doors.
 - d. Clopay Building Products; a Griffon company.
 - e. Fimbel Architectural Door Specialties.
 - f. General American Door Company.
 - g. Haas Door; a Nofziger company.
 - h. Martin Door Manufacturing.
 - i. Overhead Door Corporation.
 - j. Raynor.
 - k. Rite-Hite Corporation.
 - l. Wayne-Dalton Corp.
 - m. Windsor Republic Doors.
 - n. **<Insert manufacturer's name>**.
 - o. or approved equal.
- B. Operation Cycles: Not less than **[10,000] [20,000] [50,000] [100,000] <Insert number>**.
- C. **[Installed]** R-Value: **[4.5 deg F x h x sq. ft./Btu (0.792 K x sq. m/W)] [6.0 deg F x h x sq. ft./Btu (1.057 K x sq. m/W)] [12.0 deg F x h x sq. ft./Btu (2.113 K x sq. m/W)] [15.0 deg F x h x sq. ft./Btu (2.642 K x sq. m/W)] [17.5 deg F x h x sq. ft./Btu (3.082 K x sq. m/W)] <Insert value>**.
- D. Steel Sections: Zinc-coated (galvanized) steel sheet with **[G60 (Z180)] [G90 (Z275)]** zinc coating.
1. Section Thickness: **[1-3/8 inches (35 mm)] [1-3/4 inches (44 mm)] [2 inches (51 mm)] <Insert dimension>**.
 2. Exterior-Face, Steel Sheet Thickness: **[0.064-inch- (1.63-mm-)] [0.040-inch- (1.02-mm-)] [0.028-inch- (0.71-mm-)] [0.022-inch- (0.56-mm-)] [0.019-inch- (0.48-mm-)] <Insert dimension>** nominal coated thickness.
 - a. Surface: Flat.
 - b. Surface: Manufacturer's standard, **[grooved] [ribbed] [paneled] [wood-grain embossed] <Insert requirement>**.
 3. Insulation: **[Board] [Foamed in place]**.
 4. Interior Facing Material: Zinc-coated (galvanized) steel sheet of **[0.028-inch- (0.71-mm-)] [0.022-inch- (0.56-mm-)] [0.019-inch- (0.48-mm-)] [manufacturer's recommended thickness to meet performance requirements] <Insert thickness>** nominal coated thickness.
 5. Interior Facing Material: Hardboard panel.
- E. Wood Sections: **[Paneled] [Flush] [and with manufacturer's standard insulation]**.
- F. Aluminum Sections: **[Solid panels] [Full vision] [with manufacturer's standard, nonglazed panels across bottom section of door]**.
- G. Translucent Sections: Manufacturer's standard **[with manufacturer's standard, nonglazed panels across bottom section of door]**.

- H. Track Configuration: [**Standard-lift**] [**Low-headroom**] [**High-lift**] [**Vertical-lift**] [**Contour**] <Insert description> track[**with removable center post shared with adjacent door**].
- I. Weatherseals: Fitted to bottom and top[**and around entire perimeter**] of door.[**Provide combination bottom weatherseal and sensor edge.**]
- J. Windows: Approximately [**24 by 7 inches** (610 by 178 mm)] [**24 by 11 inches** (610 by 279 mm)] <Insert dimensions> [, **with curved corners,**] [, **with square corners,**] and spaced apart the approximate distance as indicated on Drawings; in [**one row**] [**two rows**] <Insert number of rows> at height indicated on Drawings; installed with[**insulated**] glazing of the following type:
1. Clear Float Glass: 3 mm thick and complying with ASTM C 1036, Type I, Class 1, Quality Q3.
 2. Clear Acrylic Plastic: 3 mm thick, transparent, smooth or polished, and formulated to be UV resistant.
 3. Clear Polycarbonate Plastic: 3-mm-thick, transparent, fire-retardant, UV-resistant, polycarbonate sheet manufactured by extrusion process.
 4. Insulating Glass: [**Manufacturer's standard**] <Insert description>.
- K. Pass Door: As shown.
- L. Roller-Tire Material: [**Case-hardened steel**] [**Neoprene or bronze**] [**Manufacturer's standard**].
- M. Locking Devices: Equip door with [**slide bolt for padlock**] [**locking device assembly**] [**and**] [**chain lock keeper**].
1. Locking Device Assembly: [**Single-jamb side**] [**Cremona type, both jamb sides,**] locking bars, operable from [**inside with thumbturn**] [**outside with cylinder**] [**outside only, with cylinder**] [**inside and outside, with cylinders**] <Insert requirement>.
- N. Counterbalance Type: [**Torsion spring**] [**Weight counterbalance**].
- O. Manual Door Operator: [**Push-up operation**] [**Chain-hoist operator**].
- P. Electric Door Operator:
1. Usage Classification: [**Heavy duty, 60 to 90 cycles per hour**] [**Standard duty, up to 60 cycles per hour**] [**Medium duty, up to 15 cycles per hour**] [**Light duty, up to 10 cycles per hour**] <Insert classification>.
 2. Operator Type: [**Trolley**] [**Jackshaft, center mounted**] [**Jackshaft, side mounted**] [**As shown on Drawings**].
 3. Motor Exposure: [**Interior, clean, and dry**] [**Exterior, dusty, wet, or humid**].
 4. Emergency Manual Operation: [**Push-up**] [**Chain**] type.
 5. Obstruction-Detection Device: Automatic [**photoelectric sensor**] [**electric sensor edge on bottom bar**] [**pneumatic sensor edge on bottom bar**]; [**self-monitoring type**].

- a. Sensor Edge Bulb Color: **[Black] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 6. Remote-Control Station: **[Interior] [Exterior] [Where shown on Drawings] <Insert location>**.
 7. Other Equipment: **[Audible and visual signals] [Radio-control system] <Insert device>**.
- Q. Door Finish:
1. Aluminum Finish: **[Clear anodized] [Bronze anodized] [Anodized color matching DEN Project Manager's sample] [Anodized color as selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 2. Baked-Enamel or Powder-Coated Finish: **[Color and gloss as indicated by manufacturer's designations] [Color and gloss matching DEN Project Manager's sample] [Color and gloss as selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>**.
 3. Factory Prime Finish: Manufacturer's standard color.
 4. Finish of Interior Facing Material: **[Match finish of exterior section face] [Finish as indicated by manufacturer's designations] [Finish matching DEN Project Manager's sample] [Finish as selected by DEN Project Manager from manufacturer's full range] <Insert finish>**.

2.12 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.13 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, **[AA-M12C22A41, Class I, 0.018 mm] [AA-M12C22A31, Class II, 0.010 mm]** or thicker.
- B. Color Anodic Finish: AAMA 611, **[AA-M12C22A42/A44, Class I, 0.018 mm] [AA-M12C22A32/A34, Class II, 0.010 mm]** or thicker.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.

2.14 STEEL AND GALVANIZED-STEEL FINISHES

- A. Factory Prime Finish: Manufacturer's standard primer, compatible with field-applied finish. Comply with coating manufacturer's written instructions for cleaning,

pretreatment, application, and minimum dry film thickness.

- B. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Tracks:
 - 1. Fasten vertical track assembly to opening jambs and framing, spaced not more than **24 inches** (610 mm) apart.
 - 2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.
 - 3. Repair galvanized coating on tracks according to ASTM A 780.
- C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

3.3 STARTUP SERVICES

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust doors and seals to provide weathertight fit around entire perimeter.
- D. Align and adjust motors, pulleys, belts, sprockets, chains, and controls according to manufacturer's written instructions.
- E. Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A 780.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.
 - 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 083613

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. **[Exterior] [Interior] [Exterior and interior]** storefront framing.
2. Storefront framing for window walls.
3. Storefront framing for ribbon walls.
4. Storefront framing for punched openings.
5. **[Exterior] [Interior] [Exterior and interior]** manual-swing entrance doors[**and door-frame units**].

B. Related Sections:

1. Section 084126 "All-Glass Entrances and Storefronts" for systems without aluminum support framing.
2. Section 084229.13 "Folding Automatic Entrances" for folding automatic entrances.
3. Section 084229.23 "Sliding Automatic Entrances" for sliding automatic entrances.
4. Section 084229.33 "Swinging Automatic Entrances" for swinging automatic entrances.
5. Section 084233 "Revolving Door Entrances" for revolving entrances.
6. Section 084243 "Intensive Care Unit/Critical Care Unit (ICU/CCU) Entrances" for manual-sliding entrances.
7. Section 084413 "Glazed Aluminum Curtain Walls" for curtain-wall systems that mechanically retain glazing on four sides.
8. Section 084423 "Structural-Sealant-Glazed Curtain Walls" for curtain-wall systems that retain glazing with structural sealant.
9. Section 089116 "Operable Wall Louvers," Section 089119 "Fixed Louvers," and Section 089516 "Wall Vents" for units installed with aluminum-framed systems.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
 2. Dimensional tolerances of building frame and other adjacent construction.
 3. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferring to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
 - d. Glazing-to-glazing contact.
 - e. Noise or vibration created by wind and by thermal and structural movements.
 - f. Loosening or weakening of fasteners, attachments, and other components.
 - g. Sealant failure.
 - h. Failure of operating units.
- B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Structural Loads:
1. Wind Loads: **[As indicated on Drawings.] <Insert loads>**.
 - a. Basic Wind Speed: **[85 mph (38 m/s)] [90 mph (40 m/s)] [100 mph (44 m/s)] [110 mph (49 m/s)] <Insert value>**.
 - b. Importance Factor: **<Insert factor>**.
 - c. Exposure Category: **[A] [B] [C] [D]**.
 2. Seismic Loads: **[As indicated on Drawings] <Insert loads>**.
 3. Blast Loads: **[As indicated on Drawings] <Insert loads>**.
- D. Deflection of Framing Members:
1. Deflection Normal to Wall Plane: Limited to **[edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite] [1/175 of clear span for spans up to**

- 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m)] <Insert deflection limit> or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.**
2. Deflection Parallel to Glazing Plane: Limited to **[L/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller] [amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components directly below them to less than 1/8 inch (3.2 mm) and clearance between members and operable units directly below them to less than 1/16 inch (1.5 mm)] <Insert deflection limit>.**
- E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
 2. When tested at **[150] <Insert number>** percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding **[0.2] <Insert number>** percent of span.
 3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.
- F. Windborne-Debris-Impact-Resistance Performance: Provide aluminum-framed systems that pass missile-impact and cyclic-pressure tests when tested according to **[ASTM E 1886 and testing information in ASTM E 1996] [or] [AAMA 506] <Insert requirement>**.
1. Large-Missile Impact: For aluminum-framed systems located within **30 feet (9.1 m)** of grade.
 2. Small-Missile Impact: For aluminum-framed systems located more than **30 feet (9.1 m)** above grade.
- G. Story Drift: Provide aluminum-framed systems that accommodate design displacement of adjacent stories indicated.
1. Design Displacement: **[As indicated on Drawings] <Insert design displacement>**.
 2. Test Performance: Meet criteria for passing, based on building occupancy type, when tested according to AAMA 501.4 at design displacement **[and 1.5 times design displacement]**.
- H. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of **[0.06 cfm/sq. ft. (0.03 L/s per sq. m)] <Insert rate>** of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of **[1.57 lbf/sq. ft. (75 Pa)] [6.24 lbf/sq. ft. (300 Pa)] <Insert pressure>**.
- I. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested

- according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than [6.24 lbf/sq. ft. (300 Pa)] <Insert pressure>.
- J. Water Penetration under Dynamic Pressure: Provide aluminum-framed systems that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than [6.24 lbf/sq. ft. (300 Pa)] <Insert pressure>.
1. Maximum Water Leakage: [According to AAMA 501.1] [No uncontrolled water penetrating aluminum-framed systems or water appearing on systems' normally exposed interior surfaces from sources other than condensation]. Water leakage does not include water controlled by flashing and gutters that is drained to exterior and water that cannot damage adjacent materials or finishes.
- K. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
 2. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
 - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of [180 deg F (82 deg C)] <Insert temperature>.
 - b. Low Exterior Ambient-Air Temperature: [0 deg F (minus 18 deg C)] <Insert temperature>.
 3. Interior Ambient-Air Temperature: [75 deg F (24 deg C)] <Insert temperature>.
- L. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than [45] [53] <Insert number> when tested according to AAMA 1503.
- M. Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having an average U-factor of not more than [0.57 Btu/sq. ft. x h x deg F (3.23 W/sq. m x K)] [0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K)] <Insert U-factor> when tested according to AAMA 1503.
- N. Sound Transmission: Provide aluminum-framed systems with fixed glazing and framing areas having the following sound-transmission characteristics:
1. Sound Transmission Class (STC): Minimum [26] [30] [35] <Insert rating> STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.

2. Outdoor-Indoor Transmission Class (OITC): Minimum **[26] [30] [34] <Insert rating>** OITC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.
- O. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by aluminum-framed systems without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.
 1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
 2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.
- P. Structural-Sealant Joints: Designed to produce tensile or shear stress of less than **20 psi (138 kPa)**.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.
 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 1. Product Data for Credit IEQ 4.1: For adhesives and sealants used inside of the weatherproofing system, documentation including printed statement of VOC content.
 2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants used inside the weatherproofing system, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
 1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
 2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
- D. Samples for Initial Selection: For units with factory-applied color finishes.
- E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

- F. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:
1. Joinery, including concealed welds.
 2. Anchorage.
 3. Expansion provisions.
 4. Glazing.
 5. Flashing and drainage.
- G. Other Action Submittals:
1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- H. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of aluminum-framed systems.
 2. Include design calculations.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer[**and testing agency**].
- B. Seismic Qualification Certificates: For aluminum-framed systems, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
- C. Welding certificates.
- D. Preconstruction Test Reports: For sealant.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.
- F. Source quality-control reports.
- G. Quality-Control Program for Structural-Sealant-Glazed System: Include reports.
- H. Field quality-control reports.
- I. Warranties: Sample of special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures"

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.
- D. Quality-Control Program for Structural-Sealant-Glazed System: Develop quality control program specifically for Project. Document quality-control procedures and verify results for aluminum-framed systems. Comply with ASTM C 1401 recommendations including, but not limited to, system material-qualification procedures, preconstruction sealant-testing program, procedures for system fabrication and installation, and intervals of reviews and checks.
- E. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
 - 1. Do not revise intended aesthetic effects, as judged solely by DEN Project Manager, except with DEN Project Manager's approval. If revisions are proposed, submit comprehensive explanatory data to DEN Project Manager for review.
- F. Preconstruction Sealant Testing: For structural-sealant-glazed systems, perform sealant manufacturer's standard tests for compatibility with and adhesion of each material that will come in contact with sealants and each condition required by aluminum-framed systems.
 - 1. Test a minimum five samples each of metal, glazing, and other material.
 - 2. Prepare samples using techniques and primers required for installed systems.
 - 3. For materials that fail tests, determine corrective measures necessary to prepare each material to ensure compatibility with and adhesion of sealants including, but

not limited to, specially formulated primers. After performing these corrective measures on the minimum number of samples required for each material, retest materials.

- G. Accessible Entrances: Comply with applicable provisions in **[the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines]** **[and]** **[ICC/ANSI A117.1]**.
- H. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.
- I. Structural-Sealant Glazing: Comply with ASTM C 1401, "Guide for Structural Sealant Glazing" for design and installation of structural-sealant-glazed systems.
- J. Structural-Sealant Joints: Design reviewed and approved by structural-sealant manufacturer.
- K. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."
- L. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Field testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 - 4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- M. Preinstallation Conference: Conduct conference at **[Project site]** **[location and time as determined by DEN Project Manager]** **<Insert location>**.

1.9 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:

- a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.
 - c. Deterioration of metals[, **metal finishes**,] and other materials beyond normal weathering.
 - d. Adhesive or cohesive sealant failures.
 - e. Water leakage through fixed glazing and framing areas.
 - f. Failure of operating components.
2. Warranty Period: Minimum **[two (2)] [five (5)] [ten (10)] <Insert number>** years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
1. Warranty Period: Minimum **[five (5)] [ten (10)] [twenty (20)] <Insert number>** years from date of Substantial Completion.
- 1.11 MAINTENANCE SERVICE
- A. Entrance Door Hardware:
1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
 2. Initial Maintenance Service: Beginning at Substantial Completion, provide **[six] <Insert number>** months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.
- B. Structural-Sealant-Glazed Systems:
1. Initial Maintenance Service: Beginning at Substantial Completion, provide **[six] [12] <Insert number>** months' full maintenance by skilled employees of structural-sealant-glazed system Installer. Include **[monthly] [quarterly] <Insert interval>** preventive maintenance, repair, or replacement to ensure long-term performance and durability of structural-sealant-glazed system as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original system.
 2. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. [Arcadia, Inc.](#)
2. [Arch Aluminum & Glass Co., Inc.](#)
3. [CMI ArchitecturalCommercial Architectural Products, Inc.](#)
4. [EFCO Corporation.](#)
5. [Kawneer North America; an Alcoa company.](#)
6. [Leed Himmel Industries, Inc.](#)
7. [Pittco Architectural Metals, Inc.](#)
8. [TRACO.](#)
9. [Tubelite.](#)
10. [United States Aluminum.](#)
11. [Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.](#)
12. [YKK AP America Inc.](#)
13. **<Insert manufacturer's name>.**
14. or approved equal.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: [ASTM B 209](#) (ASTM B 209M).
2. Extruded Bars, Rods, Profiles, and Tubes: [ASTM B 221](#) (ASTM B 221M).
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

- B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.

3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 1. Construction: [**Nonthermal**] [**Thermally improved**] [**Thermally broken**] [**Structurally glazed**] <Insert description>.
 2. Glazing System: [**Retained mechanically with gaskets on four sides**] [**Retained by structural sealant at vertical edges and mechanically with gaskets at horizontal edges**] <Insert description>.
 3. Glazing Plane: [**As indicated**] [**Front**] [**Center**] [**Back**] [**Multiplane**] <Insert description>.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 2. Reinforce members as required to receive fastener threads.
 3. Use exposed fasteners with countersunk Phillips screw heads[, **finished to match framing system**] [, **fabricated from stainless steel**].
- D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.
- E. Concealed Flashing: [**Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials**] [**Dead-soft, 0.018-inch-(0.457-mm-) thick stainless steel, ASTM A 240/A 240M of type recommended by manufacturer**].
- F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.
 1. Sealants used inside the weatherproofing system shall have a VOC content of [**250**] <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Section 088000 "Glazing."

- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.
- D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.
- E. Glazing Sealants: For structural-sealant-glazed systems, as recommended by manufacturer for joint type, and as follows:
 - 1. Structural Sealant: ASTM C 1184, single-component neutral-curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by a structural-sealant manufacturer for use in aluminum-framed systems indicated.
 - a. Sealants used inside the weatherproofing system shall have a VOC content of **[100] <Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - c. Color: **[Black] [As selected by DEN Project Manager from manufacturer's full range of colors].**
 - 2. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; single-component neutral-curing formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and aluminum-framed-system manufacturers for this use.
 - a. Sealants used inside the weatherproofing system shall have a VOC content of **[250] <Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - c. Color: Matching structural sealant.

2.5 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
 - 1. Door Construction: **[1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch- (3.2-mm-)] [2-inch (50.8-mm) overall thickness, with minimum**

0.188-inch- (4.8-mm-)] [2- to 2-1/4-inch (50.8- to 57.2-mm) overall thickness, with minimum 0.125-inch- (3.2-mm-)] thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

- a. Thermal Construction: **[High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior] <Insert description>.**
 2. Door Design: **[As indicated] [Narrow stile; 2-1/8-inch (54-mm) nominal width] [Medium stile; 3-1/2-inch (88.9-mm) nominal width] [Wide stile; 5-inch (127-mm) nominal width] <Insert description>.**
 - a. Accessible Doors: Smooth surfaced for width of door in area within **10 inches (255 mm)** above floor or ground plane.
 3. Glazing Stops and Gaskets: **[Beveled] [Square] <Insert description>**, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.
- B. Entrance Door Hardware: As specified in Section 087100 "Door Hardware."

2.6 ENTRANCE DOOR HARDWARE

- A. General: Provide entrance door hardware[**and entrance door hardware sets indicated in door and frame schedule] [and entrance door hardware sets indicated in "Entrance Door Hardware Sets" Article]** for each entrance door to comply with requirements in this Section.
1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and **[named manufacturers' products] [products equivalent in function and comparable in quality to named products] [products complying with BHMA standard referenced].**
 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
 3. Opening-Force Requirements:
 - a. Egress Doors: Not more than **15 lbf (67 N)** to release the latch and not more than **30 lbf (133 N)** to set the door in motion[**and not more than 15 lbf (67 N) to open the door to its minimum required width.**
 - b. Accessible Interior Doors: Not more than **5 lbf (22.2 N)** to fully open door.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
 2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.
- C. Opening-Force Requirements:
1. Delayed-Egress Locks: Lock releases within 15 seconds after applying a force of not more than **15 lbf (67 N)** for not more than 3 seconds.
 2. Latches and Exit Devices: Not more than **15 lbf (67 N)** required to release latch.
- D. Pivot Hinges: BHMA A156.4, Grade 1.
1. Offset-Pivot Hinges: Provide top, bottom, and intermediate offset pivots at each door leaf.
- E. Butt Hinges: BHMA A156.1, Grade 1, radius corner.
1. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while entrance door is closed.
 2. Exterior Hinges: [**Stainless steel, with stainless-steel pin**] [**Nonferrous**] **<Insert material>**.
 3. Quantities:
 - a. For doors up to [**87 inches (2210 mm)**] **<Insert height>** high, provide 3 hinges per leaf.
 - b. For doors more than [**87 and up to 120 inches (2210 and up to 3048 mm)**] **<Insert range>** high, provide 4 hinges per leaf.
- F. Continuous-Gear Hinges: Manufacturer's standard with stainless-steel bearings between knuckles, fabricated to full height of door and frame.
- G. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.
- H. Manual Flush Bolts: BHMA A156.16, Grade 1.
- I. Automatic and Self-Latching Flush Bolts: BHMA A156.3, Grade 1.
- J. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- K. Cylinders: [**As specified in Section 087100 "Door Hardware."**] [**BHMA A156.5, Grade 1.**]
1. Keying: [**No master**] [**Master**] key system. Permanently inscribe each key with a visual key control number and include notation [**"DO NOT DUPLICATE"**] [**to be furnished by Owner**].

- L. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- M. Operating Trim: BHMA A156.6.
- N. Removable Mullions: BHMA A156.3, extruded aluminum.
 - 1. When used with panic exit devices, provide removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305. Use only mullions that have been tested with exit devices to be used.
- O. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to meet field conditions and requirements for opening force.
- P. Concealed Overhead Holders: BHMA A156.8, Grade 1.
- Q. Surface-Mounted Holders: BHMA A156.16, Grade 1.
- R. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.
- S. Weather Stripping: Manufacturer's standard replaceable components.
 - 1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
 - 2. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
- T. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- U. Silencers: BHMA A156.16, Grade 1.
- V. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (13 mm).
- W. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

2.7 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Section 079200 "Joint Sealants."
 - 1. Sealants used inside the weatherproofing system shall have a VOC content of **[250]** <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for **30-mil (0.762-mm)** thickness per coat.

2.8 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 1. Profiles that are sharp, straight, and free of defects or deformations.
 2. Accurately fitted joints with ends coped or mitered.
 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
 4. Physical and thermal isolation of glazing from framing members.
 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 6. Provisions for field replacement of glazing from **[exterior] [interior] [interior for vision glass and exterior for spandrel glazing or metal panels]**.
 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.
- F. Storefront Framing: Fabricate components for assembly using **[shear-block system] [screw-spline system] [head-and-sill-receptor system with shear blocks at intermediate horizontal members] <Insert system>**.
- G. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 1. At exterior doors, provide compression weather stripping at fixed stops.
 2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

- H. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
 - 1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
 - 2. At exterior doors, provide weather sweeps applied to door bottoms.
- I. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- J. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
- B. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.
 - 1. Color: [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Champagne**] [**Black**] <Insert color>.
 - 2. Color: [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**].
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils (0.04 mm)**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.
- D. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with [**AAMA 2604**] [**AAMA 2605**] and containing not less than [**50**] [**70**] percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.
- E. High-Performance Organic Finish: [**3**] [**4**]-coat fluoropolymer finish complying with AAMA 2605 and containing not less than [**50**] [**70**] percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>**.

2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: **[Owner will engage] [Engage]** a qualified testing agency to evaluate structural-sealant-glazed systems.
- B. Structural-Sealant-Glazed Systems: Perform quality-control procedures complying with ASTM C 1401 recommendations, including, but not limited to, system material-qualification procedures, sealant testing, and system fabrication reviews and checks.
- C. Structural-sealant-glazed system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:
 1. Comply with manufacturer's written instructions.
 2. Do not install damaged components.
 3. Fit joints to produce hairline joints free of burrs and distortion.
 4. Rigidly secure nonmovement joints.
 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
 6. Seal joints watertight unless otherwise indicated.
- B. Metal Protection:
 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.
- E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- F. Install glazing as specified in Section 088000 "Glazing."
 - 1. Structural-Sealant Glazing:
 - a. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
 - b. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.
- G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
 - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- H. Install perimeter joint sealants as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

3.3 ERECTION TOLERANCES

- A. Install aluminum-framed systems to comply with the following maximum erection tolerances:
 - 1. Location and Plane: Limit variation from true location and plane to **1/8 inch in 12 feet** (3 mm in 3.7 m); **1/4 inch** (6 mm) over total length.
 - 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to **1/16 inch** (1.5 mm).
 - b. Where surfaces meet at corners, limit offset from true alignment to **1/32 inch** (0.8 mm).
- B. Diagonal Measurements: Limit difference between diagonal measurements to **1/8 inch** (3 mm).

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: **[Owner will engage] [Engage]** a qualified independent testing and inspecting agency to perform field tests and inspections.
- B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive phases as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.
1. Structural-Sealant Compatibility and Adhesion: Structural sealant shall be tested according to recommendations in ASTM C 1401.
 - a. Destructive Test Method A, "Hand Pull Tab (Destructive)," in ASTM C 1401, Appendix X2, shall be used.
 - 1) A minimum of **[two] [four] [six] <Insert number>** areas on each building face shall be tested.
 - 2) Repair installation areas damaged by testing.
 2. Structural-Sealant Glazing Inspection: After installation of aluminum-framed systems is complete, structural-sealant glazing shall be inspected and evaluated according to recommendations in ASTM C 1401.
 3. Air Infiltration: Areas shall be tested for air leakage of **[1.5 times the rate specified for laboratory testing under "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft. (0.03 L/s per sq. m),] <Insert rate>** of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure difference of **[1.57 lbf/sq. ft. (75 Pa)] [6.24 lbf/sq. ft. (300 Pa)] <Insert pressure>**.
 4. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum **[uniform] [and] [cyclic]** static-air-pressure difference of **[0.67 times the static-air-pressure difference specified for laboratory testing under "Performance Requirements" Article, but not less than 4.18 lbf/sq. ft. (200 Pa)] <Insert pressure>**, and shall not evidence water penetration.
 5. Water Spray Test: Before installation of interior finishes has begun, a minimum area of **75 feet (23 m)** by 1 story of aluminum-framed systems designated by DEN Project Manager shall be tested according to AAMA 501.2 and shall not evidence water penetration.
- C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- E. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
 - 1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to **3 inches (75 mm)** from the latch, measured to the leading door edge.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain entrances and storefronts.
- B. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

3.7 ENTRANCE DOOR HARDWARE SETS

Door Hardware Set No. Insert number
Door No. Insert designation(s); each to have the following:

Qty.	Item	Description	Manufacturer	Finish
*	Hanging Devices	Insert description.	Insert manufacturer.	Insert finish.
#	Securing Devices (inactive leaf)	Insert description.	Insert manufacturer.	Insert finish.
#	Securing Devices (active leaf)	Insert description.	Insert manufacturer.	Insert finish.
#	Operating Trim	Insert description.	Insert manufacturer.	Insert finish.
#	Accessories for Pairs of Doors	Insert description.	Insert manufacturer.	Insert finish.
#	Closing Devices	Insert description.	Insert manufacturer.	Insert finish.
#	Protective Trim Units	Insert description.	Insert manufacturer.	Insert finish.
#	Stops and Holders	Insert description.	Insert manufacturer.	Insert finish.
#	Accessories	Insert description.	Insert manufacturer.	Insert finish.
#	Miscellaneous Items	Insert description.	Insert manufacturer.	
*	Number of hinges, as specified.			

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 084113

SECTION 084229.23 - SLIDING AUTOMATIC ENTRANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes **[exterior] [and] [interior]**, sliding, power-operated automatic entrances.
- B. Related Requirements:
 - 1. **[Section 033000 "Cast-in-Place Concrete"] [Section 033053 "Miscellaneous Cast-in-Place Concrete"]** for **[installing recessed metal frames for control mats in concrete] [and] [forming recesses in concrete for recessed thresholds]**.
 - 2. Section 087113 "Automatic Door Operators" for automatic door operators furnished separately from doors and frames.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. AAADM: American Association of Automatic Door Manufacturers.
- B. Activation Device: A control that, when actuated, sends an electrical signal to the door operator to open the door.
- C. IBC: International Building Code.
- D. Safety Device: A control that, to avoid injury, prevents a door from opening or closing.
- E. For automatic door terminology, refer to BHMA A156.10 for definitions of terms.

1.4 COORDINATION

- A. Coordinate sizes and locations of recesses in concrete floors for **[recessed sliding tracks] [and] [recessed control mats]** that control automatic entrances. Concrete, reinforcement, and formwork requirements are specified elsewhere.

- B. Templates: Distribute for doors, frames, and other work specified to be factory prepared for installing automatic entrances.
- C. Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish. Coordinate hardware for automatic entrances with hardware required for rest of Project.
- D. Electrical System Roughing-in: Coordinate layout and installation of automatic entrances with connections to power supplies[**and access-control system**].

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic entrances.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 3. Include data substantiating that materials comply with requirements.
- B. Product certificates signed by the aluminum sliding glass door manufacturer certifying that door units comply with specified performance requirements.
- C. Shop Drawings: For automatic entrances.
 - 1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
 - 2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
 - 4. Indicate locations of activation and safety devices.
 - 5. Include hardware schedule and indicate hardware types, functions, quantities, and locations.
- D. Samples for Initial Selection: For units with factory-applied **[color] [and] [metal-clad]** finishes.
 - 1. Include Samples of hardware and accessories involving color or finish selection.
- E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
 - 1. The DEN Project Manager reserves the right to require additional samples that show fabrication techniques and workmanship, and design of hardware and

accessories.

- F. Delegated-Design Submittal: For automatic entrances.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For [Installer] [manufacturer] [Certified Inspector].
- B. Product Certificates: For each type of automatic entrance. [**Include emergency-exit features of automatic entrances serving as a required means of egress.**]
- C. Product Test Reports: For each type of automatic entrance, for tests performed by a qualified testing agency.
- D. Field quality-control reports.
- E. Sample Warranties: For manufacturer's special warranties.

1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For automatic entrances, safety devices, and control systems to include in operation and maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.9 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer with company certificate issued by AAADM indicating that manufacturer has a Certified Inspector on staff.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project[**and who employs a Certified Inspector**].
 - 1. Maintenance Proximity: Not more than [two] <Insert number> hours' normal travel time from Installer's place of business to Project site.
- C. Certified Inspector Qualifications: Certified by AAADM.

1.10 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of sliding aluminum-framed glass door openings by field measurements before fabrication.
 - 1. Coordinate fabrication schedule with construction progress to avoid delay. Where

necessary, proceed with fabrication without field measurements, and coordinate fabrication tolerances to ensure proper fit of sliding glass door units.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of automatic entrances that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Structural failures including, but not limited to, excessive deflection.
- b. Faulty operation of operators, controls, and hardware.
- c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Minimum **[two (2)] <Insert number>** years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

- a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
- b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
- c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: Minimum **[five (5)] [ten (10)] [twenty (20)] <Insert number>** years from date of Substantial Completion.

1.12 CONSTRUCTION WASTE MANAGEMENT

A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 AUTOMATIC ENTRANCE ASSEMBLIES

A. Source Limitations: Obtain sliding **[folding] [and] [swinging]** automatic entrances from single source from single manufacturer.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Power-Operated Door Standard: BHMA A156.10.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design automatic entrances.
- B. Structural Performance: Automatic entrances shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to **[ASCE/SEI 7] <Insert requirement>**.
 - 1. Seismic Loads: **<Insert loads>**.
 - 2. Wind Loads: **<Insert loads>**.
- C. Windborne-Debris Impact Resistance: Automatic entrances shall pass **[large-missile-impact] [small-missile-impact]** and cyclic-pressure tests of **[ASTM E 1996 according to the IBC] <Insert testing and code requirements>** for **[Wind Zone 1] [Wind Zone 2] [Wind Zone 3] [Wind Zone 4]**.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: **[120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces] <Insert temperature change>**.
- E. Operating Temperature Range: Automatic entrances shall operate within **[minus 30 to plus 120 deg F (minus 35 to plus 49 deg C)] <Insert temperature range>**.
- F. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of **[1.25 cfm/sq. ft. (6.4 L/s x sq. m)] <Insert value>** of fixed entrance-system area when tested according to ASTM E 283 at a minimum static-air-pressure difference of **[1.57 lbf/sq. ft. (75 Pa)] [6.24 lbf/sq. ft. (300 Pa)] <Insert value>**.
- G. Opening Force:
 - 1. Power-Operated Doors: Not more than **50 lbf (222 N)** required to manually set door in motion if power fails, and not more than **15 lbf (67 N)** required to open door to minimum required width.
 - 2. Breakaway Device for Power-Operated Doors: Not more than **50 lbf (222 N)** required for a breakaway door or panel to open.
- H. Entrapment-Prevention Force:
 - 1. Power-Operated Sliding Doors: Not more than **30 lbf (133 N)** required to prevent stopped door from closing.

2.3 SLIDING AUTOMATIC ENTRANCES

A. General: Provide manufacturer's standard automatic entrances including doors, sidelites, framing, headers, carrier assemblies, roller tracks, door operators, controls, and accessories required for a complete installation.

B. **[All-Glass] [Sliding] [Telescoping] Automatic Entrance <Insert drawing designation>:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. [Single-] [and] [Biparting-]Sliding Units:

- 1) Besam Entrance Solutions; Subsidiary of ASSA ABLOY Entrance Systems.
- 2) DORMA Automatics; Division of DORMA Group North America.
- 3) Gildor Automatic Doors.
- 4) Horton Automatics; a division of Overhead Door Corporation.
- 5) Hunter Automatics Inc.
- 6) Nabco Entrances Inc.
- 7) record-usa.
- 8) Stanley Access Technologies, LLC; Division of Stanley Security Solutions.
- 9) Tormax Technologies, Inc.
- 10) **<Insert manufacturer's name>.**
- 11) or approved equal.

b. [Single-] [and] [Biparting-]Telescoping Sliding Units:

- 1) Besam Entrance Solutions; Subsidiary of ASSA ABLOY Entrance Systems.
- 2) DORMA Automatics; Division of DORMA Group North America.
- 3) Gildor Automatic Doors.
- 4) Horton Automatics; a division of Overhead Door Corporation.
- 5) Nabco Entrances Inc.
- 6) record-usa.
- 7) Stanley Access Technologies, LLC; Division of Stanley Security Solutions.
- 8) Tormax Technologies, Inc.
- 9) **<Insert manufacturer's name>.**
- 10) or approved equal.

2. Configuration: Single-sliding door with one sliding leaf[, **transom,**] **[and] [pocketed]** sidelite.

- a. Traffic Pattern: **[One] [Two]** way.
- b. Emergency Breakaway Capability: **[As indicated on Drawings] [Sliding leaf only] [Sliding leaf and sidelite].**
- c. Mounting: **[Between jambs] [Surface].**

3. Configuration: Biparting-sliding doors with two sliding leaves[, **transom,**] **[and [pocketed]** sidelites on each side.
 - a. Traffic Pattern: **[One] [Two]** way.
 - b. Emergency Breakaway Capability: **[As indicated on Drawings] [Sliding leaves only] [Sliding leaves and sidelites]**.
 - c. Mounting: **[Between jambs] [Surface]**.

4. Configuration: **[Single-telescoping-sliding door with two] [Biparting-telescoping-sliding doors with four]** sliding leaves[, **transom,**] and sidelite(s).
 - a. Traffic Pattern: **[One] [Two]** way.
 - b. Emergency Breakaway Capability: **[As indicated on Drawings] [Center leaves only] [All leaves]**.
 - c. Mounting: Between jambs.

5. Operator Features:
 - a. Power opening and closing.
 - b. Drive System: **[Chain] [or] [belt]**.
 - c. Adjustable opening and closing speeds.
 - d. Adjustable hold-open time between zero and 30 seconds.
 - e. Obstruction recycle.
 - f. On-off/hold-open switch to control electric power to operator[, **key operated]**.
 - g. **<Insert features required>**.

6. Sliding-Door Carrier Assemblies and Overhead Roller Tracks: Carrier assembly that allows vertical adjustment; consisting of nylon- or delrin-covered, ball-bearing-center steel wheels operating on a continuous roller track, or ball-bearing-center steel wheels operating on a nylon- or delrin-covered, continuous roller track. Support doors from carrier assembly by cantilever and pivot assembly.
 - a. Rollers: Minimum of two ball-bearing roller wheels and two antirise rollers for each active leaf.

7. Sliding-Door Threshold: Threshold members and bottom-guide-track system with stainless-steel, ball-bearing-center roller wheels.
 - a. Configuration: Saddle-type threshold across door opening and **[surface-mounted] [recessed]** guide-track system at sidelites.
 - b. Configuration: No threshold across door opening and **[surface-mounted] [recessed]** guide-track system at sidelites.

8. Controls: Activation and safety devices **[as indicated on Drawings and]**according to BHMA standards.

- a. Activation Device: Motion sensor mounted on each side of door header to detect pedestrians in activating zone and to open door.
 - b. Activation Device: Control mat installed on ingress side of door to detect pedestrians in activating zone and to open door.
 - c. Activation Device: **[Push-plate switch] [Push-button switch] [Key switch][on each side of door]** to activate door operator.
 - d. Safety Device: Two photoelectric beams mounted in sidelite jambs on each side of door to detect pedestrians in presence zone and to prevent door from closing.
 - e. Safety Device: Presence sensor mounted to underside of door header and two photoelectric beams mounted in sidelite jambs on one side of the door to detect pedestrians in presence zone and to prevent door from closing.
 - f. Safety Device: Presence sensor mounted on each side of door header and two photoelectric beams mounted in sidelite jambs on one side of the door to detect pedestrians in presence zone and to prevent door from closing.
 - g. Safety Device: Control mat(s) installed on egress side of door to detect pedestrians in presence and safety zones and to prevent door from closing.
 - h. Sidelite Safety Device: Presence sensor, mounted above each sidelite on side of door opening through which doors travel, to detect obstructions and to prevent door from opening.
 - i. Opening-Width Control: Two-position switch that in the normal position allows sliding doors to travel to full opening width and in the alternate position reduces opening to a selected partial opening width.
9. Finish: Finish framing, door(s), and header with **[Class I, clear anodic finish] [Class II, clear anodic finish] [Class I, color anodic finish] [Class II, color anodic finish] [baked-enamel or powder-coat finish] [high-performance organic finish (two-coat fluoropolymer)] [high-performance organic finish (three-coat fluoropolymer)] [finish matching adjacent curtain wall] [finish matching adjacent storefront]**.
- a. Color: **[Light bronze] [Medium bronze] [Dark bronze] [Black] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors and color densities] <Insert color>**.
10. Metal Cladding and Finish: Clad framing, door(s), and header with **[No. 4 directional-satin-finish stainless-steel sheet] [No. 8 mirrorlike reflective, nondirectional-polish-finish stainless-steel sheet] [satin-brass sheet] [polished-brass sheet] [satin-bronze sheet] [polished-bronze sheet] [metal sheet in finish matching DEN Project Manager's sample] [metal sheet in finish as selected by DEN Project Manager from manufacturer's full range] [metal sheet in finish matching adjacent storefront] <Insert finish>**.

2.4 ENTRANCE COMPONENTS

- A. Framing Members: Extruded aluminum, minimum **0.125 inch (3.2 mm)** thick and reinforced as required to support imposed loads.

1. Nominal Size: **[As indicated on Drawings]** [1-3/4 by 4-1/2 inches (45 by 115 mm)] [1-3/4 by 6 inches (45 by 150 mm)] **<Insert dimensions>**.
 2. Extruded Glazing Stops and Applied Trim: Minimum **0.062-inch** (1.6-mm) wall thickness.
- B. Stile and Rail Doors: **1-3/4-inch-** (45-mm-) thick, glazed doors with minimum **0.125-inch-** (3.2-mm-) thick, extruded-aluminum tubular stile and rail members. Mechanically fasten corners with reinforcing brackets that are welded, or incorporate concealed tie-rods that span full length of top and bottom rails.
1. Glazing Stops and Gaskets: **[Beveled]** **[Square]**, snap-on, extruded-aluminum stops and preformed gaskets.
 2. Stile Design: **[As indicated on Drawings]** **[Thin stile, less than 1-3/4-inch** (45-mm) **nominal width]** **[Narrow stile, 2-1/8-inch** (55-mm) **nominal width]** **[Medium stile, 3-1/2-inch** (90-mm) **nominal width]** **[Wide stile, more than 4-inch** (100-mm) **nominal width]**.
 3. Rail Design: **[As indicated on Drawings]** **[5-inch** (125-mm) **nominal height]** **[6-1/2-inch** (165-mm) **nominal height]** **[10-inch** (254-mm) **nominal height]**.
 4. Muntin Bars: Horizontal tubular rail member for each door; match stile design and finish.
- C. All-Glass Sliding Doors: Fabricated from 13-mm-thick tempered glass, with polished vertical edges and minimum **0.125-inch-** (3.2-mm-) thick, extruded-aluminum top and bottom rails.
1. Rail Design: **[3-1/2-inch** (90-mm)] **[5-inch** (125-mm)] nominal height.
- D. **[Sidelite(s)] [and] [Transom]:** **1-3/4-inch-** (45-mm-) deep **[sidelite(s)] [and] [transom]** with minimum **0.125-inch-** (3.2-mm-) thick, extruded-aluminum tubular stile and rail members matching door design.
1. Glazing Stops and Gaskets: Same materials and design as for stile and rail door.
 2. Glazing Stops and Gaskets: **[Beveled]** **[Square]**, snap-on, extruded-aluminum stops and preformed gaskets.
 3. Muntin Bars: Horizontal tubular rail members for each sidelite; match stile design.
- E. Headers: Fabricated from minimum **0.125-inch-** (3.2-mm-) thick extruded aluminum and extending full width of automatic entrance units to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.
1. Mounting: **[Surface mounted]** **[Concealed, with one side of header flush with framing]**.
 2. Capacity: Capable of supporting doors up to **[175 lb (79 kg) per leaf over spans up to 14 feet** (4.3 m)] **<Insert load and span required>** without intermediate supports.
 - a. Provide sag rods for spans exceeding **14 feet** (4.3 m).

- F. Brackets and Reinforcements: High-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- G. Signage: As required by cited BHMA standard.
 - 1. Application Process: **[Decals] [Silk-screened] [Door manufacturer's standard process] <Insert requirement>**.
 - 2. Provide sign materials with instructions for field application after glazing is installed.

2.5 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 1. Extrusions: **ASTM B 221** (ASTM B 221M).
 - 2. Sheet: **ASTM B 209** (ASTM B 209M).
- B. Steel Reinforcement: Reinforcement with corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Use surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
- C. Stainless-Steel Bars: ASTM A 276 or ASTM A 666, **[Type 304] [Type 316] <Insert type>**.
- D. Stainless-Steel Tubing: ASTM A 554, **[Grade MT 304] [Grade MT 316] <Insert grade>**.
- E. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, **[Type 304] [Type 316] <Insert type>**, stretcher-leveled standard of flatness, in entrance manufacturer's standard thickness.
- F. Brass Sheet: ASTM B 36/B 36M, Alloy UNS No. C26000 (cartridge brass, 70 percent copper), in entrance manufacturer's standard thickness.
- G. Bronze Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper) or Alloy UNS No. C23000 (red brass, 85 percent copper), in entrance manufacturer's standard thickness.
- H. Expanded Aluminum Mesh: **[Expanded] [Expanded and flattened]** aluminum sheet according to the geometry of ASTM F 1267.
- I. Polycarbonate Sheet: ASTM C 1349, Appendix X1, Type II, coated, mar-resistant, UV-stabilized polycarbonate with coating on both surfaces.
- J. Glazing: As specified in **[Section 088000 "Glazing."] [Section 088853 "Security Glazing."]**
- K. Sealants and Joint Fillers: As specified in Section 079200 "Joint Sealants."

- L. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout; complying with ASTM C 1107/C 1107M; of consistency suitable for application.
- M. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.
- N. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.6 DOOR OPERATORS AND CONTROLS

- A. General: Provide operators and controls, which include activation and safety devices, according to BHMA standards, for condition of exposure, and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.
- B. Door Operators: Provide door operators of size recommended by manufacturer for door size, weight, and movement.
 - 1. Door Operator Performance: Door operators shall open and close doors and maintain them in fully closed position when subjected to Project's design wind loads.
 - 2. Electromechanical Operators: Concealed, self-contained, overhead unit powered by fractional-horsepower, permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor; with solid-state microprocessor controller; UL 325; and with manual operation with power off.
- C. Motion Sensors: Self-contained, K-band-frequency, microwave-scanner units; fully enclosed by its plastic housing; adjustable to provide detection-field sizes and functions required by BHMA A156.10.
 - 1. Provide capability for switching between bidirectional and unidirectional detection.
 - 2. For one-way traffic, sensor on egress side shall not be active when doors are fully closed.
- D. Presence Sensors: Self-contained, active-infrared scanner units; adjustable to provide detection-field sizes and functions required by BHMA A156.10. Sensors shall remain active at all times.
- E. Photoelectric Beams: Pulsed infrared, sender-receiver assembly for recessed mounting. Beams shall not be active when doors are fully closed.
- F. Control Mats: **1/2-inch- (13-mm-)** thick, synthetic-rubber or flexible-plastic mat in safety-ribbed surface pattern, with extruded-aluminum frame; with pressure switches for low-voltage control wiring; and complying with performance requirements of BHMA A156.10.
 - 1. Frame: [**Recessed to fit flush with floor, with concealed anchors**] [**Surface mounted, with tapered safety edge**].

2. Size: As indicated, but no smaller than required by BHMA A156.10 including Appendix A.
 3. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**].
- G. Push-Plate Switch: Momentary-contact door-control switch with flat push-plate actuator[**with contrasting-colored, engraved message**].
1. Configuration: [**Round**] [**Square**] push plate with **4-by-4-inch** (100-by-100-mm) junction box.
 - a. Mounting: [**As indicated on Drawings**] [**Recess mounted, semiflush in wall**] [**Surface mounted on wall**].
 2. Configuration: Rectangular push plate with **2-by-4-inch** (50-by-100-mm) junction box.
 - a. Mounting: [**As indicated on Drawings**] [**Recess mounted, semiflush in wall**] [**Recess mounted in doorjamb**] [**Surface mounted on wall**] [**Surface mounted on post**] [**Surface mounted on guide rail**].
 3. Push-Plate Material: [**Stainless steel**] [**Plastic**] as selected by DEN Project Manager from manufacturer's full range.
 4. Message: [**Plain face with no message.**] [**"Push to Open."**] [**International symbol of accessibility.**] [**International symbol of accessibility and "Push to Open."**]
- H. Push-Button Switch: Momentary-contact door-control switch with one red-button actuator; enclosed in nominal [**2-by-4-inch** (50-by-100-mm)] [**4-by-4-inch** (100-by-100-mm)] junction box.
1. Provide faceplate engraved with "Press to Open" letters[**and international symbol of accessibility**] in contrasting color.
 2. Provide blue plastic cover engraved with "Press Button to Open" in white letters and international symbol of accessibility.
 3. Mounting: [**As indicated on Drawings**] [**Surface mounted on wall**] [**Surface mounted on post**] [**Surface mounted on guide rail**] [**Recess mounted in wall**].
 4. Face-Plate Material: [**Stainless steel**] [**Painted metal**] as selected by DEN Project Manager from manufacturer's full range.
- I. Key Switch: Recess-mounted, door-control switch with key-controlled actuator; enclosed in **2-by-4-inch** (50-by-100-mm) junction box. Provide faceplate engraved with letters indicating switch functions.
1. Face-Plate Material: [**Stainless steel**] [**Painted metal**] as selected by DEN Project Manager from manufacturer's full range.

2. Functions: **[On-off, momentary contact] [On-off, maintained contact] [Two-way automatic, hold open, one-way exit, and off] [Two-way automatic, hold open, one-way exit, off, full open, and partial open].**
 3. Mounting: **[As indicated on Drawings] [Recess mounted, semiflush in wall] [Recess mounted in doorjamb] [Surface mounted on wall] [Surface mounted on post].**
- J. Wireless or Remote Radio Control Switch: Auxiliary radio control system consisting of header-mounted receiver and **[wall-mounted] [hand-held, battery-operated]** transmitter switch **[for each entrance] <Insert requirement>**.
1. Wall-Mounted Transmitter Switch: One red-button, momentary-contact actuator enclosed in **4-by-4-inch (100-by-100-mm)** junction box. Provide blue plastic cover engraved with "Press Button to Open" in white letters and international symbol of accessibility.
- K. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

2.7 HARDWARE

- A. General: Provide units in sizes and types recommended by automatic entrance and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish **[unless otherwise indicated].**
- B. Breakaway Device for Power-Operated Doors: Device that allows door to swing out in direction of egress to full 90 degrees from any operating position. Maximum force to open door shall be as stipulated in "Performance Requirements" Article. Interrupt powered operation of door operator while in breakaway mode.
- C. Deadlocks: Deadbolt operated by exterior cylinder and interior thumb turn, with minimum **1-inch- (25-mm-)** long throw bolt; BHMA A156.5, Grade 1.
1. Cylinders: **[BHMA A156.5, Grade 1, six-pin mortise type.] [As specified in Section 087100 "Door Hardware."] [As specified in Section 087111 "Door Hardware (Descriptive Specification)."]**
 - a. Keying: **[No master] [Integrate into building master]** key system.
 2. Deadbolts: **[Laminated-steel hook] [Steel]**, mortise type, BHMA A156.5, Grade 1.
 3. Two-Point Locking for Stile and Rail Sliding Doors: Mechanism in stile of active door leaf that automatically extends second lockbolt into **[overhead carrier assembly] [threshold].**
- D. Automatic Locking: Electrically controlled device mounted in header that automatically locks sliding door against sliding when in closed position. Provide fail **[secure] [safe]** operation if power fails.

1. Include concealed, vertical-rod exit devices, UL 305, with latching into threshold and overhead carrier assembly and released by **[full-width panic bar] [push paddle]**; and that prevent emergency breakaway doors from swinging unless released to permit emergency egress.
 2. Include locking devices for sidelites to prevent manual break out.
- E. Dustproof Strikes for All-Glass Sliding Doors: **[Recessed, floor-type, BHMA A156.16, Grade 1, to receive deadbolt.] [As specified in Section 087100 "Door Hardware."]** **[As specified in Section 087111 "Door Hardware (Descriptive Specification)."]**
- F. Weather Stripping: Replaceable components.
1. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

2.8 FABRICATION

- A. Fabricate sliding aluminum-framed glass doors in sizes indicated. Include a complete system for assembling components and anchoring doors.
- B. Assembly: Assemble components into complete weathertight units with flush, rigid, hairline joints. Mill, cope, butt, and miter necessary joints; secure by mechanical devices or by other means to ensure permanently watertight joints. Provide at least 2 corrosion resistant, pre lubricated, or self-lubricating rollers for each sliding panel, of sufficient capacity to assure easy, quiet, and smooth operation.
- C. Fabricate sliding aluminum-framed glass doors that are reglazable without dismantling panel framing.

2.9 ACCESSORIES

- A. Guide Rails: **[Anodized aluminum] [Baked-enamel or powder-coated aluminum] [Stainless steel]**, fabricated from **[bars] [or] [tubing]**, minimum **30 inches** (762 mm) high, and finished to match doors unless otherwise indicated; positioned and projecting from face of door jamb for distance as indicated, but not less than **[that required by BHMA A156.10 for type of door and direction of travel] <Insert dimension>**; with filler panel.
1. Filler Panel: **[Expanded aluminum mesh] [Clear polycarbonate sheet] [Colored polycarbonate sheet] <Insert material>**.
 - a. Orient expanded aluminum mesh with long dimension of diamonds **[parallel to top rail] [perpendicular to top rail]**.
 - b. Color: **[Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 2. Mounting: **[As indicated on Drawings] [Jamb and floor] [Floor, freestanding]**.

3. Aluminum Finish: [**Class I, clear anodic finish**] [**Class II, clear anodic finish**] [**Class I, color anodic finish**] [**Class II, color anodic finish**] [**Baked-enamel or powder-coat finish**] [**Finish matching door and frame**] <Insert finish>.ol style="list-style-type: none;"> - a. Color: [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**] <Insert color>.
4. Stainless-Steel Finish: [**No. 4 directional-satin-finish stainless steel**] [**Finish matching door and frame**] <Insert finish>.
- B. Guide Rails: See [**Section 055213 "Pipe and Tube Railings."**] [**Section 057300 "Decorative Metal Railings."**]

2.10 FABRICATION

- A. General: Factory fabricate automatic entrance components to designs, sizes, and thicknesses indicated and to comply with indicated standards.
1. Form aluminum shapes before finishing.
 2. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
 3. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws[, **finished to match framing**] [, **fabricated from stainless steel**].ol style="list-style-type: none;"> - a. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 - b. Reinforce members as required to receive fastener threads.
4. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
- B. Framing: Provide automatic entrances as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.
1. Fabricate tubular and channel frame assemblies with welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support required loads.
 2. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
 3. Form profiles that are sharp, straight, and free of defects or deformations.
 4. Provide components with concealed fasteners and anchor and connection devices.
 5. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.

6. Fabricate exterior components to drain condensation and water passing joints within system to the exterior.
 7. Provide anchorage and alignment brackets for concealed support of assembly from building structure.
 8. Allow for thermal expansion of exterior units.
- C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.
- D. Metal Cladding: Factory-fabricated and installed metal cladding, completely covering all visible surfaces as part of prefabricated entrance assembly before shipment to Project site.
1. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
 2. Form profiles that are sharp, straight, and free of defects or deformations.
 3. Provide components with concealed fasteners and anchor and connection devices.
 4. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.
 5. Fabricate exterior components to drain water passing joints and condensation and moisture occurring or migrating within system to the exterior.
 6. Allow for thermal expansion at exterior entrances.
- E. Door Operators: Factory fabricated and installed in headers, including adjusting and testing.
- F. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual."
- G. Hardware: Factory install hardware to greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.
1. Provide sliding-type weather stripping, mortised into door, at perimeter of doors[**and breakaway sidelites**].
- H. Controls:
1. General: Factory install activation and safety devices in doors and headers as required by BHMA A156.10 for type of door and direction of travel.
 2. Install photoelectric beams in vertical jambs of sidelites, with dimension above finished floor as follows:
 - a. Top Beam: [48 inches (1219 mm)] <Insert dimension>.
 - b. Bottom Beam: [24 inches (610 mm)] <Insert dimension>.

2.11 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.12 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
- B. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils (0.04 mm)**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
- D. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with [**AAMA 2604**] [**AAMA 2605**] and containing not less than [**50**] [**70**] percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- E. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than [**50**] [**70**] percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of automatic entrances.
- B. Examine roughing-in for electrical systems to verify actual locations of power connections before automatic entrance installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install automatic entrances according to manufacturer's written instructions and cited BHMA standard for direction of pedestrian travel, including signage, controls, wiring, and connection to the building's power supply.
1. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.
 2. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
 3. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous coating.
- B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.
1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
 2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.
 3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior.
 4. Level recesses for recessed thresholds using nonshrink grout.
- C. Door Operators: Connect door operators to electrical power distribution system.
- D. Access-Control Devices: Connect access-control devices to access-control system as specified in Section 281300 "Access Control."
- E. Controls: Install and adjust activation and safety devices according to manufacturer's written instructions and cited BHMA standard for direction of pedestrian travel. Connect control wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- F. Guide Rails: Install rails according to BHMA A156.10, including Appendix A, and manufacturer's written instructions unless otherwise indicated.
- G. Glazing: Install glazing as specified in [**Section 088000 "Glazing."**] [**Section 088853 "Security Glazing."**]
- H. Sealants: Comply with requirements specified in Section 079200 "Joint Sealants" to provide weathertight installation.
1. Set [**thresholds,]** [**bottom-guide-track system,**] framing members and flashings in full sealant bed.
 2. Seal perimeter of framing members with sealant.

- I. Signage: Apply signage on both sides of each door[**and breakaway sidelite**] as required by cited BHMA standard for direction of pedestrian travel.
- J. Wiring within Automatic Entrance Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's written limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 FIELD QUALITY CONTROL

- A. Certified Inspector: [**Owner will engage**] [**Engage**] a Certified Inspector to test and inspect components, assemblies, and installations, including connections.
- B. Perform the following tests and inspections[**with the assistance of a factory-authorized service representative**]:
 - 1. Test and inspect each automatic entrance, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.
- C. Automatic entrances will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust hardware, moving parts, door operators, and controls to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.
 - 1. Adjust exterior doors for weathertight closure.
- B. Readjust door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).
- C. Occupancy Adjustments: When requested within [**12**] <Insert number> months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to [**two**] <Insert number> visits to Project during other-than-normal occupancy hours for this purpose.

3.5 CLEANING

- A. Clean glass and metal surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.
 - 1. Comply with requirements in [**Section 088000 "Glazing"**] [**Section 088853 "Security Glazing"**] for cleaning and maintaining glass.

3.6 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include **[three] [six] [nine] [12]** month's full maintenance by skilled employees of automatic entrance Installer. Include **[monthly] [quarterly]** preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper automatic entrance operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
1. Engage a Certified Inspector to perform safety inspection after each adjustment or repair and at end of maintenance period. Furnish completed inspection reports to Owner.
 2. Perform maintenance, including emergency callback service, during normal working hours.
 3. Include 24-hour-per-day, 7-day-per-week, emergency callback service.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic entrances.
1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 084229.23

SECTION 084229.33 - SWINGING AUTOMATIC ENTRANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. **[Exterior] [and] [interior]**, swinging, power-operated automatic entrances.
 - 2. **[Exterior] [and] [interior]**, swinging, **[power-assist] [and] [low-energy]** automatic entrances.
- B. Related Requirements:
 - 1. **[Section 033000 "Cast-in-Place Concrete"] [Section 033053 "Miscellaneous Cast-in-Place Concrete"]** for installing recessed metal frames for control mats in concrete.
 - 2. Section 087113 "Automatic Door Operators" for automatic door operators furnished separately from doors and frames.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. AAADM: American Association of Automatic Door Manufacturers.
- B. Activation Device: A control that, when actuated, sends an electrical signal to the door operator to open the door.
- C. Double-Egress Doors: A pair of doors that simultaneously swing with the two doors moving in opposite directions with no mullion between them.
- D. Double-Swing Doors: A pair of doors that swing with the two doors moving in opposite directions with a mullion between them; each door functioning as a single-swing door.
- E. IBC: International Building Code.
- F. Safety Device: A control that, to avoid injury, prevents a door from opening or closing.

- G. For automatic door terminology, refer to **[BHMA A156.10]** [and] **[BHMA A156.19]** for definitions of terms.

1.4 COORDINATION

- A. Coordinate sizes and locations of recesses in concrete floors for recessed control mats that control automatic entrances. Concrete, reinforcement, and formwork requirements are specified elsewhere.
- B. Templates: Distribute for doors, frames, and other work specified to be factory prepared for installing automatic entrances.
- C. Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish. Coordinate hardware for automatic entrances with hardware required for rest of Project.
- D. Electrical System Roughing-in: Coordinate layout and installation of automatic entrances with connections to power supplies[**and access-control system**].

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site]** [location and time as determined by **DEN Project Manager**]<Insert location>.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic entrances.
 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 3. Include data substantiating that materials comply with requirements.
- B. Product certificates signed by the aluminum sliding glass door manufacturer certifying that door units comply with specified performance requirements.
- C. Shop Drawings: For automatic entrances.
1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
 2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
 4. Indicate locations of activation and safety devices.
 5. Include hardware schedule and indicate hardware types, functions, quantities, and locations.

- D. Samples for Initial Selection: For units with factory-applied **[color] [and] [metal-clad]** finishes.
 - 1. Include Samples of hardware and accessories involving color or finish selection.
- E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
 - 1. The DEN Project Manager reserves the right to require additional samples that show fabrication techniques and workmanship, and design of hardware and accessories.
- F. Delegated-Design Submittal: For automatic entrances.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[Installer] [manufacturer] [Certified Inspector]**.
- B. Product Certificates: For each type of automatic entrance. **[Include emergency-exit features of automatic entrances serving as a required means of egress.]**
- C. Product Test Reports: For each type of automatic entrance, for tests performed by a qualified testing agency.
- D. Field quality-control reports.
- E. Sample Warranties: For manufacturer's special warranties.

1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For automatic entrances, safety devices, and control systems to include in operation and maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.9 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer with company certificate issued by AAADM indicating that manufacturer has a Certified Inspector on staff.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project **[and who employs a Certified Inspector]**.
 - 1. Maintenance Proximity: Not more than **[two] <Insert number>** hours' normal travel time from Installer's place of business to Project site.

- C. Certified Inspector Qualifications: Certified by AAADM.

1.10 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of sliding aluminum-framed glass door openings by field measurements before fabrication.
1. Coordinate fabrication schedule with construction progress to avoid delay. Where necessary, proceed with fabrication without field measurements, and coordinate fabrication tolerances to ensure proper fit of sliding glass door units.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of automatic entrances that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Faulty operation of operators, controls, and hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
2. Warranty Period: Minimum [**two (2)**] <Insert number> years from date of Substantial Completion.

- B. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.

1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Warranty Period: Minimum [**five (5)**] [**ten (10)**] [**twenty (20)**] <Insert number> years from date of Substantial Completion.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 AUTOMATIC ENTRANCE ASSEMBLIES

- A. Source Limitations: Obtain swinging [**folding**] [**and**] [**sliding**] automatic entrances from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Power-Operated Door Standard: BHMA A156.10.
- D. Power-Assist and Low-Energy Door Standard: BHMA A156.19.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design automatic entrances.
- B. Structural Performance: Automatic entrances shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to [**ASCE/SEI 7**] <Insert requirement>.
 - 1. Seismic Loads: <Insert loads>.
 - 2. Wind Loads: <Insert loads>.
- C. Windborne-Debris Impact Resistance: Automatic entrances shall pass [**large-missile-impact**] [**small-missile-impact**] and cyclic-pressure tests of [**ASTM E 1996 according to the IBC**] <Insert testing and code requirements> for [**Wind Zone 1**] [**Wind Zone 2**] [**Wind Zone 3**] [**Wind Zone 4**].
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: [**120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces**] <Insert temperature change>.
- E. Operating Temperature Range: Automatic entrances shall operate within [**minus 30 to plus 120 deg F (minus 35 to plus 49 deg C)**] <Insert temperature range>.
- F. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of [**1.25 cfm/sq. ft. (6.4 L/s x sq. m)**] <Insert value> of fixed entrance-system area when tested according to ASTM E 283 at a minimum static-air-pressure difference of [**1.57 lbf/sq. ft. (75 Pa)**] [**6.24 lbf/sq. ft. (300 Pa)**] <Insert value>.
- G. Opening Force:

1. Power-Operated Doors: Not more than **50 lbf (222 N)** required to manually set door in motion if power fails, and not more than **15 lbf (67 N)** required to open door to minimum required width.
2. Power-Operated Swinging Doors: Not more than **30 lbf (133 N)** required to manually open door if power fails.
3. Breakaway Device for Power-Operated Doors: Not more than **50 lbf (222 N)** required for a breakaway door or panel to open.
4. Power-Assist and Low-Energy Doors: Not more than **15 lbf (67 N)** required to release a latch if provided, not more than **30 lbf (133 N)** required to manually set door in motion, and not more than **15 lbf (67 N)** required to fully open door if power fails.
5. Accessible, Power-Assist Interior Doors: Not more than **5 lbf (22 N)** to push or pull door to fully open position.

H. Entrapment-Prevention Force:

1. Power-Operated Swinging Doors: Not more than **40 lbf (178 N)** required to prevent stopped door in the last 10 degrees of opening from moving in the direction of opening; not more than **30 lbf (133 N)** required to prevent stopped door from moving in direction of closing.
2. Low-Energy Doors: Not more than **15 lbf (67 N)** required to prevent stopped door from closing or opening.

2.3 SWINGING AUTOMATIC ENTRANCES

- A. General: Provide manufacturer's standard automatic entrances including doors, framing, headers, door operators, controls, and accessories required for a complete installation.
- B. Swinging, Power-Operated Automatic Entrance **<Insert drawing designation>**:
 1. Manufacturers: Subject to compliance with requirements, provide products by the following] [provide products by one of the following:
 - a. [Besam Entrance Solutions; Subsidiary of ASSA ABLOY Entrance Systems.](#)
 - b. [DORMA Automatics; Division of DORMA Group North America.](#)
 - c. [Horton Automatics; a division of Overhead Door Corporation.](#)
 - d. [Nabco Entrances Inc.](#)
 - e. [Stanley Access Technologies, LLC; Division of Stanley Security Solutions.](#)
 - f. [Tormax Technologies, Inc.](#)
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
 2. Configuration: Single-swinging door[**with transom**].
 - a. Traffic Pattern: [**One**] [**Two**] way.
 - b. Mounting: [**Between jambs**] [**Surface**].
 3. Configuration: Pair of swinging doors[**with transom**].

- a. Traffic Pattern: [**One way**] [**Two way**] [**Double egress**] [**Double swing**].
 - b. Mounting: [**Between jambs**] [**Surface**].
4. Operator Features:
- a. Power opening and [**power-assist**] spring closing.
 - b. Adjustable opening and closing speeds.
 - c. Adjustable hold-open time between zero and 30 seconds.
 - d. Adjustable backcheck and latching.
 - e. Obstruction recycle.
 - f. Automatic door re-open if stopped while closing.
 - g. On-off/hold-open switch to control electric power to operator[, **key operated**].
 - h. **<Insert features required>**.
5. Controls: Activation and safety devices [**as indicated on Drawings and**]
[according to BHMA standards.
- a. Activation Device: Motion sensor mounted on ingress side of door header to detect pedestrians in activating zone and to open door.
 - b. Activation Device: Control mat installed on ingress side of door to detect pedestrians in activating zone and to open door.
 - c. Activation Device: [**Push-plate switch**] [**Push-button switch**] [**Key switch**] [**on each side of door**] to activate door operator.
 - d. Safety Device: Presence sensor mounted on [**door header**] [**horizontal door muntin**] [**guide rail**] to detect pedestrians in presence zone and to prevent door from closing.
 - e. Safety Device: One photoelectric beam mounted in guide rails to detect pedestrians in presence zone and to prevent door from closing.
 - f. Safety Device: Control mat(s) installed on egress side of door to detect pedestrians in presence and safety zones and to prevent door from closing.
6. Finish: Finish framing, door(s), and header with [**Class I, clear anodic finish**] [**Class II, clear anodic finish**] [**Class I, color anodic finish**] [**Class II, color anodic finish**] [**baked-enamel or powder-coat finish**] [**high-performance organic finish (two-coat fluoropolymer)**] [**high-performance organic finish (three-coat fluoropolymer)**] [**finish matching adjacent curtain wall**] [**finish matching adjacent storefront**].
- a. Color: [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**] **<Insert color>**.
7. Metal Cladding and Finish: Clad framing, door(s), and header with [**No. 4 directional-satin-finish stainless-steel sheet**] [**No. 8 mirrorlike reflective, nondirectional-polish-finish stainless-steel sheet**] [**satin-brass sheet**] [**polished-brass sheet**] [**satin-bronze sheet**] [**polished-bronze sheet**] [**metal sheet in finish matching DEN Project Manager's sample**] [**metal sheet in**

finish as selected by DEN Project Manager from manufacturer's full range
[metal sheet in finish matching adjacent storefront] <Insert finish>.

- C. Swinging, **[Power-Assist] [Low-Energy, Power-Operated] [Low-Energy, Power-Open]** Automatic Entrance **<Insert drawing designation>**:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [DORMA Automatics; Division of DORMA Group North America.](#)
 - b. [Horton Automatics; a division of Overhead Door Corporation.](#)
 - c. [Nabco Entrances Inc.](#)
 - d. [Tormax Technologies, Inc.](#)
 - e. **<Insert manufacturer's name>**.
 - f. or approved equal.
 2. Configuration: Single-swinging door[**with transom**].
 - a. Traffic Pattern: **[One] [Two]** way.
 - b. Mounting: **[Between jambs] [Surface]**.
 3. Configuration: Pair of swinging doors[**with transom**].
 - a. Traffic Pattern: **[One way] [Two way] [Double egress] [Double swing]**.
 - b. Mounting: **[Between jambs] [Surface]**.
 4. Operator Features:
 - a. Power opening and **[power-assist]** spring closing.
 - b. Adjustable opening and closing speeds.
 - c. Adjustable hold-open time between zero and 30 seconds.
 - d. Adjustable backcheck and latching.
 - e. Obstruction recycle.
 - f. Automatic door re-open if stopped while closing.
 - g. On-off/hold-open switch to control electric power to operator[, **key operated**].
 - h. **<Insert features required>**.
 5. Activation Device: **[Push-plate switch] [Push-button switch] [Key switch] [on each side of door]** to activate door operator.
 6. Finish: Finish framing, door(s), and header with **[Class I, clear anodic finish] [Class II, clear anodic finish] [Class I, color anodic finish] [Class II, color anodic finish] [baked-enamel or powder-coat finish] [high-performance organic finish (two-coat fluoropolymer)] [high-performance organic finish (three-coat fluoropolymer)] [finish matching adjacent curtain wall] [finish matching adjacent storefront]**.
 - a. Color: **[Light bronze] [Medium bronze] [Dark bronze] [Black] [As indicated by manufacturer's designations] [Match DEN Project**

Manager's sample] [As selected by DEN Project Manager from full range of industry colors and color densities] <Insert color>.

7. Metal Cladding and Finish: Clad framing, door(s), and header with **[No. 4 directional-satin-finish stainless-steel sheet] [No. 8 mirrorlike reflective, nondirectional-polish-finish stainless-steel sheet] [satin-brass sheet] [polished-brass sheet] [satin-bronze sheet] [polished-bronze sheet] [metal sheet in finish matching DEN Project Manager's sample] [metal sheet in finish as selected by DEN Project Manager from manufacturer's full range] [metal sheet in finish matching adjacent storefront] <Insert finish>.**

2.4 ENTRANCE COMPONENTS

- A. Framing Members: Extruded aluminum, minimum **0.125 inch (3.2 mm)** thick and reinforced as required to support imposed loads.
 1. Nominal Size: **[As indicated on Drawings] [1-3/4 by 4-1/2 inches (45 by 115 mm)] [1-3/4 by 6 inches (45 by 150 mm)] <Insert dimensions>.**
 2. Extruded Glazing Stops and Applied Trim: Minimum **0.062-inch (1.6-mm)** wall thickness.
- B. Stile and Rail Doors: **1-3/4-inch- (45-mm-)** thick, glazed doors with minimum **0.125-inch- (3.2-mm-)** thick, extruded-aluminum tubular stile and rail members. Mechanically fasten corners with reinforcing brackets that are welded, or incorporate concealed tie-rods that span full length of top and bottom rails.
 1. Glazing Stops and Gaskets: **[Beveled] [Square]**, snap-on, extruded-aluminum stops and preformed gaskets.
 2. Stile Design: **[As indicated on Drawings] [Narrow stile, 2-1/8-inch (55-mm) nominal width] [Medium stile, 3-1/2-inch (90-mm) nominal width].**
 3. Rail Design: **[As indicated on Drawings] [5-inch (125-mm) nominal height] [6-1/2-inch (165-mm) nominal height] [10-inch (254-mm) nominal height].**
 4. Muntin Bars: Horizontal tubular rail member for each door; match stile design and finish.
- C. **[Sidelite(s)] [and] [Transom]: 1-3/4-inch- (45-mm-)** deep **[sidelite(s)] [and] [transom]** with minimum **0.125-inch- (3.2-mm-)** thick, extruded-aluminum tubular stile and rail members matching door design.
 1. Glazing Stops and Gaskets: Same materials and design as for stile and rail door.
 2. Muntin Bars: Horizontal tubular rail members for each sidelite; match stile design.
- D. Headers: Fabricated from minimum **0.125-inch- (3.2-mm-)** thick extruded aluminum and extending full width of automatic entrance units to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.
 1. Mounting: **[Surface mounted] [Concealed, with one side of header flush with framing].**

- E. Brackets and Reinforcements: High-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- F. Signage: As required by cited BHMA standard.
 - 1. Application Process: **[Decals] [Silk-screened] [Door manufacturer's standard process] <Insert requirement>**.
 - 2. Provide sign materials with instructions for field application after glazing is installed.

2.5 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 1. Extrusions: **ASTM B 221** (ASTM B 221M).
 - 2. Sheet: **ASTM B 209** (ASTM B 209M).
- B. Steel Reinforcement: Reinforcement with corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Use surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
- C. Stainless-Steel Bars: ASTM A 276 or ASTM A 666, **[Type 304] [Type 316] <Insert type>**.
- D. Stainless-Steel Tubing: ASTM A 554, **[Grade MT 304] [Grade MT 316] <Insert grade>**.
- E. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, **[Type 304] [Type 316] <Insert type>**, stretcher-leveled standard of flatness, in entrance manufacturer's standard thickness.
- F. Brass Sheet: ASTM B 36/B 36M, Alloy UNS No. C26000 (cartridge brass, 70 percent copper), in entrance manufacturer's standard thickness.
- G. Bronze Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper) or Alloy UNS No. C23000 (red brass, 85 percent copper), in entrance manufacturer's standard thickness.
- H. Expanded Aluminum Mesh: **[Expanded] [Expanded and flattened]** aluminum sheet according to the geometry of ASTM F 1267.
- I. Polycarbonate Sheet: ASTM C 1349, Appendix X1, Type II, coated, mar-resistant, UV-stabilized polycarbonate with coating on both surfaces.
- J. Glazing: As specified in **[Section 088000 "Glazing."] [Section 088853 "Security Glazing."]**
- K. Sealants and Joint Fillers: As specified in Section 079200 "Joint Sealants."

- L. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.
- M. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.6 DOOR OPERATORS AND CONTROLS

- A. General: Provide operators and controls, which include activation and safety devices, according to BHMA standards, for condition of exposure, and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.
- B. Door Operators: Provide door operators of size recommended by manufacturer for door size, weight, and movement.
 - 1. Door Operator Performance: Door operators shall open and close doors and maintain them in fully closed position when subjected to Project's design wind loads.
 - 2. Electromechanical Operators: Concealed, self-contained, overhead unit powered by fractional-horsepower, permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor; with solid-state microprocessor controller; UL 325; and with manual operation with power off.
- C. Motion Sensors: Self-contained, K-band-frequency, microwave-scanner units; fully enclosed by its plastic housing; adjustable to provide detection-field sizes and functions required by BHMA A156.10.
 - 1. Provide capability for switching between bidirectional and unidirectional detection.
 - 2. For one-way traffic, sensor on egress side shall not be active when doors are fully closed.
- D. Presence Sensors: Self-contained, active-infrared scanner units; adjustable to provide detection-field sizes and functions required by BHMA A156.10. Sensors shall remain active at all times.
- E. Photoelectric Beams: Pulsed infrared, sender-receiver assembly for recessed mounting. Beams shall not be active when doors are fully closed.
- F. Control Mats: **1/2-inch- (13-mm-)** thick, synthetic-rubber or flexible-plastic mat in safety-ribbed surface pattern, with extruded-aluminum frame; with pressure switches for low-voltage control wiring; and complying with performance requirements of BHMA A156.10.
 - 1. Frame: [**Recessed to fit flush with floor, with concealed anchors**] [**Surface mounted, with tapered safety edge**].
 - 2. Size: As indicated, but no smaller than required by BHMA A156.10 including Appendix A.

3. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors and color densities].**
- G. Push-Plate Switch: Momentary-contact door-control switch with flat push-plate actuator **[with contrasting-colored, engraved message].**
1. Configuration: **[Round] [Square]** push plate with **4-by-4-inch** (100-by-100-mm) junction box.
 - a. Mounting: **[As indicated on Drawings] [Recess mounted, semiflush in wall] [Surface mounted on wall].**
 2. Configuration: Rectangular push plate with **2-by-4-inch** (50-by-100-mm) junction box.
 - a. Mounting: **[As indicated on Drawings] [Recess mounted, semiflush in wall] [Recess mounted in door jamb] [Surface mounted on wall] [Surface mounted on post] [Surface mounted on guide rail].**
 3. Push-Plate Material: **[Stainless steel] [Plastic]** as selected by DEN Project Manager from manufacturer's full range.
 4. Message: **[Plain face with no message.] ["Push to Open."] [International symbol of accessibility.] [International symbol of accessibility and "Push to Open."]**
- H. Push-Button Switch: Momentary-contact door-control switch with one red-button actuator; enclosed in nominal **[2-by-4-inch (50-by-100-mm)] [4-by-4-inch (100-by-100-mm)]** junction box.
1. Provide faceplate engraved with "Press to Open" letters **[and international symbol of accessibility]** in contrasting color.
 2. Provide blue plastic cover engraved with "Press Button to Open" in white letters and international symbol of accessibility.
 3. Mounting: **[As indicated on Drawings] [Surface mounted on wall] [Surface mounted on post] [Surface mounted on guide rail] [Recess mounted in wall].**
 4. Face-Plate Material: **[Stainless steel] [Painted metal]** as selected by DEN Project Manager from manufacturer's full range.
- I. Key Switch: Recess-mounted, door-control switch with key-controlled actuator; enclosed in **2-by-4-inch** (50-by-100-mm) junction box. Provide faceplate engraved with letters indicating switch functions.
1. Face-Plate Material: **[Stainless steel] [Painted metal]** as selected by DEN Project Manager from manufacturer's full range.
 2. Functions: **[On-off, momentary contact] [On-off, maintained contact] [Two-way automatic, hold open, one-way exit, and off] [Two-way automatic, hold open, one-way exit, off, full open, and partial open].**

3. Mounting: **[As indicated on Drawings] [Recess mounted, semiflush in wall] [Recess mounted in doorjamb] [Surface mounted on wall] [Surface mounted on post]**.
- J. Wireless or Remote Radio Control Switch: Auxiliary radio control system consisting of header-mounted receiver and **[wall-mounted] [hand-held, battery-operated]** transmitter switch **[for each entrance] <Insert requirement>**.
1. Wall-Mounted Transmitter Switch: One red-button, momentary-contact actuator enclosed in **4-by-4-inch (100-by-100-mm)** junction box. Provide blue plastic cover engraved with "Press Button to Open" in white letters and international symbol of accessibility.
- K. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.
- 2.7 HARDWARE
- A. General: Provide units in sizes and types recommended by automatic entrance and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish **[unless otherwise indicated]**.
- B. Manual Opening for Power-Operated Swinging Doors: Provide hardware that, in a power failure, allows door to open with a manual force stipulated in "Performance Requirements" Article.
- C. Breakaway Device for Power-Operated Doors: Device that allows door to swing out in direction of egress to full 90 degrees from any operating position. Maximum force to open door shall be as stipulated in "Performance Requirements" Article. Interrupt powered operation of door operator while in breakaway mode.
- D. Manual Opening for Power-Assist and Low-Energy Doors: Provide hardware that, in a power failure, allows door to open with a manual force as stipulated in "Performance Requirements" Article.
- E. Hinges:
1. Center-Pivot Sets: BHMA A156.4, Grade 1, with exposed parts of cast-aluminum alloy.
 2. Offset Pivots: BHMA A156.4, Grade 1, with exposed parts of cast-aluminum alloy.
 3. Butt Hinges: BHMA A156.1, Grade 1, five-knuckle, **4-1/2-by-4-inch (114-by-102-mm)** ball-bearing butts.
 - a. Provide nonremovable pins at hinges exposed on outside of door.
 - b. Provide nonferrous hinges for doors exposed to weather.

- c. Provide three hinges at each leaf for doors up to **36 inches** (914 mm) wide and **80 inches** (2032 mm) tall; provide four hinges at each leaf for wider or taller doors.
 - F. Deadlocks: Deadbolt operated by exterior cylinder and interior thumb turn, with minimum **1-inch-** (25-mm-) long throw bolt; BHMA A156.5, Grade 1.
 - 1. Cylinders: **[BHMA A156.5, Grade 1, six-pin mortise type.] [As specified in Section 087100 "Door Hardware."] [As specified in Section 087111 "Door Hardware (Descriptive Specification)."]**
 - a. Keying: **[No master] [Integrate into building master]** key system.
 - 2. Deadbolts: Laminated-steel hook, mortise type, BHMA A156.5, Grade 1.
 - 3. Two-Point Locking for Swinging Doors: Mechanism in stile of active door leaf that automatically extends second lockbolt into **[header] [threshold]**.
 - G. Push Bars: **[As selected by DEN Project Manager from manufacturer's full range of full-door-width, single] [Manufacturer's standard surface-mounted, aluminum]** push bars.
 - H. Pull Handles: **[As selected by DEN Project Manager from manufacturer's full range of pull handles and plates] [Manufacturer's standard aluminum pull handles]**.
 - I. Thresholds: BHMA A156.21, extruded-aluminum raised thresholds; with beveled edges with a slope of not more than 1:2 and a maximum height of **1/2 inch** (13 mm). Provide cutouts as required for door operating hardware.
 - J. Weather Stripping: Replaceable components.
 - 1. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
 - 2. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
 - 3. Weather Sweeps: Nylon brush sweep mounted to underside of door bottom.
 - K. Finger Guards: Collapsible neoprene or PVC gasket.
- 2.8 ACCESSORIES
- A. Guide Rails: **[Anodized aluminum] [Baked-enamel or powder-coated aluminum] [Stainless steel]**, fabricated from **[bars] [or] [tubing]**, minimum **30 inches** (762 mm) high, and finished to match doors unless otherwise indicated; positioned and projecting from face of door jamb for distance as indicated, but not less than **[that required by BHMA A156.10 for type of door and direction of travel] <Insert dimension>**; with filler panel.
 - 1. Filler Panel: **[Expanded aluminum mesh] [Clear polycarbonate sheet] [Colored polycarbonate sheet] <Insert material>**.

- a. Orient expanded aluminum mesh with long dimension of diamonds **[parallel to top rail] [perpendicular to top rail]**.
 - b. Color: **[Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
2. Provide intermediate rail in guide rail suitable for supporting photoelectric beams.
 3. Mounting: **[As indicated on Drawings] [Jamb and floor] [Floor, freestanding]**.
 4. Aluminum Finish: **[Class I, clear anodic finish] [Class II, clear anodic finish] [Class I, color anodic finish] [Class II, color anodic finish] [Baked-enamel or powder-coat finish] [Finish matching door and frame] <Insert finish>**.
 - a. Color: **[Light bronze] [Medium bronze] [Dark bronze] [Black] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors and color densities] <Insert color>**.
 5. Stainless-Steel Finish: **[No. 4 directional-satin-finish stainless steel] [Finish matching door and frame] <Insert finish>**.
- B. Guide Rails: See **[Section 055213 "Pipe and Tube Railings."]** **[Section 057300 "Decorative Metal Railings."]**

2.9 FABRICATION

- A. General: Factory fabricate automatic entrance components to designs, sizes, and thicknesses indicated and to comply with indicated standards.
1. Form aluminum shapes before finishing.
 2. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
 3. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, **finished to match framing** [, **fabricated from stainless steel**].
 - a. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 - b. Reinforce members as required to receive fastener threads.
 4. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
- B. Framing: Provide automatic entrances as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.
1. Fabricate tubular and channel frame assemblies with welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support required loads.

2. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
 3. Form profiles that are sharp, straight, and free of defects or deformations.
 4. Provide components with concealed fasteners and anchor and connection devices.
 5. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.
 6. Fabricate exterior components to drain condensation and water passing joints within system to the exterior.
 7. Provide anchorage and alignment brackets for concealed support of assembly from building structure.
 8. Allow for thermal expansion of exterior units.
- C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.
- D. Metal Cladding: Factory-fabricated and installed metal cladding, completely covering all visible surfaces as part of prefabricated entrance assembly before shipment to Project site.
1. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
 2. Form profiles that are sharp, straight, and free of defects or deformations.
 3. Provide components with concealed fasteners and anchor and connection devices.
 4. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.
 5. Fabricate exterior components to drain water passing joints and condensation and moisture occurring or migrating within system to the exterior.
 6. Allow for thermal expansion at exterior entrances.
- E. Door Operators: Factory fabricated and installed in headers, including adjusting and testing.
- F. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual."
- G. Hardware: Factory install hardware to greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.
1. Provide sliding-type weather stripping, mortised into door, at perimeter of doors[**and breakaway sidelites**].
 2. Provide compression-type weather stripping at fixed stops of exterior doors. At locations without fixed stops, provide sliding-type weather stripping retained in adjustable strip mortised into door edge.
 3. Provide weather sweeps mounted to underside of door bottoms of exterior doors.
 4. Provide finger guards at each swinging-door leaf that has clearance at hinge side greater than **1/4 inch (6 mm)** and less than **3/4 inch (19 mm)** with door in any position. Anchor guards to hinge-jamb frame.

H. Controls:

1. General: Factory install activation and safety devices in doors and headers as required by BHMA A156.10 for type of door and direction of travel.
2. Install photoelectric beams in sides of guide rails, with dimension above finished floor not less than **24 inches** (610 mm).

2.10 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.11 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
- B. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils** (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
- D. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with [**AAMA 2604**] [**AAMA 2605**] and containing not less than [**50**] [**70**] percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- E. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than [**50**] [**70**] percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of automatic entrances.
- B. Examine roughing-in for electrical systems to verify actual locations of power connections before automatic entrance installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install automatic entrances according to manufacturer's written instructions and cited BHMA standard for direction of pedestrian travel, including signage, controls, wiring, and connection to the building's power supply.
 - 1. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.
 - 2. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
 - 3. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous coating.
- B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.
 - 1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
 - 2. Set headers, operating brackets, and guides level and true to location with anchorage for permanent support.
 - 3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior.
 - 4. Provide thresholds **[at exterior doors] [and] [where indicated]**.
- C. Door Operators: Connect door operators to electrical power distribution system.
- D. Access-Control Devices: Connect access-control devices to access-control system as specified in Section 281300 "Access Control."
- E. Controls: Install and adjust activation and safety devices according to manufacturer's written instructions and cited BHMA standard for direction of pedestrian travel. Connect control wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

- F. Guide Rails: Install rails according to BHMA A156.10, including Appendix A, and manufacturer's written instructions unless otherwise indicated.
- G. Glazing: Install glazing as specified in [**Section 088000 "Glazing."**] [**Section 088853 "Security Glazing."**]
- H. Sealants: Comply with requirements specified in Section 079200 "Joint Sealants" to provide weathertight installation.
 - 1. Set thresholds, framing members, and flashings in full sealant bed.
 - 2. Seal perimeter of framing members with sealant.
- I. Signage: Apply signage on both sides of each door[**and breakaway sidelite**] as required by cited BHMA standard for direction of pedestrian travel.
- J. Wiring within Automatic Entrance Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's written limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 FIELD QUALITY CONTROL

- A. Certified Inspector: [**Owner will engage**] [**Engage**] a Certified Inspector to test and inspect components, assemblies, and installations, including connections.
- B. Perform the following tests and inspections[**with the assistance of a factory-authorized service representative**]:
 - 1. Test and inspect each automatic entrance, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.
- C. Automatic entrances will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust hardware, moving parts, door operators, and controls to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.
 - 1. Adjust exterior doors for weathertight closure.
- B. Readjust door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).
- C. Occupancy Adjustments: When requested within [**12**] **<Insert number>** months of date of Substantial Completion, provide on-site assistance in adjusting system to suit

actual occupied conditions. Provide up to **[two]** <Insert number> visits to Project during other-than-normal occupancy hours for this purpose.

3.5 CLEANING

- A. Clean glass and metal surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.
 - 1. Comply with requirements in **[Section 088000 "Glazing"]** **[Section 088853 "Security Glazing"]** for cleaning and maintaining glass.

3.6 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include **[three]** **[six]** **[nine]** **[12]** months' full maintenance by skilled employees of automatic entrance Installer. Include **[monthly]** **[quarterly]** preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper automatic entrance operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 1. Engage a Certified Inspector to perform safety inspection after each adjustment or repair and at end of maintenance period. Furnish completed inspection reports to Owner.
 - 2. Perform maintenance, including emergency callback service, during normal working hours.
 - 3. Include 24-hour-per-day, 7-day-per-week, emergency callback service.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic entrances.
 - 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 084229.33

SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes conventionally glazed aluminum curtain walls installed as **[stick]** **[unitized]** **[unit-and-mullion]** assemblies.
- B. Related Sections:
 - 1. Section 079200 "Joint Sealants" for installation of joint sealants installed with glazed aluminum curtain walls **[and for sealants to the extent not specified in this Section]**.
 - 2. Section 084423 "Structural-Sealant-Glazed Curtain Walls" for structural-sealant-glazed curtain walls.
 - 3. Section 084433 "Sloped Glazing Assemblies" for sloped glazing **[installed with glazed aluminum curtain walls]**.
 - 4. Section 089116 "Operable Wall Louvers," Section 089119 "Fixed Louvers," and Section 089516 "Wall Vents" for units installed with glazed aluminum curtain walls.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ALLOWANCES

- A. Provide **[preconstruction]** **[field quality-control]** testing as part of testing and inspecting allowance.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by **[preconstruction]** testing of **[manufacturer's standard]** glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Glazed aluminum curtain walls shall withstand movements of supporting structure **[indicated on Drawings]** including, but not limited to, story drift, twist,

- column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- B. Delegated Design: Design glazed aluminum curtain walls, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Structural Loads:
 1. Wind Loads:[**As indicated on Drawings.**]
 - a. Basic Wind Speed: **115 mph (50 m/s)**
 - b. Importance Factor: 1.15.
 - c. Exposure Category: C.
 2. Blast Loads: [**As indicated on Drawings**] **<Insert loads>**.
 3. Periodic Maintenance-Equipment Loads: [**As indicated on Drawings**] **<Insert loads>**.
- D. Structural-Test Performance: Test according to ASTM E 330 as follows:
 1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 2. When tested at [**150**] **<Insert number>** percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding [**0.2**] **<Insert number>** percent of span.
 3. Test Durations: As required by design wind velocity, but not less than [**10**] **<Insert number>** seconds.
- E. Deflection of Framing Members: At design wind pressure, as follows:
 1. Deflection Normal to Wall Plane: Limited to [**edge of glass in a direction perpendicular to glass plane not exceeding L/175 of the glass edge length for each individual glazing lite**] [**1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m)**] **<Insert deflection limit>** or an amount that restricts edge deflection of individual glazing lites to **3/4 inch (19 mm)**, whichever is less.
 2. Deflection Parallel to Glazing Plane: Limited to [**L/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller**] [**amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which**

reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm)].

- a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.
3. Cantilever Deflection: Where framing members overhang an anchor point, limit deflection to two times the length of cantilevered member, divided by 175.
- F. Windborne-Debris-Impact-Resistance Performance: Pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996 for Wind [**Zone 1**] [**Zone 2**] [**Zone 3**] [**Zone 4**].
 1. Large-Missile Test: For glazed openings located within 30 feet (9.1 m) of grade.
 2. Small-Missile Test: For glazed openings located more than 30 feet (9.1 m) above grade.
- G. Seismic Performance: Glazed aluminum curtain walls shall withstand the effects of earthquake motions determined according to [**SEI/ASCE 7**] <Insert requirement>.
 1. Component Importance Factor is [**1.3**] <Insert factor>.
- H. Story Drift: Accommodate design displacement of adjacent stories indicated.
 1. Design Displacement: [**As indicated on Drawings**] <Insert design displacement>.
 2. Test Performance: Meeting criteria for passing based on building occupancy type when tested according to AAMA 501.4 at design displacement[**and 1.5 times the design displacement**].
- I. Water Penetration under Static Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than [**6.24 lbf/sq. ft. (300 Pa)**] [**10 lbf/sq. ft. (480 Pa)**] [**15 lbf/sq. ft. (720 Pa)**] <Insert value>.
- J. Water Penetration under Dynamic Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to AAMA 501.1 at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than [**6.24 lbf/sq. ft. (300 Pa)**] [**10 lbf/sq. ft. (480 Pa)**] [**15 lbf/sq. ft. (720 Pa)**] <Insert value>.
 1. Maximum Water Leakage: [**According to AAMA 501.1**] [**No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation**]. Water leakage does not include water controlled by flashing and gutters that is drained to exterior.
- K. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures:

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
 2. Test Interior Ambient-Air Temperature: [75 deg F (24 deg C)] <Insert temperature>.
 3. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
- L. Energy Performance: Glazed aluminum curtain walls shall have certified and labeled energy performance ratings in accordance with NFRC.
1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than [0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K)] [0.57 Btu/sq. ft. x h x deg F (3.23 W/sq. m x K)] [0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K)] <Insert value> as determined according to NFRC 100.
 2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than [0.35] [0.40] [0.45] <Insert value> as determined according to NFRC 200.
 3. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of [0.30 cfm/sq. ft. (1.50 L/s per sq. m)] <Insert value> of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of [1.57 lbf/sq. ft. (75 Pa)] [6.24 lbf/sq. ft. (300 Pa)] <Insert value>.
 4. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than [15] [25] [35] [45] <Insert value> as determined according to NFRC 500.
- M. Sound Transmission: Provide glazed aluminum curtain walls with fixed glazing and framing areas having the following sound-transmission characteristics:
1. Outdoor-Indoor Transmission Class: Minimum [26] [30] [34] <Insert number> when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.

1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Provide glazed aluminum curtain walls that comply with test-performance requirements indicated, as evidenced by reports [based on **Project-specific preconstruction testing**] [of tests performed on manufacturer's **standard assemblies**] by a qualified testing agency.
1. [Owner will engage] [Engage] a qualified testing agency to perform preconstruction testing on laboratory mockups.
 2. Build laboratory mockups at testing agency facility using personnel, materials, and methods of construction that will be used at Project site.
 3. Notify DEN Project Manager [seven] <Insert number> days in advance of the dates and times when laboratory mockups will be constructed.
 4. Preconstruction Testing Program: Perform tests specified in "Performance Requirements" Article on laboratory mockups in the following order:

- a. Structural-performance preloading at 50 percent of the specified wind-load design pressure when tested according to ASTM E 330.
- b. Air infiltration when tested according to ASTM E 283.
- c. Water penetration under static pressure when tested according to ASTM E 331.
- d. Water penetration under dynamic pressure when tested according to AAMA 501.1.
- e. Structural performance at design load when tested according to ASTM E 330.
- f. Repeat air filtration when tested according to ASTM E 283.
- g. Repeat water penetration under static pressure when tested according to ASTM E 331.
- h. Structural performance at maximum 150 percent of positive and negative wind-load design pressures when tested according to ASTM E 330.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 1. Product Data for Credit IEQ 4.1: For glazing sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
 2. Laboratory Test Reports for Credit IEQ 4: For glazing sealants used inside the weatherproofing system, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.
 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 2. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
 3. Include laboratory mockup Shop Drawings, prepared by a qualified preconstruction testing agency, showing details of laboratory mockup.

- a. Resubmit Shop Drawings with changes made to glazed aluminum curtain walls to successfully complete preconstruction testing.
- D. Samples for Initial Selection: For units with factory-applied color finishes.
- E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- F. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from **12-inch (300-mm)** lengths of full-size components and showing details of the following:
 1. Joinery, including concealed welds.
 2. Anchorage.
 3. Expansion provisions.
 4. Glazing.
 5. Flashing and drainage.
- G. Delegated-Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Preconstruction Mockup Submittals:
 1. Preconstruction Testing Program: Developed specifically for Project.
 2. Preconstruction Test Reports: Prepared by a qualified preconstruction testing agency for each mockup test.
 3. Photographs:
 - a. Take a minimum of **[10] [20] <Insert number>** photographs at locations and intervals as required by DEN Project Manager.
 - b. Submit **[35mm color transparencies] [digital color images on CD-R] [VHS color videotape] <Insert medium requirements>** of mockup before, during, and after preconstruction testing.
 4. Record Drawings: Submit record drawings of preconstruction mockups prepared by preconstruction testing agency.
- B. Qualification Data: For qualified Installer[**and preconstruction testing agency**] [**and testing agency**].
- C. Seismic Qualification Certificates: For glazed aluminum curtain walls, accessories, and components[, **from manufacturer**].
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
- D. Welding certificates.

- E. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components, from manufacturer.
 - 1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified preconstruction testing agency, for glazed aluminum curtain walls, indicating compliance with performance requirements.
- G. Field quality-control reports.
- H. Warranties: Sample of special warranties.

1.8 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.9 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating glazed aluminum curtain walls that meet or exceed energy performance requirements indicated and of documenting this performance by certification, labeling, and inclusion in lists.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
 - 1. A firm that has specialized in installation of types of products required for Project for not less than five (5) years and which is acceptable to manufacturer(s) of primary materials.
- C. Preconstruction Testing Agency Qualifications: Qualified according to ISO/IEC 17025 and accredited by ICC-ES for preconstruction testing indicated.
- D. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- E. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not revise intended aesthetic effects, as judged solely by DEN Project Manager, except with DEN Project Manager's approval. If revisions are proposed, submit comprehensive explanatory data to DEN Project Manager for review.
- F. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 3. Comply with requirements of Section 050510 "Welding".
- G. Energy Performance Standards: Comply with NFRC for minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
1. Provide NFRC-certified glazed aluminum curtain walls with an attached label.
- H. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockup of typical wall area as shown on Drawings.
 2. Field testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- I. Preinstallation Conference: Conduct conference at **[Project site][location and time as determined by DEN Project Manager] <Insert location>**.
- 1.10 PROJECT CONDITIONS
- A. Field Measurements: Verify actual locations of structural supports for glazed aluminum curtain walls by field measurements before fabrication and indicate measurements on Shop Drawings.
- 1.11 WARRANTY
- A. Special Assembly Warranty: Standard form in which **[manufacturer] [Installer]** agrees to repair or replace components of glazed aluminum curtain walls that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration created by wind and thermal and structural movements.

- c. Deterioration of metals[, **metal finishes**,] and other materials beyond normal weathering.
 - d. Water penetration through fixed glazing and framing areas.
 - e. Failure of operating components.
 2. Warranty Period: Minimum [**two (2)**] [**five (5)**] [**ten (10)**] <Insert number> years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Warranty Period: Minimum [**five (5)**] [**ten (10)**] [**twenty (20)**] <Insert number> years from date of Substantial Completion.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. [Arcadia, Inc.](#)
 2. [Arch Aluminum & Glass Co., Inc.](#)
 3. [Bruce Wall Systems Corporation.](#)
 4. [CMI Architectural.](#)
 5. [EFCO Corporation.](#)
 6. [Glassalum International Corporation.](#)
 7. [Kawneer North America; an Alcoa company.](#)
 8. [Pittco Architectural Metals, Inc.](#)
 9. [Tingwall Inc.](#)
 10. [TRACO.](#)
 11. [Tubelite.](#)
 12. [United States Aluminum.](#)

13. [Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.](#)
14. [Waltek & Company Limited.](#)
15. [Wausau Window and Wall Systems.](#)
16. [YKK AP America Inc.](#)
17. **<Insert manufacturer's name>.**
18. or approved equal.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Sheet and Plate: [ASTM B 209](#) (ASTM B 209M).
 2. Extruded Bars, Rods, Profiles, and Tubes: [ASTM B 221](#) (ASTM B 221M).
 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 4. Structural Profiles: ASTM B 308/B 308M.
 5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING

- A. Framing Members: Manufacturer's standard extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction: [**Nonthermal**] [**Thermally improved**] [**Thermally broken**] **<Insert description>.**
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Plane: Front.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 2. Reinforce members as required to receive fastener threads.

3. Use exposed fasteners with countersunk Phillips screw heads[, **finished to match framing system**] [, **fabricated from 300 series stainless steel**].
- D. Anchors: Three-way adjustable anchors with minimum adjustment of [1 inch (25.4 mm)] **<Insert dimension>** that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- E. Concealed Flashing: [**Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials**] [**Dead-soft, 0.018-inch-(0.457-mm-) thick stainless steel, ASTM A 240/A 240M of type recommended by manufacturer**].
- F. Framing Sealants: Manufacturer's standard sealants.
- 2.4 GLAZING
- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: [**Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.**] [**Comply with Section 088000 "Glazing."**]
- C. Glazing Sealants: [**As recommended by manufacturer.**] [**Comply with Section 088000 "Glazing."**]
1. Sealants used inside the weatherproofing system shall have a VOC content of [**250**] **<Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- 2.5 INSULATED SPANDREL PANELS
- A. Insulated Spandrel Panels: Comply with Section 074213.19 "Insulated Metal Wall Panels."
- B. Insulated Spandrel Panels: Laminated, metal-faced flat panels with no deviations in plane exceeding 0.8 percent of panel dimension in width or length.
1. Overall Panel Thickness: [**As indicated**] [1 inch (25.4 mm)] **<Insert thickness>**.
 2. Exterior Skin: Aluminum.

- a. Thickness: [**Manufacturer's standard for finish and texture indicated**] **<Insert thickness>**.
 - b. Finish: [**Matching framing system**] **<Insert finish>**.
 - c. Texture: [**Smooth**] [**Embossed**] **<Insert texture>**.
 - d. Backing Sheet: [**1/8-inch- (3.2-mm-) thick, tempered hardboard**] [**0.157-inch- (4-mm-) thick, cement board**] [**0.125-inch- (3.2-mm-) thick, corrugated, high-density polyethylene**] **<Insert material>**.
3. Interior Skin: [**Aluminum**] [**Manufacturer's standard galvanized-steel sheet**].
- a. Thickness: [**Manufacturer's standard for finish and texture indicated**] **<Insert thickness>**.
 - b. Finish: [**Matching curtain-wall framing**] [**Low-gloss, white baked enamel**] [**Mill finish**] **<Insert finish>**.
 - c. Texture: [**Smooth**] [**Embossed**] **<Insert texture>**.
 - d. Backing Sheet: [**1/8-inch- (3.2-mm-) thick, tempered hardboard**] [**0.157-inch- (4-mm-) thick, cement board**] [**1/2-inch- (12.7-mm-) thick, gypsum board with proprietary fire-resistance-rated core**] [**0.125-inch- (3.2-mm-) thick, corrugated, high-density polyethylene**] **<Insert material>**.
4. Thermal Insulation Core: Manufacturer's standard [**rigid, closed-cell, polyisocyanurate board**] [**extruded-polystyrene board**] [**expanded-perlite, mineral-insulation board**] **<Insert insulation>**.
5. Surface-Burning Characteristics: For exposed interior surfaces of panels, when tested according to ASTM E 84 as follows:
- a. Flame-Spread Index: [**25**] **<Insert number>** or less.
 - b. Smoke-Developed Index: [**450**] **<Insert number>** or less.
- 2.6 OPERABLE UNITS
- A. Venting Windows: Comply with Section 085113 "Aluminum Windows."
 - B. Doors: Comply with Section 084113 "Aluminum-Framed Entrances and Storefronts."
- 2.7 ACCESSORY MATERIALS
- A. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for **30-mil (0.762-mm)** thickness per coat.
- 2.8 FABRICATION
- A. Form or extrude aluminum shapes before finishing.

- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
 2. Accurately fitted joints with ends coped or mitered.
 3. Physical and thermal isolation of glazing from framing members.
 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 5. Provisions for field replacement of glazing from **[exterior] [interior] [interior for vision glass and exterior for spandrel glazing or metal panels]**.
 6. Provisions for safety railings mounted **[on interior face of mullions] [between mullions at interior]**.
 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
 8. Components curved to indicated radii.
- D. Fabricate components that, when assembled, have the following characteristics:
1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
 2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.
- E. Curtain-Wall Framing: Fabricate components for assembly using **[shear-block system] [screw-spline system] [head-and-sill-receptor system with shear blocks at intermediate horizontal members]** <Insert description>.
- F. Factory-Assembled Frame Units:
1. Rigidly secure nonmovement joints.
 2. Seal joints watertight unless otherwise indicated.
 3. Install glazing to comply with requirements in Section 088000 "Glazing."
- G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, **[AA-M12C22A41, Class I, 0.018 mm] [AA-M12C22A31, Class II, 0.010 mm]** or thicker.
- B. Color Anodic Finish: AAMA 611, **[AA-M12C22A42/A44, Class I, 0.018 mm] [AA-M12C22A32/A34, Class II, 0.010 mm]** or thicker.

1. Color: [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Champagne**] [**Black**] <Insert color>.
 2. Color: [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**].
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils** (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.
- D. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with [**AAMA 2604**] [**AAMA 2605**] and containing not less than [**50**] [**70**] percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.
- E. High-Performance Organic Finish: [**Three**] [**Four**]-coat fluoropolymer finish complying with AAMA 2605 and containing not less than [**50**] [**70**] percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.
- F. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 and containing 100 percent FEVE resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Install glazing as specified in Section 088000 "Glazing."

3.3 ERECTION TOLERANCES

A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: **1/8 inch in 10 feet** (3.2 mm in 3 m); **1/4 inch in 40 feet** (6 mm in 12 m).
2. Level: **1/8 inch in 20 feet** (3.2 mm in 6 m); **1/4 inch in 40 feet** (6 mm in 12 m).
3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to **1/2 inch** (12.7 mm) wide, limit offset from true alignment to **1/16 inch** (1.6 mm).
 - b. Where surfaces are separated by reveal or protruding element from **1/2 to 1 inch** (12.7 to 25.4 mm) wide, limit offset from true alignment to **1/8 inch** (3.2 mm).
 - c. Where surfaces are separated by reveal or protruding element of **1 inch** (25.4 mm) wide or more, limit offset from true alignment to **1/4 inch** (6 mm).

4. Location: Limit variation from plane to **1/8 inch in 12 feet** (3.2 mm in 3.7 m); **1/2 inch** (12.7 mm) over total length.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: **[Owner will engage] [Engage]** a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing and inspecting of representative areas of glazed aluminum curtain walls shall take place as installation proceeds to determine compliance of installed assemblies with specified requirements.
 1. Air Infiltration: Areas shall be tested for air leakage of **[1.5 times the rate specified for laboratory testing in "Performance Requirements" Article, but not more than 0.50 cfm/sq. ft. (2.25 L/s per sq. m),] <Insert rate>** of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure differential of **[1.57 lbf/sq. ft. (75 Pa)] [6.24 lbf/sq. ft. (300 Pa)] <Insert value>**.
 - a. Test Area: **[One bay wide, but not less than 30 feet (9.1 m), by one story of glazed aluminum curtain wall] <Insert requirements>**.
 - b. Perform a minimum of **[two] [three] <Insert number>** tests in areas as directed by DEN Project Manager.
 - c. Perform tests in each test area as directed by DEN Project Manager. Perform at least three tests, prior to **[10, 35, and 70 percent completion] <Insert requirements>**.
 2. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum **[uniform] [and] [cyclic]** static-air-pressure differential of **[0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa)] <Insert pressure>**, and shall not evidence water penetration.
 - a. Test Area: **[One bay wide, but not less than 30 feet (9.1 m), by one story of glazed aluminum curtain wall] <Insert requirements>**.
 - b. Perform a minimum of **[two] [three] <Insert number>** tests in areas as directed by DEN Project Manager.
 - c. Perform tests in each test area as directed by DEN Project Manager. Perform at least three tests, prior to **[10, 35, and 70 percent completion] <Insert requirements>**.
 3. Water Spray Test: Before installation of interior finishes has begun, areas designated by DEN Project Manager shall be tested according to AAMA 501.2 and shall not evidence water penetration.
 - a. Test Area: **[A minimum area of 75 feet (23 m) by one story of glazed aluminum curtain wall] <Insert requirements>**.
- C. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

- D. Prepare test and inspection reports.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 084413

SECTION 085113 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes aluminum windows for exterior locations.
- B. Related Requirements:
 - 1. Section 084113 "Aluminum-Framed Entrances and Storefronts" for coordinating finish among aluminum fenestration units.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>**.
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review and discuss the finishing of aluminum windows that is required to be coordinated with the finishing of other aluminum work for color and finish matching.
 - 3. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for anchorage, flashing, sealing perimeters, and protecting finishes.
 - 4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
 - 5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.
 2. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
- C. Samples: For each exposed product and for each color specified, [**2 by 4 inches (50 by 100 mm)**] <Insert dimensions> in size.
- D. Samples for Initial Selection: For units with factory-applied color finishes.
1. Include similar Samples of hardware and accessories involving color selection.
- E. Samples for Verification: For aluminum windows and components required, showing full range of color variations for finishes, and prepared on Samples of size indicated below:
1. Exposed Finishes: [**2 by 4 inches (50 by 100 mm)**] <Insert dimensions>.
 2. Exposed Hardware: Full-size units.
- F. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.
- B. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For manufacturer's warranties.

1.6 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports, and calculations.

- B. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.
 - 1. A firm that has specialized in installation of types of products required for Project for not less than five (5) years and which is acceptable to manufacturer(s) of primary materials.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.

1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to meet performance requirements.
 - b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
 - c. Faulty operation of movable sash and hardware.
 - d. Deterioration of materials and finishes beyond normal weathering.
 - e. Failure of insulating glass.
 - 2. Warranty Period:
 - a. Window: Minimum **[ten (10)]** <Insert number> years from date of Substantial Completion.
 - b. Glazing Units: Minimum **[five (5)] [ten (10)] [twenty (20)]** <Insert number> years from date of Substantial Completion.
 - c. Aluminum Finish: Minimum **[ten (10)] [twenty (20)]** <Insert number> years from date of Substantial Completion.

B. CONSTRUCTION WASTE MANAGEMENT

- 1. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. All Seasons Window & Door Mfg., Inc.; All Seasons Commercial Division, Inc.
 2. Boyd Aluminum Manufacturing.
 3. [Custom Window Company](#).
 4. [DeSCo Architectural Inc.](#)
 5. [EFCO Corporation; a Pella company](#).
 6. [EXTECH Exterior Technologies, Inc.](#)
 7. [Fleetwood Windows & Doors](#).
 8. [Graham Architectural Products Corp.](#)
 9. [Kawneer North America; an Alcoa company](#).
 10. [Mannix Exterior Wall Systems, Inc.](#)
 11. [Peerless Products Inc.](#)
 12. [Quaker Windows Products Co. Thermal Windows, Inc.](#)
 13. [TRACO](#).
 14. [Wausau Window and Wall Systems](#).
 15. [Winco](#).
 16. [YKK AP America Inc.](#)
 17. <Insert manufacturer's name>.
 18. or approved equal.
- B. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

2.2 WINDOW PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
1. Window Certification: AMMA certified with label attached to each window.
- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
1. Minimum Performance Class: **[CW] [AW] [As indicated on Drawings] <Insert class>**.
 2. Minimum Performance Grade: **[40] [45] [50] [As indicated on Drawings] <Insert grade>**.
- C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of **[0.30 Btu/sq. ft. x h x deg F (1.71 W/sq. m x K)] [0.32 Btu/sq. ft. x h x deg F (1.83 W/sq. m x K)] [0.35 Btu/sq. ft. x h x deg F (2.0 W/sq. m x K)] [0.60 Btu/sq. ft. x h x deg F (3.43 W/sq. m x K)] <Insert value>**.
- D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of **[0.40] [0.30] [0.27] <Insert value>**.
- E. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal

performance according to AAMA 1503, showing a CRF of [45] [52] <Insert value>.

- F. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change: [120 deg F (67 deg C), ambient; 180 deg F (100 deg C) material surfaces] <Insert temperature change>.
- G. Sound Transmission Class (STC): Rated for not less than [26] [30] <Insert rating> STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.
- H. Outside-Inside Transmission Class (OITC): Rated for not less than [22] [26] [30] <Insert rating> OITC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.
- I. Windborne-Debris Resistance: Capable of resisting impact from windborne debris based on testing glazed windows identical to those specified, according to [ASTM E 1886 and testing information in ASTM E 1996] <Insert test method> and requirements of authorities having jurisdiction.

2.3 ALUMINUM WINDOWS

- A. Operating Types: Provide the following operating types in locations indicated on Drawings:
1. Casement: Project [out] [in].
 2. Awning: Project out.
 3. Hopper: Project in.
 4. Single hung.
 5. Double hung.
 6. Horizontal sliding.
 7. Fixed.
- B. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.
1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.
- C. Glass: Clear annealed glass, ASTM C 1036, Type 1, Class 1, q3.
1. Kind: Fully tempered [where indicated on Drawings] <Insert requirements>.

- D. Insulating-Glass Units: ASTM E 2190[, **certified through IGCC as complying with requirements of IGCC**].
1. Glass: ASTM C 1036, Type 1, Class 1, q3.
 - a. Tint: **[Clear] [Gray] [Bronze] [Green] <Insert tint>**.
 - b. Kind: Fully tempered **[where indicated on Drawings] <Insert requirements>**.
 2. Lites: **[Two] [Three]**.
 3. Filling: Fill space between glass lites with **[air] [argon]**.
 4. Low-E Coating: **[Pyrolytic on second surface] [Sputtered on second surface] [Sputtered on third surface] [Sputtered on second or third surface] <Insert coating>**.
 5. Integral Louver Blinds: Glass manufacturer's standard, horizontal louver blinds with aluminum slats and polyester fiber cords, located in space between glass lites, and operated by hardware located on inside face of sash.
 - a. Operation: **[Tilt only] [Tilt, raising, and lowering]**.
 - b. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
- E. Glazing System: **[Manufacturer's standard factory-glazing system that produces weathertight seal] <Insert glazing requirements>**.
1. Dual Glazing:
 - a. Interior Lite: **[Glass] <Insert type>**.
 - b. Exterior Lite: **[Glass] [Insulating-glass unit] <Insert type>**.
- F. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.
1. Exposed Hardware Color and Finish: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and finish>**.
- G. Projected Window Hardware:
1. Gear-Type Rotary Operators: Complying with AAMA 901 when tested according to ASTM E 405, Method A. Provide operators that function without requiring the removal of interior screens or using screen wickets.
 - a. Type and Style: **[Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range of types and styles] <Insert type and style>**.

2. Hinges: **[Non-friction type, not less than two per sash] <Insert requirements>**.
 3. Lock: **[Lift-type throw, cam-action lock with keeper] [Lever handle and cam-action lock with keeper] [Dual lever handles, tie rod, and cam-action lock with keepers] [Key-operated custodial lock with keeper and removable handle] [Concealed multipoint lock operated by single lever handle or lift-type throw] <Insert requirements>**.
 4. Limit Devices: **[Concealed friction adjustor, adjustable stay bar] [Concealed support arms with adjustable, limited, hold-open] <Insert type>** limit devices designed to restrict sash opening.
 - a. Limit clear opening to **[4 inches (100 mm)] [6 inches (150 mm)] <Insert dimension>** for ventilation; with custodial key release.
 5. Pole Operators: Tubular-shaped anodized aluminum; with rubber-capped lower end and standard push-pull hook at top to match hardware design; of sufficient length to operate window without reaching more than **60 inches (1500 mm)** above floor; one pole operator and pole hanger per room that has operable windows more than **72 inches (1800 mm)** above floor.
- H. Hung Window Hardware:
1. Counterbalancing Mechanism: Complying with AAMA 902, concealed, of size and capacity to hold sash stationary at any open position.
 2. Locks and Latches: Allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only. **[Provide custodial locks.]**
 3. Tilt Latch: Releasing latch allows sash to pivot about horizontal axis to facilitate cleaning exterior surfaces from the interior.
- I. Horizontal-Sliding Window Hardware:
1. Sill Cap/Track: **[Extruded-aluminum track with natural anodized finish,] [Manufacturer's standard] <Insert track material and finish>** of dimensions and profile indicated; designed to comply with performance requirements indicated and to drain to the exterior.
 2. Locks and Latches: Allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only. **[Provide custodial locks.]**
 3. Roller Assemblies: Low-friction design.
- J. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.
- K. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
1. Exposed Fasteners: Do not use exposed fasteners to the greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.4 ACCESSORIES

- A. Integral Ventilating System/Device: Where indicated, provide weather-stripped, adjustable, horizontal fresh-air vent, with a free airflow slot, full width of window sash by approximately **[1 inch (25 mm)] [3 inches (75 mm)]** when open, complying with AAMA/WDMA/CSA 101/I.S.2/A440. Equip vent bar with an integral insect screen, removable for cleaning.
- B. Dividers (False Muntins): Provide extruded-aluminum divider grilles in designs indicated for each sash lite.
1. Type: **[Permanently located at exterior lite] [Permanently located between insulating-glass lites] <Insert type>**.
 2. Pattern: **[As indicated on Drawings] <Insert pattern>**.
 3. Profile: **[As selected by DEN Project Manager from manufacturer's full range] <Insert profile>**.
- C. Horizontal Louver Blinds: Provide manufacturer's standard, removable, horizontal louver blinds with aluminum slats and polyester fiber cords that are operated by hardware located on inside face of sash.
1. Operation: **[Tilt only] [Tilt, raising, and lowering]**.
 2. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
- D. Subsills: **[Thermally broken] [Nonthermal]**, extruded-aluminum subsills in configurations indicated on Drawings.
- E. Column Covers: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
- F. Interior Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
- G. Panning Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
- H. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminum receptor system that anchors windows in place.

2.5 INSECT SCREENS

- A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.
1. Type and Location: **[Full, inside for project-out] [Full, outside for project-in] [Full, outside for double-hung] [Half, outside for single-hung] [Full, outside for sliding] [Half, outside for sliding]** sashes.

- B. Aluminum Frames: Manufacturer's standard aluminum alloy complying with SMA 1004 or SMA 1201. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.
 - 1. Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet.
- C. Glass-Fiber Mesh Fabric: [**18-by-14 (1.1-by-1.4-mm) or 18-by-16 (1.0-by-1.1-mm)**] [**20-by-20 (0.85-by-0.85-mm) or 20-by-30 (0.85-by-0.42-mm)**] <Insert type> mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration. Comply with ASTM D 3656.
 - 1. Mesh Color: [**Manufacturer's standard**] <Insert color>.
- D. Aluminum Wire Fabric: 18-by-16 (1.1-by-1.3-mm) mesh of **0.011-inch-** (0.28-mm-) diameter, coated aluminum wire.
 - 1. Wire-Fabric Finish: [**Natural bright**] [**Charcoal gray**] [**Black**] <Insert finish>.

2.6 FABRICATION

- A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- B. Glaze aluminum windows in the factory.
- C. Weather strip each operable sash to provide weathertight installation.
- D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- E. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.
- F. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design wind loads of window units.
- G. [**Bow**] [**Bay**] Window Assemblies: Provide [**operating**] [**and**] [**fixed**] units in configuration indicated. Provide window frames, sashes, hardware, and other trim and components necessary for a complete, secure, and weathertight installation, including the following:
 - 1. Angled mullion posts with interior and exterior trim.
 - 2. Angled interior and exterior extension and trim.
 - 3. Exterior head and sill casings and trim.
- H. Complete fabrication, assembly, finishing, hardware application, and other work in the

factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.
- C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
- D. Class II, Color Anodic Finish: AA-M12C22A32/A34 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, integrally colored or electrolytically deposited color coating 0.010 mm or thicker) complying with AAMA 611.
 - 1. Color: [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] <Insert color>.
 - 2. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**] <Insert color>.
- E. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
 - 1. Color: [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] <Insert color>.
 - 2. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**] <Insert color>.

- F. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.
1. Organic Coating: Thermosetting, modified-acrylic or polyester enamel primer/topcoat system complying with AAMA 2603[, **except with a minimum dry film thickness of 1.5 mils (0.04 mm)**], medium gloss.
 2. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**] <Insert color>.
- G. High-Performance Organic Finish (Two-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than [**50**] [**70**] percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with [**AAMA 2604**] [**AAMA 2605**] and with coating and resin manufacturers' written instructions.
1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**] <Insert color and gloss>.
- H. High-Performance Organic Finish (Three-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coatings; Organic Coating: manufacturer's standard three-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**] <Insert color and gloss>.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in

components to ensure weathertight window installation.

- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.
- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: **[Owner will engage] [Engage]** a qualified testing agency to perform tests and inspections.
 - 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- B. Testing Services: Testing and inspecting of installed windows shall take place as follows:
 - 1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.
 - 2. Air-Infiltration Testing:
 - a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
 - b. Allowable Air-Leakage Rate: **[1.5] <Insert number>** times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.
 - 3. Water-Resistance Testing:
 - a. Test Pressure: **[Two-thirds] <Insert number>** times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
 - b. Allowable Water Infiltration: No water penetration.

4. Testing Extent: **[Three] [Three mockup] <Insert number or description>** windows of each type as selected by DEN Project Manager and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.
 5. Test Reports: Prepared according to AAMA 502.
- C. Remove and replace noncomplying windows and retest as specified above.
 - D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 - E. Prepare test and inspection reports.
- 3.4 ADJUSTING, CLEANING, AND PROTECTION
- A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
 - B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
 1. Keep protective films and coverings in place until final cleaning.
 - C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
 - D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 085113

SECTION 085653 - SECURITY WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Vision security windows.
2. Fixed, transaction security windows.
3. Sliding, transaction security windows.

- B. Related Requirements:

1. Section 083463 "Detention Doors and Frames" for detention-grade hollow-metal windows, sidelights, and door transoms.
2. Section 085663 "Detention Windows" for windows where persons are forcibly detained.
3. Section 099113 "Exterior Painting" for field painting exterior security windows.
4. Section 099123 "Interior Painting" for field painting interior security windows.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 COORDINATION

- A. Coordinate installation of anchorages for security windows. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in adjacent construction. Deliver such items to Project site in time for installation.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for window units.
 2. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
- C. Shop Drawings: For security windows.
1. Include plans, elevations, sections, and attachments to other work.
 2. Full-size section details of framing members, including internal armoring, reinforcement, and stiffeners.
 3. Location of weep holes.
 4. Hardware for sliding window units.
 5. Glazing details.
 6. Details of **[deal tray] [transaction drawer] [transaction counter] [and] [speaking aperture]**.
- D. Samples for Initial Selection: For frame members with factory-applied color finishes.
- E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
1. Framing: **12-inch-** (305-mm-) long sections of frame members.
 2. Transaction Drawer: **6 inches** (150 mm) square.
- F. Cutaway Sample: Corner of security window, made from **12-inch** (305-mm) lengths of full-size components, and showing details of the following:
1. Joinery.
 2. Anchorage.
 3. Glazing.
 4. Flashing and drainage.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified **[Installer] [and] [testing agency]**.
- B. Welding certificates.

- C. Product Test Reports: For each type of security window and accessory indicated as **[ballistics] [or] [forced-entry]** resistant, for tests performed by a qualified testing agency.
- D. Configuration Disclosure Drawing: For each type of forced-entry-resistant security window, complying with ASTM F 1233.
- E. Sample Warranty: For special warranty.
- F. Examination reports documenting inspections of substrates, areas, and conditions.
- G. Anchor inspection reports documenting inspections of built-in and cast-in anchors.
- H. Field quality-control reports documenting inspections of installed products.
 - 1. Field quality-control certification signed by Contractor[**and Detention Specialist**].

1.7 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation[**and maintenance**] of units required for this Project.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.3, "Structural Welding Code - Sheet Steel."
 - 4. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Pack security windows in wood crates for shipment. Crate glazing separate from frames unless factory glazed.
- B. Label security window packaging with drawing designation.
- C. Store crated security windows on raised blocks to prevent moisture damage.

1.10 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.11 SEQUENCING

- A. Field Painting: Except where security windows have been preglazed before installation, complete field painting of security windows before glazing installation.

1.12 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace security windows that fail in materials or workmanship within specified warranty period.

- 1. Failures include, but are not limited to, the following:

- a. Structural failures including deflections exceeding **1/4 inch** (6 mm).
- b. Failure of welds.
- c. Excessive air leakage.
- d. Faulty operation of sliding window hardware.
- e. Faulty operation of transom drawers.
- f. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
- g. **<Insert failure modes>**.

- 2. Warranty Period: Minimum [**three (3)**] **<Insert number>** years from date of Substantial Completion.

1.13 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [**25**] **<Insert number>** percent.
- B. Attack Resistance: Provide units identical to those tested for compliance with requirements indicated, and as follows:

1. Ballistics Resistance: [**Listed and labeled as**] [**Level 1**] [**Level 2**] [**Level 3**] [**Level 4**] [**Level 5**] [**Level 6**] [**Level 7**] [**Level 8**] when tested according to UL 752.
 2. Ballistics Resistance: [**HG1**] [**HG2**] [**HG3**] [**HG4**] [**SMG**] [**R1**] [**R2**] [**R3**] [**R4-AP**] [**SH1**] [**SH2**] when tested according to ASTM F 1233.
 3. Ballistics Resistance: [**A**] [**B**] [**C**] [**D**] [**E**] when tested according to HPW-TP-0500.03.
 4. Ballistics Resistance: [**S**] [**R**] [**AP**] [**SH**] when tested according to SD-STD-01.01.
 5. Ballistics Resistance: [**Level I**] [**Level IIA**] [**Level II**] [**Level IIIA**] [**Level III**] [**Level IV**] when tested according to NIJ STD-0108.01.
 6. Forced-Entry Resistance: [**Level I**] [**Level II**] [**Level III**] [**Level IV**] [**Level V**] when tested according to HPW-TP-0500.03.
 7. Forced-Entry Resistance: [**Class I**] [**Class II**] [**Class III**] [**Class IV**] [**Class V**] when tested according to ASTM F 1233.
 8. Forced-Entry Resistance: [**Five**] [**15**] [**60**]-minute protection level when tested according to SD-STD-01.01.
- C. Structural Loads: Detention windows shall withstand the effects of wind loads, with no permanent deformation or breakage of components within window assembly when tested according to ASTM E 330.
1. Wind Loads: As indicated on Drawings.
- D. Air Infiltration: Provide windows with maximum air leakage through fixed glazing and framing areas of [**0.06 cfm/sq. ft.** (0.03 L/s per sq. m)] <Insert value> of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of [**1.57 lbf/sq. ft.** (75 Pa)] [**6.24 lbf/sq. ft.** (300 Pa)] <Insert value>.
- E. Water Penetration under Static Pressure: Provide windows that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than [**6.24 lbf/sq. ft.** (300 Pa)] <Insert value>.
- F. Energy Performance: Provide windows with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below[**and certified and labeled in accordance with NFRC**]:
1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than [**0.80 Btu/sq. ft. x h x deg F** (4.54 W/sq. m x K)] [**0.65 Btu/sq. ft. x h x deg F** (3.69 W/sq. m x K)] <Insert value> as determined according to NFRC 100.
 2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than [**0.6**] [**0.7**] <Insert value> as determined according to NFRC 200.
- G. Windborne-Debris-Impact Resistance: Provide windows that pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996 for [**Wind Zone 1**] [**Wind Zone 2**] [**Wind Zone 3**] [**Wind Zone 4**].
1. Large-Missile Test: For glazed openings located within **30 feet** (9.1 m) of grade.

2. Small-Missile Test: For glazed openings located more than **30 feet** (9.1 m) above grade.

2.2 VISION SECURITY WINDOWS

- A. Provide fixed vision security windows with framing on four sides and no operable sash or ventilator.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Action Bullet Resistant Corp.
- b. American Vault Corporation.
- c. Armortex.
- d. Chicago Bullet Proof Systems.
- e. Collier Safe Company, Inc.
- f. Creative Industries, Inc.
- g. Diebold, Incorporated.
- h. Hamilton Safe.
- i. Laurence, C. R. Co. Inc.
- j. National Bullet Proof, Inc.
- k. Norshield Security Products; a division of Norment Security Group.
- l. Overly Door Company.
- m. Quikserv Corp.
- n. SABIC Innovative Plastics IP BV; Insulgard Security Products.
- o. United States Bullet Proofing, Inc.
- p. **<Insert manufacturer's name>**.
- q. or approved equal.

- B. Framing: Fabricate perimeter framing, mullions, and glazing stops from [**steel**] [**stainless steel**] [**aluminum**] as follows:

1. Profile: [**Manufacturer's standard**] [**Narrow**], with minimum face dimension indicated.
 - a. Minimum Face Dimension: [**2 inches** (50 mm)] [**1-1/4 inches** (32 mm)] [**As indicated on Drawings**] **<Insert dimension>**.
2. Depth: [**Manufacturer's standard**] [**Adjustable, two-piece clamp**] [**As indicated on Drawings**] **<Insert depth>**.
3. Glass Orientation: [**Vertical**] [**Incline subframe 5 degrees to vertical, with top of frame slanted away from secure side of window**].

- C. Glazing and Glazing Materials: Comply with requirements in Section 088853 "Security Glazing."

- D. Materials:

1. Mild Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

2. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS (Commercial Steel), Type B; suitable for exposed applications.
3. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, CS (Commercial Steel), Type B; with **G60** (Z180) zinc (galvanized) or **A60** (ZF180) zinc-iron-alloy (galvannealed) coating designation.
4. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS (Commercial Steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.
5. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666 or ASTM A 240/A 240M, austenitic stainless steel, Type 304.
6. Aluminum Extrusions: **ASTM B 221** (ASTM B 221M). Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than **22,000-psi** (150-MPa) ultimate tensile strength.
7. Aluminum Sheet and Plate: **ASTM B 209** (ASTM B 209M).

2.3 FIXED, TRANSACTION SECURITY WINDOWS

- A. Provide fixed, framed transaction windows with operable sash or ventilator capable of allowing transfer of currency and documents.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armortex.
 - b. Chicago Bullet Proof Systems.
 - c. Collier Safe Company, Inc.
 - d. Creative Industries, Inc.
 - e. Diebold, Incorporated.
 - f. Krieger Specialty Products Company.
 - g. Laurence, C. R. Co. Inc.
 - h. National Bullet Proof, Inc.
 - i. Norshield Security Products; a division of Norment Security Group.
 - j. Overly Door Company.
 - k. Protective Structures, Ltd.
 - l. Quikserv Corp.
 - m. Ready Access.
 - n. SABIC Innovative Plastics IP BV; Insulgard Security Products.
 - o. **<Insert manufacturer's name>**.
 - p. or approved equal.

- B. Configuration: [**One fixed-glazed panel**] [**Multiple fixed-glazed panels**] [**As indicated on Drawings**].

- C. Framing: Fabricate perimeter framing, mullions, and glazing stops from [**steel**] [**stainless steel**] [**aluminum**] as follows:

1. Profile: [**Manufacturer's standard**] [**Narrow**], with minimum face dimension indicated.

- a. Minimum Face Dimension: [2 inches (50 mm)] [1-1/4 inches (32 mm)] [**As indicated on Drawings**] <Insert dimension>.
 2. Depth: [**Manufacturer's standard**] [**Adjustable, two-piece clamp**] [**As indicated on Drawings**] <Insert depth>.
 3. Provide thermally improved construction for aluminum framing.
- D. Head and Jamb Framing: Designed for [sealant glazing] [gasket glazing] [voice communication by speech at normal volume].
- E. Channel-Frame Sill: Formed from stainless steel and designed for sealant glazing.
1. Transaction Counter: Stainless steel, [12 inches (305 mm)] [18 inches (457 mm)] deep by width of security window, with integral deal tray [**centered in opening**] [**as indicated on Drawings**].
 2. Transaction Counter: Stainless steel, 21 inches (533 mm) deep by width of security window, with operable deal tray [**centered in opening**] [**as indicated on Drawings**].
- F. Voice-Communication-Type Sill: Formed from stainless steel and designed to allow passage of speech at normal speaking volume without distortion.
1. Sill Depth: [12 inches (305 mm) deep] [18 inches (457 mm) deep with 6-inch (152-mm) deep projection on nonsecure side] [21 inches (533 mm) deep with 6-inch (152-mm) deep projection on both sides].
 2. Transaction Counter: Stainless steel, [12 inches (305 mm)] [18 inches (457 mm)] deep by width of security window, with integral deal tray [**centered in opening**] [**as indicated on Drawings**].
 3. Integral Transaction-Drawer Sill: Formed from [**stainless steel**] [**framing to match head and jamb framing**]; with transaction drawer integrated into framing and contained in a stainless-steel housing that forms a transaction counter on [**secure side**] [**nonsecure side**] [**both sides**] of opening. Drawer front shall be flush with housing when drawer is closed.
- G. Glazing and Glazing Materials: Comply with requirements in Section 088853 "Security Glazing."
- H. Materials:
1. Mild Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
 2. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS (Commercial Steel), Type B; suitable for exposed applications.
 3. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, CS (Commercial Steel), Type B; with G60 (Z180) zinc (galvanized) or A60 (ZF180) zinc-iron-alloy (galvannealed) coating designation.
 4. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS (Commercial Steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.
 5. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666 or ASTM A 240/A 240M, austenitic stainless steel, Type 304.

6. Aluminum Extrusions: **ASTM B 221** (ASTM B 221M). Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than **22,000-psi** (150-MPa) ultimate tensile strength.
7. Aluminum Sheet and Plate: **ASTM B 209** (ASTM B 209M).

2.4 SLIDING, TRANSACTION SECURITY WINDOWS

- A. Provide horizontal-sliding, transaction security windows.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Action Bullet Resistant Corp.
 - b. Armortex.
 - c. Collier Safe Company, Inc.
 - d. Creative Industries, Inc.
 - e. Laurence, C. R. Co. Inc.
 - f. National Bullet Proof, Inc.
 - g. Protective Structures, Ltd.
 - h. Quikserv Corp.
 - i. Ready Access.
 - j. SABIC Innovative Plastics IP BV; Insulgard Security Products.
 - k. United States Bullet Proofing, Inc.
 - l. **<Insert manufacturer's name>**.
 - m. or approved equal.
- B. Configuration: [**One fixed-glazed panel and one horizontal-sliding glazed panel**] [**Two glazed panels that slide horizontally and meet at center of security window**] [**As indicated on Drawings**].
- C. Framing: Fabricate perimeter framing, mullions, and glazing stops from [**steel**] [**stainless steel**] [**aluminum**] as follows:
 1. Profile: [**Manufacturer's standard**] [**Narrow**], with minimum face dimension indicated.
 - a. Minimum Face Dimension: [**2 inches** (50 mm)] [**1-1/4 inches** (32 mm)] [**As indicated on Drawings**] **<Insert dimension>**.
 2. Depth: [**Manufacturer's standard**] [**Adjustable, two-piece clamp**] [**As indicated on Drawings**] **<Insert depth>**.
 3. Provide thermally improved construction for aluminum framing.
- D. Head and Jamb Framing: Designed for [**sealant**] [**gasket**] glazing.
- E. Glazing Meeting Edges: Polished glazing.
- F. Sill: Stainless-steel channel frame designed for [**sealant**] [**gasket**] glazing.

1. Shelf: Stainless steel, [12 inches (305 mm)] [18 inches (457 mm)] deep by width of security window, with integral deal tray.
- G. Sliding Window Hardware: Provide roller track designed for overhead support of two- or four-wheel carriage supporting horizontal-sliding glazed panel. Provide manufacturer's standard pull and lock with two keys for each horizontal-sliding glazed panel.
1. Provide weather stripping for exterior horizontal-sliding, transaction security windows.
- H. Glazing and Glazing Materials: Comply with requirements in Section 088853 "Security Glazing."
- I. Materials:
1. Mild Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
 2. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS (Commercial Steel), Type B; suitable for exposed applications.
 3. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, CS (Commercial Steel), Type B; with G60 (Z180) zinc (galvanized) or A60 (ZF180) zinc-iron-alloy (galvannealed) coating designation.
 4. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS (Commercial Steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.
 5. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666 or ASTM A 240/A 240M, austenitic stainless steel, Type 304.
 6. Aluminum Extrusions: ASTM B 221 (ASTM B 221M). Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi (150-MPa) ultimate tensile strength.
 7. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M).

2.5 FABRICATION

- A. General: Fabricate security windows to provide a complete system for assembly of components and anchorage of window units.
1. Provide units that are reglazable from the secure side without dismantling the nonsecure side of framing.
 2. Prepare security windows for glazing unless preglazing at the factory is indicated.
- B. Provide weep holes and internal water passages for exterior security windows to conduct infiltrating water to the exterior.
- C. Framing: Miter or cope corners the full depth of framing; weld and dress smooth.
1. Fabricate framing with manufacturer's standard, internal opaque armoring in thicknesses required for security windows to comply with ballistics-resistance performance indicated.

- D. Glazing Stops: Finish glazing stops to match security window framing.
 - 1. Secure-Side (Exterior) Glazing Stops: Welded or integral to framing.
 - 2. Nonsecure-Side (Interior) Glazing Stops: Removable, coordinated with glazing indicated.
- E. Welding: Weld components to comply with referenced AWS standard. To greatest extent possible, weld before finishing and in concealed locations to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- F. Metal Protection: Separate dissimilar metals to protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
- G. Factory-cut openings in glazing for speaking apertures.
- H. Preglazed Fabrication: Preglaze window units at factory, where required for applications indicated. Comply with requirements in Section 088853 "Security Glazing."
- I. Weather Stripping: Factory applied.

2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
- B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - 1. Color: [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] <Insert color>.
 - 2. Color: [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**].
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils** (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>.**

D. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with **[AAMA 2604] [AAMA 2605]** and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>.**

2.8 STEEL FINISHES

A. Steel Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

B. Steel Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of **1 mil** (0.025 mm) for topcoat.

1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>.**

2.9 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.

2.10 ACCESSORIES

A. Recessed Deal Trays: Formed from stainless steel **[with sliding stainless-steel cover]**; fabricated in curved shape with exposed flanges for recessed installation into horizontal surface.

1. Clear Opening Size: **[12 inches wide by 8 inches deep by 1-1/2 inches high (305 mm wide by 203 mm deep by 38 mm high)] [12 inches wide by 11 inches deep by 1-1/2 inches high (305 mm wide by 279 mm deep by 38 mm high)] [16 inches wide by 11 inches deep by 1-1/2 inches high (406 mm wide by 279 mm deep by 38 mm high)] <Insert dimensions>.**

- B. Recessed, Nonricochet Deal Trays: Formed from stainless steel; fabricated with recessed bullet trap to ricochet bullets away from secure side, with exposed flanges for recessed installation into horizontal surface[, **and with sliding stainless-steel cover**].
1. Clear Opening Size: [10 inches wide by 7 inches deep by 1-1/2 inches high (254 mm wide by 178 mm deep by 38 mm high)] [12 inches wide by 8 inches deep by 1-1/2 inches high (305 mm wide by 203 mm deep by 38 mm high)] [12 inches wide by 11 inches deep by 1-1/2 inches high (305 mm wide by 279 mm deep by 38 mm high)] [16 inches wide by 11 inches deep by 1-1/2 inches high (406 mm wide by 279 mm deep by 38 mm high)] <Insert dimensions>.
 2. Bullet Trap Location: [Secure side] [Both sides].
 3. Ballistics Resistance: [UL Level 1] [UL Level 3] [Same as security window] <Insert level>.
 4. Listed and labeled as bullet resisting according to UL 752.
- C. Rotating Deal Trays: Formed from stainless steel, with rotating recessed deal tray on each side of secure opening and with handle that rotates deal trays 180 degrees.
1. Mounting: [Drop in] [Countertop].
 2. Ballistics Resistance: [UL Level 1] [UL Level 3] [Same as security window] <Insert level>.
 3. Listed and labeled as bullet resisting according to UL 752.
- D. Transaction Drawers: Formed from [stainless steel] [steel] [bullet-resistant armoring]; with ball-bearing, telescoping sliding mechanism; with cover on secure side of top of drawer that automatically closes when drawer is extended to nonsecure side.
1. Inside Dimensions: [15-3/8 inches wide by 8-1/2 inches deep by 4-3/8 inches high (390 mm wide by 216 mm deep by 111 mm high)] [13 inches wide by 22 inches deep by 6-1/2 inches high (330 mm wide by 559 mm deep by 165 mm high)] <Insert dimensions>.
 2. Operation: Manual.
 3. Operation: Electric, with sliding handle for emergency manual operation during lack of power. Provide individual switches for power and drawer movement on secure side and call button on nonsecure side.
 4. Ballistics Resistance: [UL Level 1] [UL Level 3] [Same as security window] <Insert level>.
 5. Listed and labeled as bullet resisting according to UL 752.
- E. Speaking Apertures: Fabricate from [stainless steel] [security glazing], designed to allow passage of speech at normal speaking volume without distortion.
1. Shape: [Circular] [Square].
 2. Ballistics Resistance: [UL Level 1] [UL Level 3] [Same as security window] <Insert level>.
 3. Listed and labeled as bullet resisting according to UL 752.
- F. Concealed Bolts: ASTM A 307, Grade A unless otherwise indicated.

- G. Cast-in-Place Anchors in Concrete: Fabricated from corrosion-resistant materials capable of sustaining, without failure, a load equal to **[four]** <Insert number> times the load imposed, as determined by testing according to ASTM E 488, conducted by a qualified testing agency; of type indicated below.
1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 27/A 27M cast steel or ASTM A 47/A 47M malleable iron. Provide bolts, washers, and shims as required; hot-dip galvanized according to ASTM A 153/A 153M or ASTM F 2329.
- H. Embedded Plate Anchors: Fabricated from mild steel shapes and plates, minimum **3/16 inch** (4.8 mm) thick; with minimum **1/2-inch-** (12.7-mm-) diameter, headed studs welded to back of plate.
- I. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- J. Compression-Type Glazing Strips and Weather Stripping: Unless otherwise indicated, provide compressible stripping for glazing and weather stripping, such as molded EPDM or neoprene gaskets complying with ASTM D 2000, Designations 2BC415 to 3BC620; molded PVC gaskets complying with ASTM D 2287; or molded, expanded EPDM or neoprene gaskets complying with ASTM C 509, Grade 4.
- K. Miscellaneous Glazing Materials: Provide material, size, and shape complying with requirements of glass manufacturers and with a proven record of compatibility with surfaces contacted in installation.
1. Cleaners, Primers, and Sealers: Type recommended by sealant or gasket manufacturer.
 2. Setting Blocks: Elastomeric material with a Type A Shore durometer hardness of 85, plus or minus 5.
 3. Spacers: Elastomeric blocks or continuous extrusions with a Type A Shore durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
 4. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- L. Anchors, Clips, and Window Accessories: Stainless steel; hot-dip, zinc-coated steel or iron, complying with ASTM B 633; provide sufficient strength to withstand design pressures indicated.
- M. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- N. Sealants: For sealants required within fabricated security windows, provide type recommended by manufacturer for joint size and movement. Sealant shall remain permanently elastic, nonshrinking, and nonmigrating.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of security windows.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of security window connections before security window installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of security windows.
- D. Inspect built-in and cast-in anchor installations, before installing security windows, to verify that anchor installations comply with requirements. Prepare inspection reports.
 - 1. Remove and replace anchors where inspections indicate that they do not comply with specified requirements. Reinspect after repairs or replacements are made.
 - 2. Perform additional inspections to determine compliance of replaced or additional work. Prepare anchor inspection reports.
- E. For glazing materials whose orientation is critical for performance, verify installation orientation.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other security window anchors whose installation is specified in other Sections.
 - 1. Furnish cast-in-place anchors and similar devices to other trades for installation well in advance of time needed for coordinating other work.

3.3 INSTALLATION

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing security windows to in-place construction. Include threaded fasteners for inserts, security fasteners, and other connectors.
 - 1. Install an attached or integral flange to secure side of security windows extending over rough-in opening gap so that gap has same **[forced-entry-resistance]** **[and]** **[ballistics-resistance]** performance as security window.
- B. Voice-Communication-Type Framing: Attach removable glass spacers to jambs and head of glazing, located not more than **6 inches** (152 mm) from each corner and spaced not more than **12 inches** (305 mm) o.c.

- C. Glazed Framing: Provide **[sealant] [gasket]**-glazed framing. Comply with installation requirements in Section 088853 "Security Glazing."
- D. Removable Glazing Stops and Trim: Fasten components with security fasteners.
- E. Fasteners: Install security windows using fasteners recommended by manufacturer with head style appropriate for installation requirements, strength, and finish of adjacent materials. **[Provide stainless-steel fasteners in stainless-steel materials.]**
- F. Sealants: Comply with requirements in Section 079200 "Joint Sealants" for installing sealants, fillers, and gaskets.
 - 1. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction unless otherwise indicated.
 - 2. Seal frame perimeter with sealant to provide weathertight construction unless otherwise indicated.
- G. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended in writing by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

3.4 FIELD QUALITY CONTROL

- A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.
- B. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.
- C. Prepare field quality-control certification **[endorsed by Detention Specialist]** that states installed products and their installation comply with requirements in the Contract Documents.

3.5 ADJUSTING

- A. Adjust horizontal-sliding, transaction security windows to provide a tight fit at contact points for smooth operation and a secure enclosure.
- B. Adjust transaction drawers to provide a tight fit at contact points **[and weather stripping]** for smooth operation and **[weathertight and]** secure enclosure.
- C. Remove and replace defective work, including security windows that are warped, bowed, or otherwise unacceptable.

3.6 CLEANING AND PROTECTION

- A. Clean surfaces promptly after installation of security windows. Take care to avoid damaging the finish. Remove excess glazing and sealant compounds, dirt, and other substances.
 - 1. Lubricate sliding security window hardware.
 - 2. Lubricate transaction drawer hardware.
- B. Clean glass of preglazed security windows promptly after installation. Comply with requirements in Section 088853 "Security Glazing" for cleaning and maintenance.
- C. Provide temporary protection to ensure that security windows are without damage at time of Substantial Completion.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain [**operable security windows**] [**and**] [**security windows with transaction drawers**].
 - 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 085653

SECTION 086300 - METAL-FRAMED SKYLIGHTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes skylights with metal framing.
- B. Related Sections:
 - 1. Section 084433 "Sloped Glazing Assemblies" for glazed curtain walls in which the glazed panels are primarily on a sloped plane.
 - 2. Section 084513 "Structured-Polycarbonate-Panel Assemblies" for translucent structured-polycarbonate-panel assemblies used as skylights.
 - 3. Section 084523 "Fiberglass-Sandwich-Panel Assemblies" for translucent fiberglass-sandwich-panel assemblies used as skylights.
 - 4. Section 086100 "Roof Windows" for operable and non-operable roof windows framed of wood, aluminum, or vinyl.
 - 5. Section 086200 "Unit Skylights" for skylights without framing except at the perimeter of the glazing.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for metal-framed skylights.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit IEQ 4: For sealants used inside the weatherproofing system, documentation indicating that they comply with the testing and product requirements of the California Department of Health Services'

"Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Shop Drawings: For metal-framed skylights. Include plans, elevations, sections, details, and attachments to other work.
1. Include details of provisions for assembly expansion and contraction and for draining moisture within the assembly to the exterior.
 2. Include full-size isometric details of each vertical-to-horizontal intersection of assembly, showing the following:
 - a. Joinery including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
 3. Include laboratory mockup Shop Drawings, prepared by a qualified preconstruction testing agency, showing details of laboratory mockup.
 - a. Resubmit Shop Drawings with changes made to details of mockup to successfully complete preconstruction testing.
- D. Samples for Initial Selection: For units with factory-applied color finishes.
- E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- F. Fabrication Sample: Of each framing intersection of assemblies, made from 12-inch (305-mm) lengths of full-size components and showing details of the following:
 1. Joinery including concealed welds.
 2. Anchorage.
 3. Expansion provisions.
 4. Glazing.
 5. Flashing and drainage.
- G. Delegated-Design Submittal: For metal-framed skylights indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- 1.4 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For qualified **[Installer]** **[testing agency]**.
- B. Welding certificates.
- C. Preconstruction Test Reports: Prepared by a qualified preconstruction testing agency.

- D. Compatibility and Adhesion Test Reports: For structural-sealant-glazed skylights, test reports from sealant manufacturer indicating that joint sealants have been tested for each material that will come in contact with sealants.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for metal-framed skylights.
- F. Field quality-control reports.
- G. Warranties: Sample of special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of metal-framed skylights required for this Project.
 - 1. A firm that has specialized in installation of types of products required for Project for not less than five (5) years and which is acceptable to manufacturer(s) of primary materials.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for skylights' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including testing conducted by an independent testing agency and in-service performance.
 - 1. Do not modify intended aesthetic effects, as judged solely by DEN Project Manager, except with DEN Project Manager's approval. If modifications are proposed, submit comprehensive explanatory data to DEN Project Manager for review.
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
- E. Structural-Sealant Glazing: Comply with recommendations in ASTM C 1401, "Guide for Structural Sealant Glazing," for joint design and quality-control procedures.
 - 1. Joint designs are reviewed and approved by structural-sealant manufacturer.

2. Quality-control program development and reporting comply with ASTM C 1401 recommendations for material qualification procedures, preconstruction sealant-testing program, and procedures and intervals for fabrication and installation reviews and checks.
 3. Perform manufacturer's standard tests for compatibility and adhesion of sealants with each material that will come in contact with sealants.
- F. Provide metal-framed skylights that comply with test-performance requirements indicated, as evidenced by reports **[of tests performed on manufacturer's standard assemblies] [based on Project-specific preconstruction testing]** by a qualified independent testing agency.
1. Preconstruction Testing: **[Owner will engage] [Engage]** a qualified testing agency to perform preconstruction testing on laboratory mockups of assemblies.
 2. Build laboratory mockups at testing agency facility using personnel, materials, and methods of construction that will be used at Project site.
 3. Before performing testing on structural-sealant-glazed assemblies, remove at least one of every type of glazing lite from each laboratory mockup and replace them using reglazing procedures required for in-use skylight assembly.
 4. Notify DEN Project Manager seven (7) days in advance of the dates and times when laboratory mockups will be constructed.
 5. Preconstruction Testing Sequence: Test laboratory mockups according to AAMA 501, using the following sequence of tests:
 - a. Structural-performance preloading at one-half of the specified maximum test load (ASTM E 330).
 - b. Air infiltration (ASTM E 283).
 - c. Water penetration under static pressure (ASTM E 331).
 - d. Water penetration under dynamic pressure (AAMA 501.1).
 - e. Structural performance at design load (ASTM E 330).
 - f. Repeat air filtration (ASTM E 283).
 - g. Repeat water penetration under static pressure (ASTM E 331).
 - h. Structural performance at specified maximum test load (ASTM E 330).
- G. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockup of typical metal-framed skylights as shown on Drawings.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- H. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal-framed skylights that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.
 - c. Deterioration of metals[, **metal finishes**,] and other materials beyond normal weathering.
 - d. Adhesive or cohesive sealant failures.
 - e. Water leakage.
 2. Warranty Period: Minimum [**two (2)**] [**five (5)**] [**ten (10)**] <Insert number> years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
1. Failures include, but are not limited to, checking, crazing, peeling, chalking, and fading of finishes.
 2. Warranty Period: Minimum [**five (5)**] [**ten (10)**] [**twenty (20)**] <Insert number> years from date of Substantial Completion.

1.8 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Acralight International Skylights.
 2. Architectural Glazing Technologies.
 3. Bristolite Skylights.
 4. CPI Daylighting, Inc.
 5. Exarc Skylights, Inc.
 6. Gammans Skylight Systems.
 7. GSI Glazed Structures, Inc.
 8. Kawneer North America; an Alcoa company.

9. LinEI Signature.
10. Major Industries, Inc.; Auburn Skylights Division.
11. Naturalite Skylight Systems; Vistawall Group.
12. O'Keeffe's Inc.
13. Schuco USA, LP.
14. Skyline Sky-Lites, LLC.
15. Sunglo Skylight Products.
16. Super Sky Products, Inc.
17. J. Sussman, Inc.
18. TRACO.
19. United Skys, Inc.
20. Wasco Products, Inc.
21. **<Insert manufacturer's name>**.
22. or approved equal.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Metal-framed skylights shall withstand the effects of the following without failure due to defective manufacture, fabrication, installation, or other defects in construction:
1. Structural loads.
 2. Thermal movements.
 3. Movements of supporting structure.
 4. Dimensional tolerances of support system and other adjacent construction.
 5. Failure includes, but is not limited to, the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferring to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
 - d. Glazing-to-glazing contact.
 - e. Noise or vibration created by wind and by thermal and structural movements.
 - f. Loosening or weakening of fasteners, attachments, and other components.
 - g. Sealant failure.
- B. Delegated Design: Design metal-framed skylights, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Structural Loads:
1. Wind Loads: [**As indicated on Drawings.**]
 - a. Basic Wind Speed: [**115 mph (50 m/s)**] **<Insert value>**.
 - b. Importance Factor: 1.3 **<Insert factor>**.
 - c. Exposure Category: [**D**].

2. Seismic Loads: **[As indicated on Drawings] <Insert loads>**.
- D. Deflection of Framing Members: At design wind pressure, as follows:
1. Deflection Normal to Glazing Plane: Limited to **[edge of glass in a direction perpendicular to glass plane not exceeding L/175 of the glass edge length for each individual glazing lite] [1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans more than 13 feet 6 inches (4.1 m)] <Insert deflection limit>** or an amount that restricts edge deflection of individual glazing lites to **3/4 inch (19.1 mm)**, whichever is less.
 2. Deflection Parallel to Glazing Plane: Limited to **[L/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller] [amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm)] <Insert deflection limit>**.
- E. Lateral Bracing of Framing Members: Compression flanges of flexural members are laterally braced by cross members with minimum depth equal to 50 percent of flexural member that is braced. Glazing does not provide lateral support.
- F. Structural-Test Performance: Provide metal-framed skylights tested according to ASTM E 330, as follows:
1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 2. When tested at **[150] <Insert number>** percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding **[0.2] <Insert number>** percent of span.
 3. Test Durations: As required by design wind velocity, but not less than **[10] <Insert number>** seconds.
- G. Windborne-Debris-Impact-Resistance Performance: Provide metal-framed skylights that pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996 for Wind **[Zone 1] [Zone 2] [Zone 3] [Zone 4]**.
1. Large-Missile Test: For glazed openings located within **30 feet (9.1 m)** of grade.
 2. Small-Missile Test: For glazed openings located more than **30 feet (9.1 m)** above grade.
- H. Air Infiltration: Provide metal-framed skylights with maximum air leakage through fixed glazing and framing areas of **[0.06 cfm/sq. ft. (0.03 L/s per sq. m)] <Insert value>** of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of **[1.57 lbf/sq. ft. (75 Pa)] [6.24 lbf/sq. ft. (300 Pa)] <Insert value>**.
- I. Water Penetration under Static Pressure: Provide metal-framed skylights that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of

positive wind-load design pressure, but not less than [6.24 lbf/sq. ft. (300 Pa)] <Insert value>.

- J. Water Penetration under Dynamic Pressure: Provide metal-framed skylights that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than [6.24 lbf/sq. ft. (300 Pa)] <Insert value>.
1. Maximum Water Leakage: [According to AAMA 501.1] [No uncontrolled water penetrating aluminum-framed systems or water appearing on systems' normally exposed interior surfaces from sources other than condensation]. Water leakage does not include water controlled by flashing and gutters that is drained to exterior and water that cannot damage adjacent materials or finishes.
- K. Thermal Movements: Provide metal-framed skylights that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): [120 deg F (67 deg C), ambient; 180 deg F (100 deg C)] <Insert temperature range>, material surfaces.
- L. Condensation Resistance: Provide metal-framed skylights with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than [45] [53] <Insert number> when tested according to AAMA 1503.
- M. Structural Sealant: Capable of withstanding tensile and shear stresses imposed without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.
- N. Energy Performance: Provide metal-framed skylights with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below [and certified and labeled according to NFRC]:
1. Thermal Transmittance (U-Factor): Fixed glazing and framing areas shall have U-factor of not more than [0.80 Btu/sq. ft. x h x deg F (4.54 W/sq. m x K)] [0.65 Btu/sq. ft. x h x deg F (3.69 W/sq. m x K)] <Insert value> as determined according to NFRC 100.
 2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than [0.6] [0.7] <Insert value> as determined according to NFRC 200.

2.3 FRAMING SYSTEMS

- A. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.
1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).

3. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
 4. Structural Profiles: ASTM B 308/B 308M.
 5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.
1. Include snap-on aluminum trim that conceals fasteners.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.
- D. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. At pressure caps, use ASTM A 193/A 193M stainless-steel screws.
 2. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 3. Reinforce members as required to receive fastener threads.
 4. Use exposed fasteners with countersunk Phillips screw heads[, **finished to match framing system**] [, **fabricated from Series 300 stainless steel**].
- E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- F. Anchor Bolts: **ASTM A 307, Grade A** (ASTM F 568M, Property Class 4.6), galvanized steel.
- G. Concealed Flashing: [**Manufacturer's standard, corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials**] [**Dead-soft, 0.018-inch (0.457-mm-) thick stainless steel, ASTM A 240/A 240M of type recommended in writing by manufacturer**].
- H. Exposed Flashing and Closures: Manufacturer's standard aluminum components not less than [**0.030 inch (0.762 mm)**] [**0.040 inch (1.016 mm)**] [**0.060 inch (1.524 mm)**] **<Insert dimension>** thick.
- I. Framing Gaskets: [**Manufacturer's standard**] **<Insert requirements>**.
- J. Framing Sealants: As [**recommended in writing by manufacturer.**] [**specified in Section 079200 "Joint Sealants."**]
1. Sealants used inside the weatherproofing system shall have a VOC content of [**250**] **<Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- K. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.4 GLAZING

- A. Glazing: As specified in [Section 088000 "Glazing"] [Section 088400 "Plastic Glazing."]
- B. Spacers, Setting Blocks, and Gaskets: [Manufacturer's standard elastomeric types.] [As specified in Section 088000 "Glazing."] [As specified in Section 088400 "Plastic Glazing."]
- C. Bond-Breaker Tape: [Manufacturer's standard tetrafluoroethylene-fluorocarbon or polyethylene material to which sealants will not develop adhesion] <Insert requirements>.
- D. Glazing Sealants: As [recommended in writing by manufacturer.] [specified in Section 079200 "Joint Sealants."]
1. Sealants used inside the weatherproofing system shall have a VOC content as indicated when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 3. Structural Sealant: ASTM C 1184, neutral-curing silicone formulation compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant, and approved by structural-sealant manufacturer for use in metal-framed skylights indicated.
 - a. VOC Content: [100] <Insert value> g/L or less.
 - b. Color: [Black] [As selected by DEN Project Manager from manufacturer's full range].
 4. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; neutral-curing silicone formulation compatible with structural sealant and other components with which it comes in contact; and recommended in writing by structural- and weatherseal-sealant and metal-framed skylight manufacturers for this use.
 - a. VOC Content: [250] <Insert value> g/L or less.
 - b. Color: Matching structural sealant.

2.5 FABRICATION

- A. Where practical, fit and assemble metal-framed skylights in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

- B. Fabricate aluminum components before finishing.
- C. Fabricate aluminum components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Internal guttering systems or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within skylight to exterior.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
- D. Fabricate aluminum sill closures with weep holes and for installation as continuous component.
- E. Reinforce aluminum components as required to receive fastener threads.
- F. Weld aluminum components in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- G. Factory-Glazed, Metal-Framed Skylights:
 - 1. Factory install glazing to comply with requirements in [**Section 088000 "Glazing"**] [**Section 088400 "Plastic Glazing."**]
 - 2. Prepare surfaces that will contact structural sealant according to structural-sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
- H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
- B. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.
 - 1. Color: [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Champagne**] [**Black**] <Insert color>.
 - 2. Color: [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**].

- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils** (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>**.
- D. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with **[AAMA 2604] [AAMA 2605]** and containing not less than **[50] [70]** percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>**.
- E. High-Performance Organic Finish: **[Three] [Four]**-coat fluoropolymer finish complying with AAMA 2605 and containing not less than **[50] [70]** percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>**.

2.7 SOURCE QUALITY CONTROL

- A. Structural-Sealant Glazing: Perform quality-control procedures complying with ASTM C 1401 recommendations including, but not limited to, material qualification procedures, sealant testing, and fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:
1. Comply with manufacturer's written instructions.
 2. Do not install damaged components.

3. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
 4. Rigidly secure nonmovement joints.
 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 6. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
 7. Seal joints watertight unless otherwise indicated.
- B. Metal Protection: Where aluminum will contact dissimilar materials, protect against galvanic action by painting contact surfaces with protective coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.
- C. Install continuous aluminum sill closure with weatherproof expansion joints and locked and sealed or welded corners. Locate weep holes at rafters.
- D. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within skylight to exterior.
- E. Install components plumb and true in alignment with established lines and elevations.
- F. Install glazing as specified in [**Section 088000 "Glazing"**] [**Section 088400 "Plastic Glazing."**]
1. Structural-Sealant Glazing:
 - a. Prepare surfaces that will contact structural sealant according to structural-sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
 - b. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to weatherseal-sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind weatherseal sealant as recommended in writing by weatherseal-sealant manufacturer.
- G. Erection Tolerances: Install metal-framed skylights to comply with the following maximum tolerances:
1. Alignment: Limit offset from true alignment to **1/32 inch** (0.8 mm) where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than **3 inches** (76 mm); otherwise, limit offset to **1/8 inch** (3.2 mm).
 2. Location and Plane: Limit variation from true location and plane to **1/8 inch in 12 feet** (3.2 mm in 3.7 m) but no greater than **1/2 inch** (13 mm) over total length.
- ### 3.3 FIELD QUALITY CONTROL
- A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.

1. Water-Spray Test: Before installation of interior finishes has begun, skylights shall be tested according to AAMA 501.2 and shall not evidence water penetration.
 2. Water Penetration under Static Pressure: Before installation of interior finishes has begun, areas shall be tested according to ASTM E 1105.
 - a. Test Procedures: Test under [**uniform**] [**and**] [**cyclic**] static-air pressure.
 - b. Static-Air-Pressure Difference: <Insert pressure>.
 - c. Water Penetration: None.
 3. Structural-Sealant Compatibility and Adhesion: Structural sealant shall be tested according to recommendations in ASTM C 1401.
 - a. Destructive test method, Method A, Hand Pull Tab (Destructive) in ASTM C 1401, Appendix X2, shall be used.
 - 1) A minimum of [**one**] [**two**] <Insert number> area(s) on each skylight face shall be tested.
 - 2) Repair installation areas damaged by testing.
 4. Structural-Sealant Glazing Inspection: After installation of metal-framed skylights is complete, structural-sealant glazing shall be inspected and evaluated according to ASTM C 1401 recommendations for quality-control procedures.
- B. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 086300

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:

1. Mechanical door hardware for the following:
 - a. Swinging doors.
 - b. Sliding doors.
 - c. Folding doors.
 - d. <Insert type>
2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

- B. Related Sections:

1. Section 064023 "Interior Architectural Woodwork" for cabinet door hardware provided as part of architectural woodwork.
2. Section 081113 "Hollow Metal Doors and Frames" **[for astragals provided as part of labeled fire-rated assemblies] [and] [for door silencers provided as part of hollow-metal frames].**
3. Section 081119 "Stainless-Steel Doors and Frames" **[for astragals provided as part of labeled fire-rated assemblies] [and] [for door silencers provided as part of stainless steel frames].**
4. Section 081216 "Aluminum Frames" for door silencers provided as part of aluminum frames.
5. Section 081416 "Flush Wood Doors" for **[astragals] [and] [integral intumescent seals]** provided as part of labeled fire-rated assemblies.
6. Section 081433 "Stile and Rail Wood Doors" for **[astragals] [and] [integral intumescent seals]** provided as part of labeled fire-rated assemblies.
7. Section 083113 "Access Doors and Frames" for access door hardware, **[except] [including]** cylinders.
8. Section 083323 "Overhead Coiling Doors" for door hardware provided as part of overhead door assemblies.
9. Section 083326 "Overhead Coiling Grilles" for door hardware provided as part of overhead grille assemblies.
10. Section 084113 "Aluminum-Framed Entrances and Storefronts" for [installation

- of] entrance door hardware, [except] [including] cylinders.
11. Section 084126 "All-Glass Entrances and Storefronts" for [installation of] entrance door hardware, [except] [including] cylinders.
 12. Section 084229 "Automatic Entrances" for entrance door hardware, [except] [including] cylinders.
 13. Section 102600 "Wall and Door Protection" for plastic door protection units that match wall protection units.
 14. Section 133419 "Metal Building Systems" for door hardware, [except] [including] cylinders.
 15. Section 281300 "Access Control" for access control devices installed at door openings and provided as part of a security system.
 16. Section 281600 "Intrusion Detection" for detection devices installed at door openings and provided as part of an intrusion-detection system.
 17. Section 283100 "Intelligent Life Safety Fire Management System"

C. This section covers materials and installation of Architectural Hardware and Keying System.

1. Furnish all hardware required by the Contract Drawings and in accordance with these specifications.
 - a. The specified hardware shall be purchased by the Contractor from the Hardware Supplier.
 - b. The Contractor shall make all necessary arrangements for the purchase of the specified hardware with the Hardware Supplier, including scheduling, purchasing, delivery, training, and warranty. The Contractor shall bear all storage, handling, transportation, training, administration, and supervisory costs associated with the purchase of the specified hardware.
 - c. The Contractor's warranties for the hardware and its installation are contained in the General Conditions. The one-year warranty period set forth in the General Conditions shall be changed to two (2) years.
2. Installation of all hardware shall be by this Contractor. Coordinate with electrical, door, and security system installation.
3. The Contractor shall coordinate the purchase, supply, deliver, scheduling, training, storage, installation and required Submittals of all hardware with the Hardware Supplier. Coordination shall include coordination of approved manufacturer type and model number for each item of hardware. The Contractor shall coordinate with the Hardware Manufacturer as required. The Contractor assumes the risk of nonperformance by the Hardware Supplier or Manufacturer.

D. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DOOR HARDWARE ALLOWANCE

- A. Furnish door hardware as part of [**Door Hardware Allowance**] <Insert allowance>.

1.4 DESIGN REQUIREMENTS

- A. The drawings and schedules show the sizes and locations of plates and trim for door protection.
- B. Hardware shall comply with requirements of DHI, BHMA, and ANSI standards.
- C. Where required for handicap code hardware shall have a shape that is easy to grasp with one hand and does not require high grasping, tight pinching, or twisting of the wrist to operate, in compliance with ADA and applicable code standards. Lever type, push type mechanisms, and "U" shape handles are acceptable designs.
- D. Acceptable lockset manufacturer is the following:
 - 1. Best Access Systems. No Substitutions.

1.5 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical data for each product specified and required. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 1. Include data substantiating that materials comply with requirements.
- B. The Hardware Supplier shall be required by the Contractor to submit templates with the Hardware Submittal. Furnish hardware templates to each fabricator of doors, frames and other work to be factory-prepared for the installation of hardware. The Contractor shall check shop drawings of such other work, to confirm that adequate provisions are made for proper location and installation of hardware.
 - 1. Type, fastener, finish, style, function, size, quantity required, location, door and frame size, each hardware item.
 - 2. Name of manufacturer of each item.
- C. Operation and maintenance data.
- D. Certification that materials are per contract requirements.
- E. Shop Drawings: Details of electrified door hardware, indicating the following:
 - 1. Wiring Diagrams: For power, signal, and control wiring and including the following:
 - a. Details of interface of electrified door hardware and building safety and security systems.
 - b. Schematic diagram of systems that interface with electrified door hardware.
 - c. Point-to-point wiring.
 - d. Risers.
 - e. Elevations doors controlled by electrified door hardware.

2. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.
- F. Samples for Initial Selection: For plastic protective trim units in each finish, color, and texture required for each type of trim unit indicated.
- G. Samples for Verification: For exposed door hardware of each type required, in each finish specified, prepared on Samples of size indicated below. Tag Samples with full description for coordination with the door hardware schedule. Submit Samples before, or concurrent with, submission of door hardware schedule.
1. Sample Size: Full-size units or minimum **2-by-4-inch** (51-by-102-mm) Samples for sheet and **4-inch** (102-mm) long Samples for other products.
 - a. Full-size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.
- H. Other Action Submittals:
1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. Submittal Sequence: Submit door hardware schedule **[after] [or] [concurrent with]** submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
 - b. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.
 - c. Format: Use same scheduling sequence and format **[and use same door numbers]** as in the Contract Documents.
 - d. Content: Include the following information:
 - 1) Identification number, location, hand, fire rating, size, and material of each door and frame.
 - 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - 4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - 5) Fastenings and other pertinent information.
 - 6) Explanation of abbreviations, symbols, and codes contained in

- schedule.
 - 7) Mounting locations for door hardware.
 - 8) List of related door devices specified in other Sections for each door and frame.
2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[Installer] [and] [Architectural Hardware Consultant]**.
- B. Product Certificates: For electrified door hardware, from the manufacturer.
 - 1. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
 - 2. Manufacturer shall submit a certificate evidencing not less than five (5) years' experience in the manufacturing and supplying of the types of products to that specified.
- C. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- D. Warranty: Special warranty specified in this Section.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final **[hardware] [and] [keying]** schedule.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Door Hardware: **<Insert detailed descriptions and specific numbers of units>**.
 - 2. Electrical Parts: **<Insert detailed descriptions and specific numbers of units>**.

1.9 OCCUPANCY SUBMITTAL

- A. Following installer's Occupancy Adjustment of hardware [**three (3)**] [**six (6)**] <Insert number> months after date of Substantial Completion, prepare a written report of current and predictable problems in the performance of the hardware, and submit report to DEN Project Manager.

1.10 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and DEN Project Manager about door hardware and keying.
1. Warehousing Facilities: In Project's vicinity.
 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as follows:
1. For door hardware, an [**Architectural Hardware Consultant (AHC)**] [**Architectural Hardware Consultant (AHC) who is also an Electrified Hardware Consultant (EHC)**] [**Architectural Openings Consultant (AOC)**].
- C. Source Limitations: Obtain each type of door hardware from a single manufacturer.
1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- D. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.
- E. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
1. Air Leakage Rate: Maximum air leakage of **0.3 cfm/sq. ft.** (3 cu. m per minute/sq. m) at the tested pressure differential of **0.3-inch wg** (75 Pa) of water.

- F. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- G. Means of Egress Doors: Latches do not require more than **15 lbf** (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- H. Accessibility Requirements: For door hardware on doors in an accessible route, comply with **[the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines] [ICC/ANSI A117.1] [HUD's "Fair Housing Accessibility Guidelines"] [and] <Insert regulation>**.
1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than **5 lbf** (22.2 N).
 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: **5 lbf** (22.2 N) applied perpendicular to door.
 - b. Sliding or Folding Doors: **5 lbf** (22.2 N) applied parallel to door at latch.
 - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than **[1/2 inch (13 mm) high] [and] [3/4 inch (19 mm) high for exterior sliding doors]**.
 4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point **3 inches** (75 mm) from the latch, measured to the leading edge of the door.
- I. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." In addition to Owner[, **Construction Manager,**] Contractor, and Architect, conference participants shall also include Installer's Architectural Hardware Consultant[**and Owner's security consultant**]. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 2. Preliminary key system schematic diagram.
 3. Requirements for key control system.
 4. Requirements for access control.
 5. Address for delivery of keys.
 6. **<Insert requirements to suit Project>**.
- J. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>**.
1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 2. Inspect and discuss preparatory work performed by other trades.

3. Inspect and discuss electrical roughing-in for electrified door hardware.
 4. Review sequence of operation for each type of electrified door hardware.
 5. Review required testing, inspecting, and certifying procedures.
 6. **<Insert agenda items>.**
- K. Manufacturer shall submit a certificate evidencing not less than five (5) years' experience in the manufacturing and supplying of the types of products to that specified.
- L. Hardware supplier: Direct factory contract supplier who employs a certified architectural hardware consultant (AHC), available at reasonable times during course Work for project hardware consultation to Owner, Architect, and Contractor and is responsible for detailing, scheduling, and ordering of finish hardware.
- M. Hardware for fire rated openings to comply with NFPA Standards 80 and 101.
- N. Each type of hardware to be obtained from a single manufacturer.
- O. Reference standards as applicable: DBC BHMA UL ANSI NFPA DHI
- P. A warranty shall be required for a period of two years, by the Installer/Contractor.
- Q. Pre-Installation Conference: Prior to installation of hardware, this Contractor Installer to meet at the project site or other mutually agreed location with installers of related work, General Contractor, Hardware Supplier, Security System Installer, and Project Manager. Record discussion and provide copy to each participant.
- R. Coordinate power supply requirements for each electrically operated hardware device with Electrical/Security Contractor.
- S. Security door equipment installation requirements: Prior to the installation of the Electronic Security Equipment, the Installer of the door and door hardware shall confirm in writing the following:
1. The door has been adjusted.
 2. The door has been properly aligned on all sides.
 3. The latch is working properly.
 4. The closer is working properly. Submit copy to DEN Project Manager.
- T. The Electronic Equipment Installer shall inspect the door and door hardware installation and confirm in writing the door and hardware installation is acceptable for proper installation of the electronic equipment. 30 Days prior to installation, the Electronic Equipment supplier shall submit a current 'Access Control System' permit issued by the City and County of Denver Building Inspection Division.
- U. Should any adjustment be required for the approval of the Security door system, the modifications and or adjustments must be made concurrently by the Electronic Equipment Installer and the Door Hardware Installer.
- V. Coordinate all work with work of other trades.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- D. Deliver keys[**and permanent cores**] to Owner by registered mail or overnight package service.

1.12 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.13 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: Minimum [**three (3)**] <Insert number> years from date of

Substantial Completion, unless otherwise indicated.

- a. **[Electromagnetic] [and] [Delayed-Egress]** Locks: Minimum **[Five]** <Insert number> years from date of Substantial Completion.
- b. Exit Devices: Minimum **[two (2)]** <Insert number> years from date of Substantial Completion.
- c. Manual Closers: Minimum **[ten (10)]** <Insert number> years from date of Substantial Completion.
- d. Concealed Floor Closers: Minimum **[five (5)] [ten (10)] [twenty five) 25]** <Insert number> years from date of Substantial Completion.

1.14 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, provide **[six]** <Insert number> month's full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Provide parts and supplies that are the same as those used in the manufacture and installation of original products.

1.15 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled **[in Part 3 "Door Hardware Schedule" Article]** **[on Drawings]** to comply with requirements in this Section.
 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and **[named manufacturers' products] [products equivalent in function and comparable in quality to named products] [products complying with BHMA designations referenced]**.
 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware

designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.
2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.

2.2 HINGES

A. Hinges: BHMA A156.1. [Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.]

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Hager Companies- No substitution.

B. Hinges shall conform to ANSI A156.1. Hinges used on metal doors and frames shall also conform to ANSI A156.7. Hinge size shall conform to the hinge manufacturer's printed recommendations and shall be indicated on the hardware schedule.

C. Hinges for reverse bevel doors with locks shall have pins non-removable by means such as a set screw in the barrel. Set screw shall be inaccessible when the door is closed.

D. Hinges with anti-friction bearings may be furnished in lieu of ball bearing hinges unless prohibited by building codes.

E. Butt hinges shall conform to the following types unless otherwise specified under hardware sets:

	Wrought Steel	Wrought Steel	Wrought Brass or Bronze	Wrought Brass or Bronze	Stainless Steel	Stainless Steel
	Grade	Grade	Grade	Grade	Grade	Grade
Classification	1	2	1	2	1	2
Full Mortise	A8111	A8112	A2111	A2112	A5111	A5112
Half Mortise	A8211	A8212	A2211	A2212	A5211	A5212
Full Mortise	A8311	A8312	A2311	A2312	A5311	A5312
Half Mortise	A8411	A8412	A2411	A2412	A5411	A5412

F. Grade 1 hinges shall be used for doors subject to very high frequency use (more than 60,000 cycles per year), unusually heavy doors including all lead lined doors, doors 42 inches wide or wider, exterior doors equipped with overhead holders, and doors subject to other unusual stress conditions.

- G. Grade 2 hinges shall be used for doors subject to high frequency use (10,000 to 60,000 cycles per year), outswinging exterior doors not equipped with overhead holders, and standard weight doors with closers.
- H. Number of hinges shall be three hinges for each door leaf up to 5' high, four hinges for doors from 5' to 7'6" in height, and one additional hinge for each additional 30" or fraction thereof in height.
- I. Height of hinge shall be 4-1/2" for doors up to and including 36" wide and 5" for doors 36" to 48".
- J. Exterior outswing doors shall be finished with nonferrous hinges.
- K. Refer to hardware schedule for specific requirements.

2.3 SELF-CLOSING HINGES AND PIVOTS

- A. Self-Closing Hinges and Pivots: BHMA A156.17.
- B. Pivots shall conform to ANSI A156.4. Pivots shall be Grade 1.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies. No substitutions.

2.4 CENTER-HUNG AND OFFSET PIVOTS

- A. Center-Hung and Offset Pivots: BHMA A156.4.
- B. Pivots shall conform to ANSI A156.4. Pivots shall be Grade 1.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DORMA Architectural Hardware; Member of The DORMA Group North America.
 - b. IVES Hardware; an Ingersoll-Rand company.
 - c. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.

2.5 CONTINUOUS HINGES

- A. Continuous Hinges: BHMA A156.26; minimum **0.120-inch-** (3.0-mm-) thick, hinge leaves with minimum overall width of **4 inches** (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

- B. Continuous Hinges shall conform to ANSI A156.26.
- C. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Hager Companies, ROTON Continuous Hinge. No substitutions.
- D. Door hanging system is to be manufactured of 6063-T6 anodized aluminum, non-handed and anodized as required by design. Hinges shall be manufactured of three interlocking components, two hinge leaves, and one cover channel. The door leaf and jamb leaf shall be geared together for the entire length of the hinge, and joined by a cover channel. The pinless assembly of three interlocking extrusions shall be applied to the full height of the door and frame without mortising. All exposed working metal surfaces shall be coated with a TFE dry lubricant. Vertical door loads shall be carried on Lubriloy™ RL bearings through a full 180° opening; no other substitute material will be accepted. Standard Duty Continuous Geared Hinges, up to 83", shall have 16 each bearings; Heavy Duty Hinges, up to 83" shall have 32 each bearings. Hinges of greater length will have proportionately greater number of bearings. Bearings are to be completely concealed in the cover channel. Hinge cover channel is to be monolithic in appearance and withstand 7000 foot pounds of pull apart pressure. Hinges with visible knuckle separations are not acceptable. Self-drilling (Tek's Point), hardened and plated steel fasteners 12-24 x 11/16", flat head undercut. Phillips head screws are to be furnished. All aluminum components are to be anodized in accordance with 202-R1 (AA-M12C22A21) Clear, as required by design. All fire rated hinges shall carry Underwriters Laboratory Inc. Certification, up to and including all 90-minute applications for wood doors, as well as 3-hour applications for all fire rated metal doors.

2.6 MECHANICAL LOCKS AND LATCHES

- A. Locks and Latches shall conform to ANSI A156.13.
- B. Locks, latches, and deadlocks shall be the products of a single manufacturer. Installed locksets shall provide the required degree of resistance to unauthorized entry. Type and Function shall be as specified under hardware sets. Series 1000, Grade 1 lever handles shall be either forged or solid cast and conform to ANSI A117. Series 1000 lock and latches shall have a latch with a minimum of 3/4 inches throw, and a deadbolt with a minimum of 1 inch throw.
- C. Lock Functions: As indicated in door hardware schedule.
- D. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 - 1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.

2. Mortise Locks: Minimum **3/4-inch** (19-mm) latchbolt throw.
 3. Deadbolts: Minimum [**1-inch** (25-mm)] [**1.25-inch** (32-mm)] **<Insert dimension>** bolt throw.
- E. Lock Backset: **2-3/4 inches** (70 mm), unless otherwise indicated.
- F. Lock Trim:
1. Description: **[As indicated on Drawings] <Insert description or manufacturer's design designation>**.
 2. Levers: [**Wrought**] [**Forged**] [**Cast**].
 - a. **<Insert model number and description>**.
 3. Knobs: [**Wrought**] [**Forged**] [**Cast**].
 4. Escutcheons (Roses): [**Wrought**] [**Forged**] [**Cast**].
 5. Dummy Trim: Match [**knob**] [**lever**] lock trim and escutcheons.
 6. Operating Device: [**Lever**] [**Knob**] with escutcheons (roses).
- G. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
 4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.
- H. Bored Locks: BHMA A156.2; Grade [**1**] [**2**]; Series 4000.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Best Access Systems; Div. of Stanley Security Solutions, Inc. No substitutions.
- I. Mortise Locks: BHMA A156.13; [**Operational**] [**Security**] Grade [**1**] [**2**]; stamped steel case with steel or brass parts; Series 1000.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Best Access Systems; Div. of Stanley Security Solutions, Inc. No substitutions.
- J. Interconnected Locks: BHMA A156.12; Grade [**1**] [**2**]; Series 5000.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Best Access Systems; Div. of Stanley Security Solutions, Inc. No substitutions.
- K. Roller Latches: BHMA A156.16; Grade 1; rolling plunger that engages socket or catch, with adjustable roller projection.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Best Access Systems; Div. of Stanley Security Solutions, Inc. No substitutions.
- L. Push-Pull Latches: [**Bored, BHMA A156.2; Series 4000**] [**Mortise, BHMA A156.13**]; Grade [**1**] [**2**]; with paddle handles that retract latchbolt; capable of being mounted vertically or horizontally.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Best Access Systems; Div. of Stanley Security Solutions, Inc. No substitutions.

2.7 AUXILIARY LOCKS

- A. Bored Auxiliary Locks: BHMA A156.5: Grade [**1**] [**2**]; with strike that suits frame.
- B. Locks and Latches shall conform to ANSI A156.13. Locks, latches, and deadlocks shall be the products of a single manufacturer. Installed locksets shall provide the required degree of resistance to unauthorized entry. Type and Function shall be as specified under hardware sets. Series 1000, Grade 1 lever handles shall be either forged or solid cast and conform to ANSI A117. Series 1000 lock and latches shall have a latch with a minimum of 3/4 inches throw, and a deadbolt with a minimum of 1 inch throw.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Best Access Systems; Div. of Stanley Security Solutions, Inc. No substitutions.
- C. Mortise Auxiliary Locks: BHMA A156.5; Grade [**1**] [**2**]; with strike that suits frame.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Best Access Systems; Div. of Stanley Security Solutions, Inc. No substitutions.
- D. Narrow Stile Auxiliary Locks: BHMA A156.5; Grade [**1**] [**2**]; with strike that suits frame.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Best Access Systems; Div. of Stanley Security Solutions, Inc. No substitutions.

2.8 SLIDING AND FOLDING DOOR HARDWARE:

- A. Sliding and Folding Door Hardware shall conform to ANSI A156.14. Sliding and Folding Hardware shall be specified with the appropriate Grade for the test door weights listed in ANSI A156.14.

2.9 KEYPAD LOCKSETS:

- A. Keypad locksets shall conform to ANSI A156.13. Locks shall have 12 position keypad design with audible and visual feedback. Locks shall include optional extended battery pack. Maximum of 50 users. All programming occurs through keypad.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Acceptable keypad lock manufacturer is Best Access Systems "EZ" Series. No Substitutions.

B. EXIT DEVICES:

- C. Exit devices shall conform to ANSI A156.3. Finish shall match that specified for lock trim. Exit devices shall be Grade 1. Type and Function shall be as specified under hardware sets. Exit devices to be Modern style, with touch pad in lieu of cross bar with lever arms, as called out in ANSI A156.3. Exit devices shall have a hydraulic sound damper to reduce noise of the operation of the device. All working parts must be made of stamped steel zincdichromate parts. No diecast, plastic, or cast brass parts shall be used. Only compression springs are acceptable in device mechanism. All surface strikes shall be roller type and come complete with a plate underneath to prevent movement. The latchbolt shall have a self-lubricating coating to reduce friction and wear. Plated latch bolts are unacceptable. Wherever possible all exit devices shall have deadlocking feature. If electric operation is required for use with security system, all rim, vertical rod, and mortise lock devices shall have the capability of electric latch retraction. Manufacturer shall have accessory products available including power supplies, monitoring switches, and controls to complete the system. All components shall be UL listed. Manufacturer shall have a minimum of two years experience with electrified products installed in similar facilities. Exit Devices shall have manufacturers standard warranty for a minimum of three (3) years. The use of vertical rod devices is discouraged.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Acceptable lockset manufacturer is Von Duprin. No Substitutions.

2.10 CLOSERS:

- A. Closers shall conform to ANSI A156.4. Closers shall be Grade 1. Type and closer options to be selected for appropriate applications as recommended by closer manufacturer. Overhead closers shall have manufacturers standard warranty for a minimum of ten (10) years. Floor closers shall have a warranty for a minimum of ten (10) years. All closers to be specified with hydraulic backcheck. Separate adjusting valves shall be provided for closing speed, latching speed, and backcheck. Closers shall have multi-size spring power adjustment to permit setting of spring from (BF) 1 through 4 or 2 through 6 with additional spring power available. Closer may be deleted off HARDWARE SETS when not appropriate or required by code. All closers shall be furnished with sex nuts and bolts. Place closers inside building, stairs, and rooms. Provide plates, brackets, and special templating when needed for interface with particular header, door and wall conditions, and neighboring hardware.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acceptable closer manufacturer is Norton. No Substitutions. Use Norton 7500 at exterior doors and 7500BF at interior doors.

2.11 LOW-ENERGY POWER OPERATORS:

- A. Low-Energy power operators shall conform to ANSI A156.19. Furnish all labor, materials, equipment, and services necessary for the proper installation of Low-Energy power operator handicap door system. Low-Energy power operators shall be completely electromechanical with microprocessor control, requiring no microswitches on the operator. The electrical contractor shall provide 115V., 60Hz., one-phase 15-amp supply to the door header. Also conduit and electrical boxes, if switches are remote. Doors shall be equipped with decal(s) visible from either side, instructing the user to the operation and function of the door. In the handicap mode, one of the activating switches on either side of the door is actuated and the door opens slowly-to backcheck (80°) in 3 to 6 seconds and to fully open position in 4 to 7 seconds. The door will remain open for a period of 5 seconds (the minimum allowed by the ANSI standard) to 30 seconds as determined by the setting entered into the variable time delay on the control box. After the time delay, the door closes by the spring in the door operator from 90° to 10° in 3 to 6 seconds, and from 10° to fully closed in 1-1/2 to 2 seconds. The operator shall function as a manual door closer when not activated by activating switches.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acceptable Low-energy power operator manufacturer is Dor-O-Matic Senior Swing. No Substitutions.

2.12 DOOR TRIM:

- A. Door trim shall conform to ANSI A156.6. Flat metal trim shall be a minimum of 0.050 inches (1.27mm) thick. Size and type Kick, Mop, and Armor plates are specified or shown on the drawings.

2.13 WEATHERSTRIP AND THRESHOLDS:

- A. Weatherstrip and Thresholds shall conform to ANSI A156.21 and ANSI A156.22. Type as scheduled.
- B. Furnish surface mount fire rated door sweeps at openings where undercut of door exceeds requirements as listed in NFPA 80, Table 1-11.4 Clearances Under the Bottoms of Doors.

2.14 AUXILIARY HARDWARE:

- A. Auxiliary hardware shall conform to ANSI A156.16. Type as scheduled.

2.15 WALL AND FLOOR STOPS:

- A. Wall shall conform to ANSI A156.16. Type as scheduled.
- B. At openings where wall stops are inappropriate, a "stop arm closer" at outswing doors or an overhead stop at inswing doors shall be used.

2.16 ELECTRO-MAGNETIC DOOR HOLDERS:

- A. Electro-Magnetic door holders shall conform to ANSI A156.15.
- B. Provide wall mounted Electro-Magnetic door holders having a holding power of 25-40 pounds.
- C. All electrical wiring shall be concealed. Provide units with the required clearance needed for trim projection.
- D. Provide units with triple voltage coils, 12VDC, 24VAC/DC, and 120VAC.
- E. Anchor the electromagnet firmly since the wall portion will function as a doorstop. Locate magnet approximately 6 inches in from lock edge of door. Wall magnets should be mounted approximately 2 to 4 feet above the floor for optimum performance.
- F. All armatures shall have quick release button to aid in eliminating residual magnetism.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Acceptable Electro-Magnetic door holder manufacturer is Rixson. No Substitutions.

2.17 OVERHEAD STOPS AND HOLDERS:

- A. Overhead stops and holders shall conform to ANSI A156.8.

2.18 ELECTRO-MECHANICAL AND SECURITY HARDWARE:

- A. Due to the high level of security required by the F.A.A. for international airports, selective hardware will be required to be electrically actuated, controlled, and/or monitored as required by the security consultants. Coordinate equipment and related devices associated with security system with all trades affected, refer to Section 281300 "Access Control." The Contractor shall install and test low voltage wiring between the electric hinge and the lockset. The Contractor shall assure that the templates provided by the Hardware supplier provides oversized openings in the hollow-metal jamb for wiring entrance of the electric hinge harness. The Contractor shall provide a plastic grommet in the wiring opening of the hollow-metal frame and door.
- B. Intellikey Access Control: Where indicated in schedule this contractor shall furnish Intellikey Access Control consisting of ACS4000 Intelligent Lock Controller that consists of a circuit board with a microprocessor and associated circuitry. The miniature computer reads access information from an Intelligent Key, compares this information with the information programmed into the controller's memory, and determines if the key should be granted access. Each controller can operate as an independent, stand-alone unit. The controller right at the point of access makes all access control decisions. The controller's memory shall retain programming and audit trail information, even without batteries, for up to 100 years. The electronic controller is designed to work with any Intellikey electronic cylinder. A typical installation consists of mounting the INTELLIKEY controller using an External slimline housing. The Intelligent Key carries the access control and personal identity data of the assigned keyholder. The Intelligent Key cannot be read or duplicated except by authorized personnel equipped with site-specific INTELLIKEY equipment. The Electronic Cylinder provides the link between the INTELLIKEY controller and key. INTELLIKEY controllers and keys communicate through an invisible, encrypted infrared link provided by the cylinder. INTELLIKEY cylinders are available as replacements for the standard cylinder types, including mortise and rim. The electronic cylinder may be configured for rotating operation. The Rotating Cylinder is used in conjunction with new or existing mechanical locking devices where rotation of the cylinder retracts or throws a latch bolt.
- C. Photoelectric Sensor: Where indicated on Security System drawings this contractor shall furnish 18mm threaded barrel photoelectric sensor. Acceptable photoelectric sensor manufacturer Banner S18SN6L. No Substitutions.
- D. Door Position Switch: Where indicated on Security System drawings this contractor shall furnish surface mount door position switch with 3' of stainless steel armored

cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acceptable door position switch manufacturer Sentrol 2507A or Sentrol 2207A. No Substitutions.

2.19 KEY SYSTEMS:

- A. Locks: 3 keys for each lock
- B. All keys to be nickel silver.
- C. Cylinders shall be 7 pin interchangeable core. Facility locksmith shall determine keyway of cylinders.
- D. Construction cores shall be supplied for construction phase keying. Contractor shall provide one new core for each lock to the Owner 60 calendar days prior to scheduled initial punchlist date. Permanent master keyed cores are to be installed by the Owner to replace construction cores. The construction core shall be returned to the supplier.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acceptable key system manufacturer is Best Access Systems. No Substitutions.

2.20 SURFACE BOLTS

- A. Surface Bolts: BHMA A156.16.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Burns Manufacturing Incorporated.
 - b. Don-Jo Mfg., Inc.
 - c. Door Controls International, Inc.
 - d. IVES Hardware; an Ingersoll-Rand company.
 - e. Trimco.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.

2.21 MANUAL FLUSH BOLTS

- A. Manual Flush Bolts: BHMA A156.16; minimum **3/4-inch** (19-mm) throw; designed for mortising into door edge.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.
 - b. Burns Manufacturing Incorporated.
 - c. Don-Jo Mfg., Inc.
 - d. Door Controls International, Inc.
 - e. Hiawatha, Inc.
 - f. IVES Hardware; an Ingersoll-Rand company.
 - g. Trimco.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.

2.22 AUTOMATIC AND SELF-LATCHING FLUSH BOLTS

- A. Automatic and Self-Latching Flush Bolts: BHMA A156.16; minimum **3/4-inch** (19-mm) throw; designed for mortising into door edge.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cal-Royal Products, Inc.
 - b. Door Controls International, Inc.
 - c. IVES Hardware; an Ingersoll-Rand company.
 - d. Trimco.
 - e. **<Insert manufacturer's name>**.
 - f. or approved equal.

2.23 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
 1. No Master Key System: Only change keys operate cylinder.
 2. Master Key System: Change keys and a master key operate cylinders.
 3. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.
 4. Great-Grand Master Key System: Change keys, a master key, a grand master key, and a great-grand master key operate cylinders.
 5. Existing System:
 - a. Master key or grand master key locks to Owner's existing system.
 - b. Re-key Owner's existing master key system into new keying system.
 6. Keyed Alike: Key all cylinders to same change key.
 7. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: **["DO NOT DUPLICATE."] [Information to be furnished by**

Owner.]

8. Quantity: In addition to one extra key blank for each lock, provide the following:
 - a. Cylinder Change Keys: Three.
 - b. Master Keys: Five.
 - c. Grand Master Keys: Five.
 - d. Great-Grand Master Keys: Five.

2.24 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; air leakage not to exceed **0.50 cfm per foot** (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies.
 - b. M-D Building Products, Inc.
 - c. National Guard Products.
 - d. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
 - e. Reese Enterprises, Inc.
 - f. Sealeze; a unit of Jason Incorporated.
 - g. Zero International.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.

2.25 METAL PROTECTIVE TRIM UNITS

- A. Metal Protective Trim Units: BHMA A156.6; fabricated from **0.050-inch-** (1.3-mm-) thick **[aluminum] [brass] [bronze] [stainless steel]**; with manufacturer's standard machine or self-tapping screw fasteners.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Baldwin Hardware Corporation.
 - b. Burns Manufacturing Incorporated.
 - c. Don-Jo Mfg., Inc.
 - d. Hiawatha, Inc.
 - e. IPC Door and Wall Protection Systems, Inc.; Div. of InPro Corporation.
 - f. IVES Hardware; an Ingersoll-Rand company.
 - g. Pawling Corporation.
 - h. Rockwood Manufacturing Company.
 - i. Trimco.
 - j. **<Insert manufacturer's name>**.

- k. or approved equal.

2.26 PLASTIC PROTECTION PLATES

- A. Plastic Protection Plates: BHMA A156.6; fabricated with four sides beveled; **[plastic laminate; 1/8 inch (3.2 mm) thick; NEMA LD 3, Grade HGS] [rigid plastic; 0.060-inch- (1.5-mm-) thick, PVC or acrylic-modified vinyl plastic] [acrylic; 1/8 inch (3.2 mm) thick].**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Burns Manufacturing Incorporated.
 - c. Don-Jo Mfg., Inc.
 - d. Hiawatha, Inc.
 - e. IPC Door and Wall Protection Systems, Inc.; Div. of InPro Corporation.
 - f. Korogard Wall Protection Systems; Div. of RJF International Corporation.
 - g. Pawling Corporation.
 - h. Rockwood Manufacturing Company.
 - i. Tepromark International, Inc.
 - j. Trimco.
 - k. **<Insert manufacturer's name>**.
 - l. or approved equal.

2.27 AUXILIARY DOOR HARDWARE

- A. Auxiliary Hardware: BHMA A156.16.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Baldwin Hardware Corporation.
 - b. Cal-Royal Products, Inc.
 - c. Don-Jo Mfg., Inc.
 - d. Hager Companies.
 - e. Rockwood Manufacturing Company.
 - f. Stanley Commercial Hardware; Div. of The Stanley Works.
 - g. Trimco.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.

2.28 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by DEN Project Manager.

1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 2. Fire-Rated Applications:
 - a. Wood or Machine Screws: For the following:
 - 1) Hinges mortised to doors or frames[; **use threaded-to-the-head wood screws for wood doors and frames**].
 - 2) Strike plates to frames.
 - 3) Closers to doors and frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Surface hinges to doors.
 - 2) Closers to doors and frames.
 - 3) Surface-mounted exit devices.
 3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
 4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
 5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.29 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Finishes for hardware shall be as follows with listed ANSI A156.18 designations:
 1. Interior hinges: 652.
 2. Exterior hinges: 626 or 630.
 3. Locks and latchsets: 630.

4. Exit devices: US32D.
 5. Door trim: 630.
 6. Closers: 689.
 7. Thresholds and weather-stripping: Manufacturers standard clear aluminum finish.
 8. Use of other finishes shall not be accepted.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.30 PRODUCT HANDLING

- A. The Hardware Supplier shall tag each item or package of items with identification related to final hardware schedule, and include basic installation instructions with each item or package.
- B. Packaging of hardware is responsibility of supplier. As material is received by Hardware Supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule. Two or more identical sets may be packed in same container.
- C. Inventory hardware jointly with representatives of Hardware Supplier and Hardware Installer until each is satisfied that count is correct.
- D. Deliver individually packaged hardware items at the proper times to the proper locations (shop or project site) for installation.
- E. This contractor to securely lock-up hardware delivered to the project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable, so that completion of the work will not be delayed by hardware losses, both before and after installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors, and frames according to ANSI/SDI A250.6.
- B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

3.3 INSTALLATION

- A. This Hardware Contractor to examine and approve in writing the substrate and conditions under which work is to be performed.
- B. Hardware Contractor shall have a representative of the hardware manufacturer check all hardware for adjustment and installation prior to the Contractor's request for final acceptance and notify in writing the DEN Project Manager for contractor correction.
- C. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- D. Drill and countersink units that are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- E. Mounting Heights: Mount door hardware units at heights [**indicated on Drawings**] [**to comply with the following**] unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
 - 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors, except as specifically indicated or required to comply with governing regulations, and except as may be otherwise directed by DEN Project Manager.
- F. Install each door hardware item to comply with manufacturer's written instructions and recommendations. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. NOTE: NO POWER DRIVEN TOOLS SHALL BE USED FOR INSTALLATION OF LOCKSETS AND HARDWARE ON DOORS. ALL HOLES SHALL BE PRE-DRILLED THE APPROPRIATE SIZE FOR THE FASTENERS.
 - 2. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 3. Drill and countersink units that are not factory prepared for anchorage fasteners.

Space fasteners and anchors according to industry standards.

- G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every **30 inches** (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
 - H. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every **30 inches** (750 mm) of door height greater than **90 inches** (2286 mm).
 - I. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as **[indicated in keying schedule] [directed by Owner]**.
 - 2. Furnish permanent cores to Owner for installation.
 - J. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
 - K. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, **[above accessible ceilings] [in equipment room]**. Verify location with DEN Project Manager.
 - 1. Configuration: Provide **[one power supply for each door opening] [least number of power supplies required to adequately serve doors]** with electrified door hardware.
 - L. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of grout. Seal with butyl-rubber or polyisobutylene mastic sealant complying with requirements specified in Section 079200 "Joint Sealants."
 - M. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
 - N. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 - O. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
 - P. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.
- 3.4 FIELD QUALITY CONTROL
- A. Independent Architectural Hardware Consultant: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements. Clean adjacent surfaces soiled by hardware installation.
 1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- C. Occupancy Adjustment: Approximately [**three (3)**] [**six (6)**] <Insert number> months after date of Substantial Completion, Installer's Architectural Hardware Consultant, accompanied by the representative of the latch and lock manufacturer, shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.
 1. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace hardware items that have deteriorated or failed due to faulty design, materials, or installation of hardware units. Prepare a written report of current and predictable problems in the performance of the hardware, and submit report to DEN Project Manager.

3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to assist Contractor and train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Section 017900 "Demonstration and Training."
1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

3.8 HARDWARE SCHEDULE LEGEND

- A. Hardware schedule legend:

	ITEM	MANUFACTURER	APPROVED SUBSTITUTES
1.	Hinges Electric Hinges	(HA) Hager Hinge	No substitution
2.	Locksets	(BE) Best Access Systems	No substitution
3.	Cylinders	(BE) Best Access Systems	No substitution
4.	Exit Devices	(VD) Von Duprin	No substitution
5.	Closers	(NO) Norton	No substitution
6.	Trim	(TR) Trimco	Ives, Hager
7.	Magnetic Locks	(LO) Locknetics	
8.	Thresholds, Weatherstripping	(PE) Pemko	Reese, National Guard, Hager
9.	Auto Flush Bolts	(DC) Door Controls	Trimco, Ives
10.	Photoelectric Sensors	(BA) Banner	No substitution
11.	Door Position Switches	(SE) Sentrol	No substitution
12.	Intellikey Access Control	(IL) Intellikey	No substitution

- B. Hardware Schedule Notes:

1. Hardware specified is for typical doors. Doors that do not meet the criteria contained within the schedule contact DEN Project Manager for additional hardware requirements.
2. Delayed Egress Doors to be supplied as follows:
 - a. All Hardware adjustments on the delayed egress doors are to be made by the Contractor, through a qualified technician. The final electrical connection to panic, magnetic lock, electric hinge, power supply/controller, reset switch, and horn will be by the Contractor in the presence of DEN Personnel. Coordinate with the electrical, security, and fire alarm representatives of DEN. Contractor to install all approved electrical wires,

- power supplies, low voltage wiring, conduit, and devices.
- b. System must be U. L. listed and be approved by Denver Code Department, specifically for this project.
- c. Power supply for system shall be U. L. approved as a power supply.
- d. System will not have manual reset at door. Reset is at Central Security.
- e. System shall conform to current building code section "Special Egress Control Devices."
- f. Doorframes shall be constructed to accept any special construction of the electric hinges, and electric eye recessed in the frame and magnetic holding device where applicable. Electric boxes or raceways need to be provided on or in the frame to accommodate these devices.

3.9 DOOR HARDWARE SCHEDULE

Door Hardware Set No. <Insert number>

Locations:<Insert type of door or door numbers>; each to have the following:

Qty.	Item	Manufacturer	Product	Finish
<#>	<Insert item>.	<Insert manufacturer>.	<Insert product>.	<Insert finish>.
<#>	<Insert item>.	<Insert manufacturer>.	<Insert product>.	<Insert finish>.
<#>	<Insert item>.	<Insert manufacturer>.	<Insert product>.	<Insert finish>.
<#>	<Insert item>.	<Insert manufacturer>.	<Insert product>.	<Insert finish>.
<#>	<Insert item>.	<Insert manufacturer>.	<Insert product>.	<Insert finish>.
<#>	<Insert item>.	<Insert manufacturer>.	<Insert product>.	<Insert finish>.
<#>	<Insert item>.	<Insert manufacturer>.	<Insert product>.	<Insert finish>.
<#>	<Insert item>.	<Insert manufacturer>.	<Insert product>.	<Insert finish>.
<#>	<Insert item>.	<Insert manufacturer>.	<Insert product>.	<Insert finish>.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 087100

SECTION 087113 - AUTOMATIC DOOR OPERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Power door operators for swinging doors.
2. Low-energy door operators for swinging doors.
3. Power-assist door operators for swinging doors.
4. Guide rails.

B. Related Requirements:

1. **[Section 033000 "Cast-in-Place Concrete"] [Section 033053 "Miscellaneous Cast-in-Place Concrete"]** for installing recessed metal frames for control mats in concrete.
2. Section 084229.33 "Swinging Automatic Entrances" for swinging doors and frames packaged with automatic door operators.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. AAADM: American Association of Automatic Door Manufacturers.
- B. Activation Device: A control that, when actuated, sends an electrical signal to the door operator to open the door.
- C. Double-Egress (Doors): A pair of doors that simultaneously swing with the two doors moving in opposite directions with no mullion between them.
- D. Double-Swing (Doors): A pair of doors that swing with the two doors moving in opposite directions with a mullion between them; each door functioning as a single-swing door.
- E. Safety Device: A control that, to avoid injury, prevents a door from opening or closing.

- F. For automatic door terminology, see [**BHMA A156.10**] [and] [**BHMA A156.19**] for definitions of terms.

1.4 COORDINATION

- A. Coordinate sizes and locations of recesses in concrete floors for recessed control mats that control automatic door operators. Concrete, reinforcement, and formwork requirements are specified elsewhere.
- B. Templates: Distribute for doors, frames, and other work specified to be factory prepared and reinforced for installing automatic door operators.
- C. Coordinate hardware for doors with operators to ensure proper size, thickness, hand, function, and finish.
- D. Electrical System Roughing-in: Coordinate layout and installation of automatic door operators with connections to power supplies[**and access-control system**].
- E. Pneumatic System Roughing-in: Coordinate layout and installation of automatic door operators and power units with compressed-air piping.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at [**Project site**] [**location and time as determined by DEN Project Manager**]<Insert location>.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic door operators.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 3. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For automatic door operators.
 - 1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
 - 2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Indicate locations of activation and safety devices.
 - 4. Include diagrams for power, signal, and control wiring.
 - 5. Include plans, elevations, sections, and attachment details for guide rails.
- C. Samples: For each exposed product and for each color and texture specified, [**manufacturer's standard size**] <Insert dimensions>.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For [Installer] [Certified Inspector].
- B. Product Certificates: For each type of automatic door operator. [~~For each operator for fire-rated door assemblies, certify that operator is listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for use on types and sizes of labeled fire doors required.~~]
- C. Field quality-control reports.
- D. Sample Warranties: For manufacturer's special warranties.

1.8 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For automatic door operators, safety devices, and control systems, to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation and maintenance of units required for this Project[**and who employs a Certified Inspector**].
 - 1. Maintenance Proximity: Not more than [**two (2)**] <Insert number> hours' normal travel time from Installer's place of business to Project site.
- B. Certified Inspector Qualifications: Certified by AAADM.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of automatic door operators that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Faulty or sporadic operation of automatic door operator, including controls.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering or use.
 - 2. Warranty Period: Minimum [**two (2)**] <Insert number> years from date of Substantial Completion.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. [Besam Entrance Solutions](#); Subsidiary of ASSA ABLOY Entrance Systems.
2. [Door Motion Technologies, Inc.](#)
3. [DORMA Architectural Hardware; Div. of DORMA Group North America.](#)
4. [DORMA Automatics; Div. of DORMA Group North America.](#)
5. [Horton Automatics; a division of Overhead Door Corporation.](#)
6. [Hunter Automatics Inc.](#)
7. [LCN Closers; an Ingersoll-Rand company.](#)
8. [Nabco Entrances Inc.](#)
9. [record-usa.](#)
10. [SARGENT Manufacturing Company; an ASSA ABLOY Group company.](#)
11. [Stanley Access Technologies, LLC; Div. of Stanley Security Solutions.](#)
12. **<Insert manufacturer's name>.**
13. or approved equal.

- B. Source Limitations: Obtain automatic door operators, including activation and safety devices, from **[single source from single manufacturer.] [same manufacturer as for hardware in Section 087100 "Door Hardware."]** **[same manufacturer as for hardware in Section 087111 "Door Hardware (Descriptive Specification)."]**

2.2 AUTOMATIC DOOR OPERATORS, GENERAL

- A. General: Provide operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated; and according to UL 325. Coordinate operator mechanisms with door operation, hinges, and activation and safety devices.

1. Emergency Breakaway: Where indicated for center-pivoted doors, provide emergency breakaway feature for reverse swing of doors. Equip system to discontinue power to automatic door operator when door is in emergency breakaway position, to return door to closed position after breakaway, and to automatically reset.

2. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.
 3. Wind Load: Provide door operators on exterior doors that will open and close doors and maintain them in fully closed position when subjected to wind load of **<Insert wind load>**.
- B. Electromechanical Operating System: Self-contained unit powered by permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor, connections for power and activation- and safety-device wiring, and manual operation including spring closing when power is off.
- C. Electrohydraulic Operating System: Self-contained, low-pressure unit; with separate cylinders for power and checking, connections for power and activation- and safety-device wiring, and manual operation including spring closing when power is off.
- D. Pneumatic Operating System: Pneumatic operator, air opened and spring closed; with checking in both cycles and manual operation when power is off.
1. Power Unit: Control box and compressor unit, complete with tank, compressor, air line to operator, motor, regulator, safety valve, pressure cutoff switch, and automatic air-line filter drain.
 2. Power Unit: Remote-control box powered by compressed-air system specified in Section 221513 "General-Service Compressed-Air Piping" and Section 221519 "General-Service Packaged Air Compressors and Receivers."
- E. Hinges: See [**Section 087100 "Door Hardware"**] [**Section 087111 "Door Hardware (Descriptive Specification)"**] for hinge type for each door that door operator shall accommodate.
- F. Housing for Overhead Concealed Operators: Fabricated from minimum **0.125-inch-** (3.2-mm-) thick, extruded or formed aluminum and extending full width of door opening including door jambs to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.
- G. Cover for Surface-Mounted Operators: Fabricated from **0.125-inch-** (3.2-mm-) thick, extruded or formed aluminum[; **manufacturer's standard width**] [; **continuous over full width of operator-controlled door opening**] [; **continuous over full width of door opening including door jambs**]; with enclosed end caps, provision for maintenance access, and fasteners concealed when door is in closed position.
- H. Brackets and Reinforcements: Fabricated from aluminum with nonstaining, nonferrous shims for aligning system components.
- I. Fire-Door Package: Consisting of UL-listed latch mechanism, power-reset box, and caution signage for fire-rated doors. Latch mechanism shall allow door to swing free during automatic operation; when fire is detected, latch actuator shall cause exit hardware to latch when door closes. Provide latch actuators with fail-secure design.

- J. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 POWER DOOR OPERATORS

- A. Standard: BHMA A156.10.
- B. Performance Requirements:
1. Opening Force:
 - a. Power-Operated Doors: Not more than **50 lbf (222 N)** required to manually set door in motion if power fails; not more than **15 lbf (67 N)** required to open door to minimum required width.
 - b. Power-Operated Swinging Doors: Not more than **30 lbf (133 N)** required to manually open door if power fails.
 - c. Breakaway Device for Power-Operated Doors: Not more than **50 lbf (222 N)** required for breakaway door or panel to open.
 2. Entrapment-Prevention Force: Not more than **40 lbf (178 N)** required to prevent stopped door in the last 10 degrees of opening from moving in the direction of opening; not more than **30 lbf (133 N)** required to prevent stopped door from moving in direction of closing.
- C. Configuration: Operator to control [**single swinging door**] [**pair of swinging doors**].
1. Traffic Pattern: [**One way**] [**Two way**] [**Double swing**] [**Double egress**].
 2. Operator Mounting: [**Surface**] [**Overhead concealed**].
- D. Operation: Power opening and[**power-assisted**] spring closing. Provide time delay for door to remain open before initiating closing cycle as required by BHMA A156.10.
- E. Operating System: [**Electromechanical**] [**Electrohydraulic**] [**Pneumatic**].
- F. Microprocessor Control Unit: Solid-state controller.
- G. Features:
1. Adjustable [**opening**] [**and**] [**closing**] speed.
 2. Adjustable [**opening**] [**and**] [**closing**] force.
 3. Adjustable backcheck.
 4. Adjustable hold-open time from zero to 30 seconds.
 5. Adjustable time delay.
 6. Adjustable acceleration.
 7. Adjustable limit switch.
 8. Obstruction recycle.
 9. Automatic door re-open if stopped while closing.
 10. On-off/hold-open switch to control electric power to operator[; **key operated**].
 11. **<Insert feature>**.

- H. Controls: Activation and safety devices [**as indicated on Drawings and**] according to BHMA standards.
1. Activation Device: Motion sensor mounted on ingress side of door header to detect pedestrians in activating zone and to open door.
 2. Activation Device: Control mat installed on ingress side of door to detect pedestrians in activating zone and to open door.
 3. Activation Device: [**Push-plate switch**] [**Push-button switch**] [**Key switch**] [**on each side of door**] to activate door operator.
 4. Safety Device: Presence sensor mounted on [**door header**] [**horizontal door muntin**] [**guide rail**] to detect pedestrians in presence zone and to prevent door from closing.
 5. Safety Device: One photoelectric beam mounted in guide rails to detect pedestrians in presence zone and to prevent door from closing.
 6. Safety Device: Control mat(s) installed on egress side of door to detect pedestrians in presence and safety zones and to prevent door from closing.
- I. Exposed Finish: [**Class I, clear anodic finish**] [**Class II, clear anodic finish**] [**Class I, color anodic finish**] [**Class II, color anodic finish**] [**Baked-enamel or powder-coat finish**] [**Metal cladding**] [**Finish matching door and frame**] [**Finish matching door hardware**] <Insert finish>.
1. Color: [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**] <Insert color>.
 2. Metal Cladding: [**No. 4, directional-satin-finish stainless steel**] [**No. 8, mirrorlike-reflective, nondirectional-polish-finish stainless steel**] [**Satin brass**] [**Polished brass**] [**Satin bronze**] [**Polished bronze**] <Insert finish>.

2.4 LOW-ENERGY DOOR OPERATORS

- A. Standard: BHMA A156.19.
- B. Performance Requirements:
1. Opening Force if Power Fails: Not more than **15 lbf (67 N)** required to release latch if provided, not more than **30 lbf (133 N)** required to manually set door in motion, and not more than **15 lbf (67 N)** required to fully open door.
 2. Entrapment-Prevention Force: Not more than **15 lbf (67 N)** required to prevent stopped door from closing or opening.
- C. Configuration: Operator to control single swinging door.
1. Traffic Pattern: [**One**] [**Two**] way.
 2. Operator Mounting: [**Surface**] [**Overhead concealed**].
- D. Configuration: Operator to control pair of swinging doors.

1. Traffic Pattern: [**One way**] [**Two way**] [**Double egress**] [**Double swing**].
 2. Mounting: [**Surface**] [**Overhead concealed**].
- E. Operation: Power opening and[**power-assisted**] spring closing. Provide time delay for door to remain open before initiating closing cycle as required by BHMA A156.19. When not in automatic mode, door operator shall function as manual door closer, with or without electrical power.
- F. Operating System: [**Electromechanical**] [**Electrohydraulic**] [**Pneumatic**].
- G. Microprocessor Control Unit: Solid-state controller.
- H. Features:
1. Adjustable [**opening**] [**and**] [**closing**] speed.
 2. Adjustable [**opening**] [**and**] [**closing**] force.
 3. Adjustable backcheck.
 4. Adjustable hold-open time from zero to 30 seconds.
 5. Adjustable time delay.
 6. Adjustable acceleration.
 7. Obstruction recycle.
 8. On-off/hold-open switch to control electric power to operator[; **key operated**].
 9. <Insert feature>.
- I. Activation Device: [**Push-plate switch**] [**Push-button switch**] [**Key switch**] [**on each side of door**] to activate door operator.
- J. Exposed Finish: [**Class I, clear anodic finish**] [**Class II, clear anodic finish**] [**Class I, color anodic finish**] [**Class II, color anodic finish**] [**Baked-enamel or powder-coat finish**] [**Metal cladding**] [**Finish matching door and frame**] [**Finish matching door hardware**] <Insert finish>.
1. Color: [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**] <Insert color>.
 2. Metal Cladding: [**No. 4, directional-satin-finish stainless steel**] [**No. 8, mirrorlike-reflective, nondirectional-polish-finish stainless steel**] [**Satin brass**] [**Polished brass**] [**Satin bronze**] [**Polished bronze**] <Insert finish>.
- 2.5 POWER-ASSIST DOOR OPERATORS
- A. Standard: BHMA A156.19.
- B. Performance Requirements:
1. Opening Force:
 - a. Opening Force if Power Fails: Not more than **15 lbf (67 N)** required to release latch if provided, not more than **30 lbf (133 N)** required to manually

- set door in motion, and not more than 15 lbf (67 N) required to fully open door.
- b. Accessible Interior Doors: Not more than 5 lbf (22 N) to push or pull door to fully open position.
2. Entrapment-Prevention Force: Not more than 15 lbf (67 N) required to prevent stopped door from closing or opening.
- C. Configuration: Operator to control single swinging door.
1. Traffic Pattern: **[One]** **[Two]** way.
 2. Operator Mounting: **[Surface]** **[Overhead concealed]**.
- D. Configuration: Operator to control pair of swinging doors.
1. Traffic Pattern: **[One way]** **[Two way]** **[Double egress]** **[Double swing]**.
 2. Mounting: **[Surface]** **[Overhead concealed]**.
- E. Operation: Power-assisted opening that reduces the force to open door and **[power-assisted]** spring closing. Pushing or pulling on door activates operator. Provide time delay for door to remain open before initiating closing cycle as required by BHMA A156.19. When not in automatic mode, door operator shall function as manual door closer, with or without electrical power.
- F. Operating System: **[Electromechanical]** **[Electrohydraulic]** **[Pneumatic]**.
- G. Microprocessor Control Unit: Solid-state controller.
- H. Features:
1. Adjustable **[opening]** **[and]** **[closing]** speed.
 2. Adjustable **[opening]** **[and]** **[closing]** force.
 3. Adjustable backcheck.
 4. Adjustable hold-open time from zero to 30 seconds.
 5. Adjustable time delay.
 6. Adjustable acceleration.
 7. Obstruction recycle.
 8. On-off/hold-open switch to control electric power to operator[; **key operated**].
 9. **<Insert feature>**.
- I. Exposed Finish: **[Class I, clear anodic finish]** **[Class II, clear anodic finish]** **[Class I, color anodic finish]** **[Class II, color anodic finish]** **[Baked-enamel or powder-coat finish]** **[Metal cladding]** **[Finish matching door and frame]** **[Finish matching door hardware]** **<Insert finish>**.
1. Color: **[Light bronze]** **[Medium bronze]** **[Dark bronze]** **[Black]** **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from full range of industry colors and color densities]** **<Insert color>**.

2. Metal Cladding: **[No. 4, directional-satin-finish stainless steel] [No. 8, mirrorlike-reflective, nondirectional-polish-finish stainless steel] [Satin brass] [Polished brass] [Satin bronze] [Polished bronze] <Insert finish>**.

2.6 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 1. Extrusions: **ASTM B 221** (ASTM B 221M).
 2. Sheet: **ASTM B 209** (ASTM B 209M).
- B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, **[Type 304] <Insert alloy type>**, stretcher-leveled standard of flatness, in manufacturer's standard thickness.
- C. Brass Sheet: ASTM B 36/B 36M, Alloy UNS No. C26000 (cartridge brass, 70 percent copper), in manufacturer's standard thickness.
- D. Bronze Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper) or Alloy UNS No. C23000 (red brass, 85 percent copper), in manufacturer's standard thickness.
- E. Expanded Aluminum Mesh: **[Expanded] [Expanded and flattened]** aluminum sheet according to the geometry of ASTM F 1267.
- F. Polycarbonate Sheet: ASTM C 1349, Appendix X1, Type II, coated, mar-resistant, UV-stabilized polycarbonate with coating on both surfaces.
- G. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.7 CONTROLS

- A. General: Provide controls, including activation and safety devices, according to BHMA standards; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated. Coordinate activation and safety devices with door operation and door operator mechanisms.
- B. Motion Sensors: Self-contained, K-band-frequency, microwave-scanner units; fully enclosed in plastic housing; adjustable to provide detection field sizes and functions required by BHMA A156.10.
 1. Provide capability for switching between bidirectional and unidirectional detection.
 2. For one-way traffic, sensor on egress side shall not be active when doors are fully closed.

- C. Presence Sensors: Self-contained, active-infrared scanner units; adjustable to provide detection field sizes and functions required by BHMA A156.10. Sensors shall remain active at all times.
- D. Photoelectric Beams: Pulsed infrared, sender-receiver assembly for recessed mounting. Beams shall not be active when doors are fully closed.
- E. Control Mats: **1/2-inch- (13-mm-)** thick, synthetic-rubber or flexible-plastic mat in safety-ribbed surface pattern, with extruded-aluminum frame; with pressure switches for low-voltage control wiring; and according to performance requirements in BHMA A156.10.
1. Frame: [**Recessed to fit flush with floor, with concealed anchors**] [**Surface mounted, with tapered safety edge**].
 2. Size: As indicated, but not smaller than required by BHMA A156.10 including Appendix A.
 3. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project manager from full range of industry colors and color densities**] <Insert color>.
- F. Push-Plate Switch: Momentary-contact door control switch with flat push-plate actuator[**with contrasting-colored, engraved message**].
1. Configuration: [**Round**] [**Square**] push plate with **4-by-4-inch** (100-by-100-mm) junction box.
 - a. Mounting: [**As indicated on Drawings**] [**Recess mounted, semiflush in wall**] [**Surface mounted on wall**].
 2. Configuration: Rectangular push plate with **2-by-4-inch** (50-by-100-mm) junction box.
 - a. Mounting: [**As indicated on Drawings**] [**Recess mounted, semiflush in wall**] [**Recess mounted in doorjamb**] [**Surface mounted on wall**] [**Surface mounted on post**] [**Surface mounted on guide rail**].
 3. Push-Plate Material: [**Stainless steel**] [**Plastic**] as selected by DEN Project Manager from manufacturer's full range.
 4. Message: [**Plain face with no message.**] [**"Push to Open."**] [**International symbol of accessibility.**] [**International symbol of accessibility and "Push to Open."**]
- G. Push-Button Switch: Momentary-contact door control switch with one red-button actuator; enclosed in nominal [**2-by-4-inch** (50-by-100-mm)] [**4-by-4-inch** (100-by-100-mm)] junction box.
1. Provide faceplate engraved with "Press to Open" text[**and with international symbol of accessibility**] in contrasting color.
 2. Provide blue plastic cover engraved with "Press Button to Open" in white text and with international symbol of accessibility.

3. Mounting: **[As indicated on Drawings]** **[Surface mounted on wall]** **[Surface mounted on post]** **[Surface mounted on guide rail]** **[Recess mounted in wall]**.
 4. Faceplate Material: **[Stainless steel]** **[Painted metal]** as selected by DEN Project Manager from manufacturer's full range.
- H. Key Switch: Recess-mounted, door control switch with key-controlled actuator; enclosed in **2-by-4-inch (50-by-100-mm)** junction box. Provide faceplate engraved with text indicating switch functions.
1. Faceplate Material: **[Stainless steel]** **[Painted metal]** as selected by DEN Project Manager from manufacturer's full range.
 2. Functions: **[On-off, momentary contact]** **[On-off, maintained contact]** **[Two-way automatic, hold open, one-way exit, and off]** **[Two-way automatic, hold open, one-way exit, off, full open, and partial open]**.
 3. Mounting: **[As indicated on Drawings]** **[Recess mounted, semiflush in wall]** **[Recess mounted in door jamb]** **[Surface mounted on wall]** **[Surface mounted on post]**.
- I. Wireless or Remote Radio-Control Switch: Radio-control system consisting of header-mounted receiver and **[wall-mounted]** **[hand-held, battery-operated]** transmitter switch.
1. Wall-Mounted Transmitter Switch: One red-button, momentary-contact actuator enclosed in **4-by-4-inch (100-by-100-mm)** junction box. Provide blue plastic cover engraved with "Press Button to Open" in white text and with international symbol of accessibility.
- J. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

2.8 FABRICATION

- A. Factory fabricate automatic door operators to comply with indicated standards.
- B. Form aluminum shapes before finishing.
- C. Fabricate exterior components to drain condensation and water passing joints within operator enclosure to the exterior.
- D. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match operator.
- E. Provide metal cladding, completely covering visible surfaces before shipment to Project site. Fabricate cladding with concealed fasteners and connection devices, with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion, and with allowance for thermal expansion at exterior doors.

2.9 ACCESSORIES

- A. Signage: As required by cited BHMA standard for type of door and its operation.
1. Application Process: **[Decals] [Silk-screened] [Operator manufacturer's standard process] <Insert requirement>**.
 2. Provide sign materials with instructions for field application when operators are installed.
- B. Guide Rails: **[Anodized aluminum] [Baked-enamel or powder-coated aluminum] [Stainless steel]**, fabricated from **[bars] [or] [tubing]**, minimum **30 inches (762 mm)** high, and finished to match doors unless otherwise indicated; positioned and projecting from face of door jamb for distance as indicated, but not less than **[that required by BHMA A156.10 for type of door and direction of travel] <Insert requirement>**; with filler panel.
1. Filler Panel: **[Expanded aluminum mesh] [Clear polycarbonate sheet] [Colored polycarbonate sheet] <Insert material>**.
 - a. Orient expanded aluminum mesh with long dimension of diamonds **[parallel] [perpendicular]** to top rail.
 - b. Color: **[Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 2. Provide intermediate guide rail suitable for supporting photoelectric beams.
 3. Mounting: **[As indicated on Drawings] [Jamb and floor] [Floor, freestanding]**.
 4. Aluminum Finish: **[Class I, clear anodic finish] [Class II, clear anodic finish] [Class I, color anodic finish] [Class II, color anodic finish] [Baked-enamel or powder-coat finish] [Finish matching door and frame] <Insert finish>**.
 - a. Color: **[Light bronze] [Medium bronze] [Dark bronze] [Black] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors and color densities] <Insert color>**.
 5. Stainless-Steel Finish: **[No. 4, directional-satin-finish stainless steel] [Finish matching door and frame] <Insert finish>**.
- C. Guide Rails: See **[Section 055213 "Pipe and Tube Railings."]** **[Section 057300 "Decorative Metal Railings."]**

2.10 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping.
- B. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.

- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

2.11 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
- B. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils (0.04 mm)**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, door and frame preparation and reinforcements, and other conditions affecting performance of automatic door operators.
- B. Examine roughing-in for electrical systems to verify actual locations of power connections before automatic door operator installation.
- C. Examine roughing-in for compressed-air piping systems to verify actual locations of piping connections before automatic door operator installation.
- D. Verify that full-height finger guards are installed at each door with pivot hinges where door has a clearance at hinge side greater than **1/4 inch (6 mm)** and less than **3/4 inch (19 mm)** with door in any position.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install automatic door operators according to manufacturer's written instructions and cited BHMA standard for type of door operation and direction of pedestrian travel, including signage, controls, wiring, remote power units if any, and connection to building's power supply.
 - 1. Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion.
 - 2. Install operators true in alignment with established lines and door geometry without warp or rack. Anchor securely in place.

- B. Controls: Install activation and safety devices according to manufacturer's written instructions and cited BHMA standard for operator type and direction of pedestrian travel. Connect control wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Access-Control System: Connect operators to access-control system as specified in Section 281300 "Access Control."
- D. Signage: Apply on both sides of each door as required by cited BHMA standard for type of door operator and direction of pedestrian travel.
- E. Guide Rails: Install according to BHMA A156.10, including Appendix A and manufacturer's written instructions unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

- A. Certified Inspector: **[Owner will engage] [Engage]** a Certified Inspector to test and inspect components, assemblies, and installations, including connections.
- B. Perform the following tests and inspections[**with the assistance of a factory-authorized service representative**]:
 - 1. Test and inspect each automatic door operator installation, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.
- C. Automatic door operators will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust automatic door operators to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.
 - 1. Adjust operators on exterior doors for weathertight closure.
- B. After completing installation of automatic door operators, inspect exposed finishes on doors and operators. Repair damaged finish to match original finish.
- C. Readjust automatic door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).
- D. Occupancy Adjustment: When requested within **[12] <Insert number>** months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to **[two] <Insert number>** visits to Project during other-than-normal occupancy hours for this purpose.

3.5 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include [12] months' full maintenance by skilled employees of automatic door operator Installer. Include [monthly] [quarterly] preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
1. Engage a Certified Inspector to perform safety inspection after each adjustment or repair and at end of maintenance period. Furnish completed inspection reports to Owner.
 2. Perform maintenance, including emergency callback service, during normal working hours.
 3. Include 24-hour-per-day, 7-day-per-week, emergency callback service.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic door operators.
1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 087113

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Windows.
 - 2. Doors.
 - 3. Glazed curtain walls.
 - 4. Storefront framing.
 - 5. Glazed entrances.
 - 6. Sloped glazing.
 - 7. Skylights.
 - 8. Interior borrowed lites.
- B. Related Sections:
 - 1. Section 057300 "Decorative Metal Railings" for glass panels in railings.
 - 2. Section 084126 "All-Glass Entrances and Storefronts."
 - 3. Section 084229.13 "Folding Automatic Entrances."
 - 4. Section 084229.23 "Sliding Automatic Entrances."
 - 5. Section 084229.33 "Swinging Automatic Entrances."
 - 6. Section 084233 "Revolving Door Entrances."
 - 7. Section 084423 "Structural-Sealant-Glazed Curtain Walls" for glazing sealants.
 - 8. Section 088113 "Decorative Glass Glazing."
 - 9. Section 088300 "Mirrors."
 - 10. Section 088853 "Security Glazing" for glazing units resistant to **[ballistic attacks]** **[blunt- and sharp-tool attacks]** **[chemical threats]** **[windborne debris]** **[and]** **[airblasts]**.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Design glass, including comprehensive engineering analysis according to **[ASTM E 1300] [ICC's 2003 International Building Code]** by a qualified professional engineer, using the following design criteria:
 - 1. Design Wind Pressures: As indicated on Drawings.
 - 2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
 - a. Wind Design Data: As indicated on Drawings.
 - b. Basic Wind Speed: **115 mph (50 m/s)** **<Insert value>**.
 - c. Importance Factor: **1.3 <Insert factor>**.
 - d. Exposure Category: **[D]**.
 - 3. Design Snow Loads: **<Insert design snow load> [As indicated on Drawings]**.
 - 4. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
 - 5. Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass to resist each of the following combinations of loads:
 - a. Outward design wind pressure minus the weight of the glass. Base design on glass type factors for short-duration load.
 - b. Inward design wind pressure plus the weight of the glass plus half of the design snow load. Base design on glass type factors for short-duration load.
 - c. Half of the inward design wind pressure plus the weight of the glass plus the design snow load. Base design on glass type factors for long-duration load.
 - 6. Glass Type Factors for Wired, Patterned, and Sandblasted Glass:
 - a. Short-Duration Glass Type Factor for Wired Glass: 0.5.

- b. Long-Duration Glass Type Factor for Wired Glass: 0.3.
 - c. Short-Duration Glass Type Factor for Patterned Glass: 1.0.
 - d. Long-Duration Glass Type Factor for Patterned Glass: 0.6.
 - e. Short-Duration Glass Type Factor for Sandblasted Glass: 0.5.
7. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
 8. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
 9. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.
 10. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
 2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
 3. Test no fewer than [eight] <Insert number> Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
 4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.6 ACTION SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
1. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For glazing sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For glazing sealants used inside the weatherproofing system, documentation indicating that they comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Glass Samples: For each type of **[glass product other than clear monolithic vision glass] [the following products]**; **12 inches** (300 mm) square.

1. Tinted glass.
2. Patterned glass.
3. Coated glass.
4. Wired glass.
5. Fire-resistive glazing products.
6. Laminated glass with colored interlayer.
7. Insulating glass.

D. Glazing Accessory Samples: For **[gaskets] [sealants] [and] [colored spacers]**, in **12-inch** (300-mm) lengths. **[Install sealant Samples between two strips of material representative in color of the adjoining framing system.]**

E. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

F. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For **[installers] [manufacturers of insulating-glass units with sputter-coated, low-e coatings] [glass testing agency] [and] [sealant testing agency]**.

B. Product Certificates: For glass and glazing products, from manufacturer.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for **[tinted glass] [coated glass] [insulating glass] [glazing sealants] [and] [glazing gaskets]**.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

D. Preconstruction adhesion and compatibility test report.

- E. Warranties: Sample of special warranties.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved[**and certified**] by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- E. Source Limitations for Glass: Obtain [**ultraclear float glass**] [**tinted float glass**] [**coated float glass**] [**laminated glass**] [**and**] [**insulating glass**] from single source from single manufacturer for each glass type.
- F. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
- G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. GANA Publications: [**GANA's "Laminated Glazing Reference Manual" and**] GANA's "Glazing Manual."
 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- H. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of [**the SGCC**] [**the SGCC or another certification agency acceptable to authorities having jurisdiction**] [**or**] [**the manufacturer**]. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- I. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in

fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F (250 deg C), and the fire-resistance rating in minutes.

- J. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- K. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Install glazing in mockups specified in [**Section 084113 "Aluminum-Framed Entrances and Storefronts"**] [**Section 085113 "Aluminum Windows"**] [**Section 084413 "Glazed Aluminum Curtain Walls"**] <Insert Section number>-<Insert Section title> to match glazing systems required for Project, including glazing methods.
 - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- L. Preinstallation Conference: Conduct conference at [**Project site**] [**location and time as determined by DEN Project Manager**]<Insert location>.
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review temporary protection requirements for glazing during and after installation.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F (4.4 deg C).

1.11 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: Minimum [10] <Insert number> years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: Minimum [Five] [10] <Insert number> years from date of Substantial Completion.

C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: Minimum [10] <Insert number> years from date of Substantial Completion.

1.12 CONSTRUCTION WASTE MANAGEMENT

A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

1. Minimum Glass Thickness for Exterior Lites: Not less than **[6.0] <Insert thickness designation>** mm.
 2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass[**as needed to comply with "Performance Requirements" Article**]. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass[**as needed to comply with "Performance Requirements" Article**]. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.
- C. Windborne-Debris-Impact Resistance: Provide exterior glazing that passes **[basic] [enhanced]**-protection testing requirements in ASTM E 1996 for **[Wind Zone 1] [Wind Zone 2] [Wind Zone 3] [Wind Zone 4]** when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on the Project and shall be installed in same manner as glazing indicated for use on the Project.
1. Large-Missile Test: For glazing located within **30 feet (9.1 m)** of grade.
 2. Small-Missile Test: For glazing located more than **30 feet (9.1 m)** above grade.
 3. Large-Missile Test: For all glazing, regardless of height above grade.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For monolithic-glass lites, properties are based on units with lites **[6.0 mm thick] [of thickness indicated]**.
 2. For laminated-glass lites, properties are based on products of construction indicated.
 3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as **Btu/sq. ft. x h x deg F (W/sq. m x K)**.
 5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Ultraclear Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I, complying with other requirements specified and with visible light transmission not less than 91 percent[**and solar heat gain coefficient not less than 0.87**].

1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. [AFG Industries, Inc.](#); Krystal Klear.
 - b. [Guardian Industries Corp.](#); Ultrawhite.
 - c. [Pilkington North America](#); Optiwhite.
 - d. [PPG Industries, Inc.](#); Starphire.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.

- C. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 2. For uncoated glass, comply with requirements for Condition A.
 3. For coated vision glass, comply with requirements for Condition C (other coated glass).

- D. Pyrolytic-Coated, Self-Cleaning, Low-Maintenance Glass: Clear float glass with a coating on first surface having both photocatalytic and hydrophilic properties that act to loosen dirt and to cause water to sheet evenly over the glass instead of beading.
 1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. [AFG Industries, Inc.: Spotless Ti.](#)
 - b. [Cardinal Glass Industries; LoE2 Plus.](#)
 - c. [Pilkington North America; Activ.](#)
 - d. [PPG Industries, Inc.; SunClean.](#)
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.

- E. Uncoated Tinted Float Glass: Class 2, complying with other requirements specified.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.
 2. Tint Color: **[Blue] [Blue-green] [Bronze] [Green] [Gray] <Insert color>**.
 3. Visible Light Transmittance: **<Insert value>** percent minimum.

- F. Polished Wired Glass: ASTM C 1036, Type II, Class 1 (clear), Form 1, Quality-Q6, complying with ANSI Z97.1, Class C.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.

2. Mesh: **[M1 (diamond)] [M2 (square)]**.
- G. Film-Faced Polished Wired Glass: ASTM C 1036, Type II, Class 1 (clear), Form 1, Quality-Q6 and complying with testing requirements in 16 CFR 1201 for Category II materials.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.
 2. Mesh: **[M1 (diamond)] [M2 (square)]**.
- H. Patterned Glass: ASTM C 1036, Type II, Class 1 (clear), Form 3; Quality-Q6, **[Finish F1 (patterned one side)] [Finish F2 (patterned both sides)]**, **[Pattern P1 (linear)] [Pattern P2 (geometric)] [Pattern P3 (random)] [Pattern P4 (special)]**.
1. Products: Subject to compliance with requirements, **[provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]**:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
- I. Tempered Patterned Glass: ASTM C 1048, Kind FT (fully tempered), Type II, Class 1 (clear), Form 3; Quality-Q6, **[Finish F1 (patterned one side)] [Finish F2 (patterned both sides)]**, **[Pattern P1 (linear)] [Pattern P2 (geometric)] [Pattern P3 (random)] [Pattern P4 (special)]**.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.
- J. Patterned Wired Glass: ASTM C 1036, Type II, Class 1 (clear), Form 2, Quality-Q6, **[Finish F1 (patterned one side)] [Finish F2 (patterned both sides)]**, Mesh M1 (diamond), **[Pattern P1 (linear)] [Pattern P2 (geometric)] [Pattern P3 (random)] [Pattern P4 (special)]**.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.
- K. Ceramic-Coated Vision Glass: Heat-treated float glass, Condition C; with ceramic enamel applied by silk-screened process; complying with Specification No. 95-1-31 in GANA's Tempering Division's "Engineering Standards Manual" and with other requirements specified.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
 - b. or approved equal.
 2. Glass: **[Clear float] [Ultraclear float] [Tinted float].**
 3. Tint Color: **[Blue] [Blue-green] [Bronze] [Green] [Gray] <Insert color>.**
 4. Ceramic Coating Color and Pattern: **[As selected by DEN Project Manager from manufacturer's full range] [Match] [Provide] <Insert one manufacturer's color and pattern designation if matching is required; otherwise, insert color and pattern designation for each product named above>.**
- L. Reflective-Coated Vision Glass: ASTM C 1376, coated by **[pyrolytic process] [vacuum deposition (sputter-coating) process]**, and complying with other requirements specified.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
 - b. or approved equal.
 2. Kind: Kind CV (coated vision glass)[, **except that Kind CO (coated overhead glass) may be used where the lower edge of the glass is more than 6 feet (1.8 m) above the adjacent floor level or cannot be approached closer than 10 feet (3.0 m).**]
 3. Coating Color: **[Gold] [Pewter] [Silver] <Insert color>.**
 4. Glass: **[Clear float] [Tinted float].**
 5. Tint Color: **[Blue] [Blue-green] [Bronze] [Green] [Gray] <Insert color>.**
 6. Visible Light Transmittance: **<Insert value>** percent minimum.
 7. Outdoor Visible Reflectance: **<Insert value>** percent maximum.
 8. Self-Cleaning, Low-Maintenance Coating: Pyrolytic coating on first surface.
- M. Ceramic-Coated Spandrel Glass: ASTM C 1048, Condition B, Type I, Quality-Q3, and complying with other requirements specified.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
 - b. or approved equal.
 2. Glass: **[Clear float] [Ultraclear float] [Tinted float].**
 3. Tint Color: **[Blue] [Blue-green] [Bronze] [Green] [Gray] <Insert color>.**
 4. Ceramic Coating Color: **[As selected by DEN Project Manager from manufacturer's full range] [Match] [Provide] <Insert one manufacturer's color designation if matching is required; otherwise, insert color designation for each product named above>.**

- N. Silicone-Coated Spandrel Glass: ASTM C 1048, Condition C, Type I, Quality-Q3, and complying with other requirements specified.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
 - b. or approved equal.
 2. Glass: **[Clear float] [Ultraclear float] [Tinted float].**
 3. Tint Color: **[Blue] [Blue-green] [Bronze] [Green] [Gray] <Insert color>.**
 4. Silicone Coating Color: **[As selected by DEN Project Manager from manufacturer's full range] [Match] [Provide] <Insert one manufacturer's color designation if matching is required; otherwise, insert color designation for each product named above>.**
- O. Reflective-Coated Spandrel Glass: ASTM C 1376, Kind CS; coated by **[pyrolytic process] [vacuum deposition (sputter-coating) process]**, and complying with other requirements specified.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
 - b. or approved equal.
 2. Coating Color: **[Gold] [Pewter] [Silver] <Insert color>.**
 3. Glass: **[Clear float] [Ultraclear float] [Tinted float].**
 4. Tint Color: **[Blue] [Blue-green] [Bronze] [Green] [Gray] <Insert color>.**
 5. Visible Light Transmittance: **<Insert value>** percent minimum.
 6. Outdoor Visible Reflectance: **<Insert value>** percent maximum.

2.3 LAMINATED GLASS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. **<Insert, in separate subparagraphs, manufacturer's name>.**
 2. or approved equal.
- B. Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
1. Construction: Laminate glass with **[polyvinyl butyral interlayer] [or] [cast-in-place and cured-transparent-resin interlayer]** to comply with interlayer manufacturer's written recommendations.
 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.

3. Interlayer Color: Clear unless otherwise indicated.
- C. Windborne-Debris-Impact-Resistant Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, with "Windborne-Debris-Impact Resistance" Paragraph in "Glass Products, General" Article, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
1. Construction: Laminate glass with[**one of**] the following to comply with interlayer manufacturer's written recommendations:
 - a. Polyvinyl butyral interlayer.
 - b. Polyvinyl butyral interlayers reinforced with polyethylene terephthalate film.
 - c. Ionoplast interlayer.
 - d. Cast-in-place and cured-transparent-resin interlayer.
 - e. Cast-in-place and cured-transparent-resin interlayer reinforced with polyethylene terephthalate film.
 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 3. Interlayer Color: Clear unless otherwise indicated.
- D. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Laminated-Glass Types" Article.

2.4 INSULATING GLASS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. **<Insert, in separate subparagraphs, manufacturer's name>.**
 2. or approved equal.
- B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
1. Sealing System: Dual seal, with [**manufacturer's standard**] [**polyisobutylene and polysulfide**] [**polyisobutylene and silicone**] [**polyisobutylene and hot-melt butyl**] [**polyisobutylene and polyurethane**] primary and secondary.
 2. Spacer: [**Manufacturer's standard spacer material and construction**] [**Aluminum with mill or clear anodic finish**] [**Aluminum with black, color anodic finish**] [**Aluminum with bronze, color anodic finish**] [**Aluminum with powdered metal paint finish in color selected by DEN Project Manager**] [**Galvanized steel**] [**Stainless steel**] [**Polypropylene covered stainless steel in color selected by DEN Project Manager**] [**Thermally broken aluminum**] [**Nonmetallic laminate**] [**Nonmetallic tube**] **<Insert material>.**
 3. Desiccant: Molecular sieve or silica gel, or blend of both.

- C. Glass: Comply with applicable requirements in "Glass Products" Article[**and in "Laminated Glass" Article**] as indicated by designations in "Insulating-Glass Types" Article[**and in "Insulating-Laminated-Glass Types" Article**].

2.5 FIRE-PROTECTION-RATED GLAZING

- A. Fire-Protection-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to [NFPA 252 for door assemblies] [and] [NFPA 257 for window assemblies].

- B. Monolithic Ceramic Glazing: Clear, ceramic flat glass; 3/16-inch (5-mm) nominal thickness.

1. **Products:** Subject to compliance with requirements, provide one of the following:

- a. Nippon Electric Glass Co., Ltd. (distributed by Technical Glass Products); **[Obscure FireLite] [Premium FireLite] [Standard FireLite]**.
- b. Safti First; SuperLite C/P.
- c. Schott North America, Inc.; **[Pyran Star] [Pyran Crystal]**.
- d. Vetrotech Saint-Gobain; SGG Keralite FR-R.
- e. **<Insert manufacturer's name; product name or designation>**.
- f. or approved equal.

- C. Film-Faced Ceramic Glazing: Clear, ceramic flat glass; 3/16-inch (5-mm) nominal thickness; faced on one surface with a clear glazing film; complying with testing requirements in 16 CFR 1201 for Category II materials.

1. **Products:** Subject to compliance with requirements, provide one of the following:

- a. Nippon Electric Glass Co., Ltd. (distributed by Technical Glass Products); FireLite NT.
- b. Safti First; SuperLite C/SP.
- c. Schott North America, Inc.; [Filmed Pyran Star] [Filmed Pyran Crystal].
- d. Vetrotech Saint-Gobain; SGG Keralite FR-F.
- e. **<Insert manufacturer's name; product name or designation>**.
- f. or approved equal.

- D. Laminated Ceramic Glazing: Laminated glass made from 2 plies of clear, ceramic flat glass; 5/16-inch (8-mm) total nominal thickness; complying with testing requirements in 16 CFR 1201 for Category II materials.

1. **Products:** Subject to compliance with requirements, provide one of the following:

- a. Nippon Electric Glass Co., Ltd. (distributed by Technical Glass Products); FireLite Plus.
- b. Schott North America, Inc.; Laminated Pyran Crystal.
- c. Vetrotech Saint-Gobain; SGG Keralite FR-L.
- d. **<Insert manufacturer's name; product name or designation>**.

- e. or approved equal.
- E. Fire-Protection-Rated Tempered Glass: [1/4-inch- (6.4-mm-)] [3/8-inch- (9.5-mm-)] [1/2-inch- (12.7-mm-)] thick, fire-protection-rated tempered glass, complying with testing requirements in 16 CFR 1201 for Category II materials.
1. **Products:** Subject to compliance with requirements, provide one of the following:
- [InterEdge, Inc., a subsidiary of AFG Industries, Inc.; PyroEdge-20.](#)
 - [Safti First; SuperLite20.](#)
 - [Vetrotech Saint-Gobain; SSG Pyroswiss.](#)
 - <Insert manufacturer's name; product name or designation>.
 - or approved equal.
- F. Fire-Protection-Rated Laminated Glass: 5/16-inch- (8-mm-) thick, fire-protection-rated laminated glass, complying with testing requirements in 16 CFR 1201 for Category II materials.
1. **Products:** Subject to compliance with requirements, provide one of the following:
- [Oldcastle Glass, Inc.;](#) Pyroguard.
 - <Insert manufacturer's name; product name or designation>.
 - or approved equal.
- G. Laminated Glass with Intumescent Interlayers: Laminated glass made from multiple plies of uncoated, clear float glass; with intumescent interlayers; complying with testing requirements in 16 CFR 1201 for Category II materials.
1. **Products:** Subject to compliance with requirements, **provide one of the following:**
- [InterEdge, Inc., a subsidiary of AFG Industries, Inc.; Pyrobel.](#)
 - [Pilkington Group Limited \(distributed by Technical Glass Products\); PyroStop.](#)
 - [Vetrotech Saint-Gobain; \[SGG Contraflam N2\] \[SGG Swissflam N2\].](#)
 - <Insert manufacturer's name; product name or designation>.
 - or approved equal.
- H. Gel-Filled, Double Glazing Units: Double glazing units made from two lites of uncoated, clear, fully tempered float glass; with a perimeter metal spacer separating lites and dual-edge seal enclosing a cavity filled with clear, fully transparent, heat-absorbing gel; complying with testing requirements in 16 CFR 1201 for Category II materials.
1. **Products:** Subject to compliance with requirements, **provide one of the following:**
- [Safti First;](#) SuperLite II.
 - <Insert manufacturer's name; product name or designation>.
 - or approved equal.

2.6 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from[**one of**] the following:
1. Neoprene complying with ASTM C 864.
 2. EPDM complying with ASTM C 864.
 3. Silicone complying with ASTM C 1115.
 4. Thermoplastic polyolefin rubber complying with ASTM C 1115.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned [**neoprene**] [**EPDM**] [**silicone**] [**or**] [**thermoplastic polyolefin rubber**] gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.
- C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.7 GLAZING SEALANTS

- A. General:
1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 3. Sealants used inside the weatherproofing system, shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 4. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 5. Colors of Exposed Glazing Sealants: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**].
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 790.
 - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
 - c. May National Associates, Inc.; Bondaflex Sil 290.
 - d. Pecora Corporation; 890.
 - e. Sika Corporation, Construction Products Division; SikaSil-C990.
 - f. Tremco Incorporated; Spectrem 1.
 - g. **<Insert manufacturer's name; product name or designation>.**
 - h. or approved equal.

 2. Applications: **<Describe types of glazing applications where this sealant is required>.**
- C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.
1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Omniseal 50.
 - b. Dow Corning Corporation; [756 SMS] [791] [795] [995].
 - c. GE Advanced Materials - Silicones; [SilGlaze II SCS2800] [SilPruf NB SCS9000] [SilPruf SCS2000] [UltraPruf II SCS2900].
 - d. May National Associates, Inc.; Bondaflex Sil 295.
 - e. Pecora Corporation; [864] [895] [898].
 - f. Polymeric Systems, Inc.; PSI-641.
 - g. Sika Corporation, Construction Products Division; SikaSil-C995.
 - h. Tremco Incorporated; [Spectrem 2] [Spectrem 3].
 - i. **<Insert manufacturer's name; product name or designation>.**
 - j. or approved equal.

 2. Applications: **<Describe types of glazing applications where this sealant is required>.**
- D. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 799.
 - b. GE Advanced Materials - Silicones; [UltraGlaze SSG4000] [UltraGlaze SSG4000AC].
 - c. May National Associates, Inc.; [Bondaflex Sil 200 GPN] [Bondaflex Sil 201 FC].
 - d. Polymeric Systems, Inc.; PSI-631.
 - e. Schnee-Morehead, Inc., an ITW company; SM5731 Poly-Glaze Plus.
 - f. Tremco Incorporated; [Proglaze SSG] [Tremsil 600].
 - g. **<Insert manufacturer's name; product name or designation>.**
 - h. or approved equal.

2. Applications: **<Describe types of glazing applications where this sealant is required>**.
- E. Glazing Sealant: Acid-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; OmniPlus.
 - b. Bostik, Inc.; Chem-Calk 1200.
 - c. Dow Corning Corporation; 999-A.
 - d. GE Advanced Materials - Silicones; [Contractors SCS1000] [Construction SCS1200].
 - e. May National Associates, Inc.; [Sil 100 GC] [Sil 100 GP] [Sil 100 WF].
 - f. Pecora Corporation; 860.
 - g. Polymeric Systems, Inc.; PSI-601.
 - h. Schnee-Morehead, Inc., an ITW company; SM5732 Polyglaze.
 - i. Tremco Incorporated; [Proglaze] [Tremsil 200].
 - j. **<Insert manufacturer's name; product name or designation>**.
 - k. or approved equal.
 2. Applications: **<Describe types of glazing applications where this sealant is required>**.
- F. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated.

2.8 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.10 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

2.11 MONOLITHIC-GLASS TYPES

- A. Glass Type [GL-<#>]: Clear [float glass] [heat-strengthened float glass] [fully tempered float glass].
 - 1. Thickness: [6.0 mm] <Insert thickness designation>.
 - 2. Provide safety glazing labeling.
- B. Glass Type [GL-<#>]: Ultraclear [float glass] [heat-strengthened float glass] [fully tempered float glass].

1. Thickness: **[6.0 mm]** <Insert thickness designation>.
 2. Provide safety glazing labeling.
- C. Glass Type **[GL-<#>]**: Pyrolytic-coated, self-cleaning, low-maintenance, clear **[float glass]** **[heat-strengthened float glass]** **[fully tempered float glass]**.
1. Thickness: **[6.0 mm]** <Insert thickness designation>.
 2. Provide safety glazing labeling.
- D. Glass Type **[GL-<#>]**: Tinted **[float glass]** **[heat-strengthened float glass]** **[fully tempered float glass]**.
1. Thickness: **[6.0 mm]** <Insert thickness designation>.
 2. Winter Nighttime U-Factor: <Insert value> maximum.
 3. Summer Daytime U-Factor: <Insert value> maximum.
 4. Solar Heat Gain Coefficient: <Insert value> maximum.
 5. Provide safety glazing labeling.
- E. Glass Type **[GL-<#>]**: Polished wired glass.
1. Thickness: 6.0 mm.
- F. Glass Type **[GL-<#>]**: Patterned glass.
1. Thickness: **[4.0]** **[5.0]** **[6.0]** mm.
- G. Glass Type **[GL-<#>]**: Tempered patterned glass.
1. Thickness: **[4.0]** **[5.0]** **[6.0]** mm.
 2. Provide safety glazing labeling.
- H. Glass Type **[GL-<#>]**: Patterned wired glass.
1. Thickness: 6.0 mm.
- I. Glass Type **[GL-<#>]**: Ceramic-coated vision glass, **[heat-strengthened float glass]** **[fully tempered float glass]**.
1. Thickness: **[6.0 mm]** <Insert thickness designation>.
 2. Coating Location: Second surface.
 3. Winter Nighttime U-Factor: <Insert value> maximum.
 4. Summer Daytime U-Factor: <Insert value> maximum.
 5. Solar Heat Gain Coefficient: <Insert value> maximum.
 6. Provide safety glazing labeling.
- J. Glass Type **[GL-<#>]**: Reflective-coated vision glass, **[float glass]** **[heat-strengthened float glass]** **[fully tempered float glass]**.
1. Thickness: **[6.0 mm]** <Insert thickness designation>.
 2. Coating Location: **[First]** **[Second]** surface.
 3. Winter Nighttime U-Factor: <Insert value> maximum.

4. Summer Daytime U-Factor: **<Insert value>** maximum.
5. Solar Heat Gain Coefficient: **<Insert value>** maximum.
6. Provide safety glazing labeling.

K. Glass Type [GL-#]: Ceramic-coated spandrel glass, **[heat-strengthened float glass] [fully tempered float glass]**.

1. Thickness: **[6.0 mm] <Insert thickness designation>**.
2. Coating Location: Second surface.
3. Winter Nighttime U-Factor: **<Insert value>** maximum.
4. Summer Daytime U-Factor: **<Insert value>** maximum.
5. Fallout Resistance: Passes fallout-resistance test in ASTM C 1048 for an assembly of glass and adhered reinforcing material.

L. Glass Type [GL-#]: Silicone-coated spandrel glass, **[heat-strengthened float glass] [fully tempered float glass]**.

1. Thickness: **[6.0 mm] <Insert thickness designation>**.
2. Coating Location: Second surface.
3. Winter Nighttime U-Factor: **<Insert value>** maximum.
4. Summer Daytime U-Factor: **<Insert value>** maximum.
5. Fallout Resistance: Passes fallout-resistance test in ASTM C 1048 for an assembly of glass and adhered reinforcing material.

M. Glass Type [GL-#]: Reflective-coated spandrel glass, **[heat-strengthened float glass] [fully tempered float glass]**.

1. Thickness: **[6.0 mm] <Insert thickness designation>**.
2. Coating Location: **[First] [Second]** surface.
3. Winter Nighttime U-Factor: **<Insert value>** maximum.
4. Summer Daytime U-Factor: **<Insert value>** maximum.
5. Fallout Resistance: Passes fallout-resistance test in ASTM C 1048 for an assembly of glass and adhered reinforcing material.
6. Factory apply manufacturer's standard opacifier of the following material to coated second surface of lites, with resulting products complying with Specification No. 89-1-6 in GANA's Tempering Division's "Engineering Standards Manual":
 - a. Manufacturer's standard opacifier material.
 - b. Polyester film laminated to glass with solvent-based adhesive.

2.12 LAMINATED-GLASS TYPES

A. Glass Type [GL-#]: Clear laminated glass with two plies of **[float glass] [heat-strengthened float glass] [fully tempered float glass] [ultraclear float glass] [ultraclear heat-strengthened float glass] [ultraclear fully tempered float glass]**.

1. Thickness of Each Glass Ply: **[3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] [As indicated] <Insert thickness designation>**.

2. Interlayer Thickness: [0.030 inch (0.76 mm)] [0.060 inch (1.52 mm)] [0.090 inch (2.29 mm)].
 3. Provide safety glazing labeling.
- B. Glass Type [GL-<#>]: Antireflective-coated clear laminated glass with two plies of [float glass] [heat-strengthened float glass] [fully tempered float glass] [ultraclear float glass] [ultraclear heat-strengthened float glass] [ultraclear fully tempered float glass].
1. Thickness of Each Glass Ply: [3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm].
 2. Interlayer Thickness: [0.030 inch (0.76 mm)] [0.060 inch (1.52 mm)] [0.090 inch (2.29 mm)].
 3. Visible Reflectance: Less than 2 percent.
 4. Winter Nighttime U-Factor: <Insert value> maximum.
 5. Summer Daytime U-Factor: <Insert value> maximum.
 6. Solar Heat Gain Coefficient: <Insert value> maximum.
 7. Provide safety glazing labeling.
- C. Glass Type [GL-<#>]: Tinted laminated glass with two plies of [float glass] [heat-strengthened float glass] [fully tempered float glass] with outer ply Class 2 (tinted) and inner ply Class 1 (clear).
1. Thickness of Each Glass Ply: [3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] [As indicated] <Insert thickness designation>.
 2. Interlayer Thickness: [0.030 inch (0.76 mm)] [0.060 inch (1.52 mm)] [0.090 inch (2.29 mm)].
 3. Winter Nighttime U-Factor: <Insert value> maximum.
 4. Summer Daytime U-Factor: <Insert value> maximum.
 5. Solar Heat Gain Coefficient: <Insert value> maximum.
 6. Provide safety glazing labeling.
- D. Glass Type [GL-<#>]: Tinted laminated glass with two plies of clear [float glass] [heat-strengthened float glass] [fully tempered float glass] and tinted interlayer.
1. Thickness of Each Glass Ply: [3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] [As indicated] <Insert thickness designation>.
 2. Interlayer Thickness: [0.030 inch (0.76 mm)] [0.060 inch (1.52 mm)] [0.090 inch (2.29 mm)].
 3. Interlayer Color: [Blue-green] [Bronze light] [Gray] <Insert color>.
 4. Winter Nighttime U-Factor: <Insert value> maximum.
 5. Summer Daytime U-Factor: <Insert value> maximum.
 6. Solar Heat Gain Coefficient: <Insert value> maximum.
 7. Provide safety glazing labeling.
- E. Glass Type [GL-<#>]: Ceramic-coated, laminated vision glass with two plies of [heat-strengthened float glass] [fully tempered float glass].
1. Thickness of Each Glass Ply: [3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] [As indicated] <Insert thickness designation>.

2. Interlayer Thickness: [0.030 inch (0.76 mm)] [0.060 inch (1.52 mm)] [0.090 inch (2.29 mm)].
 3. Coating Location: [Second] [Third] [Fourth] surface.
 4. Winter Nighttime U-Factor: <Insert value> maximum.
 5. Summer Daytime U-Factor: <Insert value> maximum.
 6. Solar Heat Gain Coefficient: <Insert value> maximum.
 7. Provide safety glazing labeling.
- F. Glass Type [GL-<#>]: Reflective-coated, laminated vision glass with two plies of [heat-strengthened float glass] [fully tempered float glass] with inner ply Class 1 (clear).
1. Thickness of Each Glass Ply: [3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] [As indicated] <Insert thickness designation>.
 2. Interlayer Thickness: [0.030 inch (0.76 mm)] [0.060 inch (1.52 mm)] [0.090 inch (2.29 mm)].
 3. Coating Location: [First] [Second] [Third] surface.
 4. Winter Nighttime U-Factor: <Insert value> maximum.
 5. Summer Daytime U-Factor: <Insert value> maximum.
 6. Solar Heat Gain Coefficient: <Insert value> maximum.
 7. Provide safety glazing labeling.
- G. Glass Type [GL-<#>]: Low-e-coated, laminated vision glass with two plies of clear [float glass] [heat-strengthened float glass] [fully tempered float glass].
1. Thickness of Each Glass Ply: [3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] [As indicated] <Insert thickness designation>.
 2. Interlayer Thickness: [0.030 inch (0.76 mm)] [0.060 inch (1.52 mm)] [0.090 inch (2.29 mm)].
 3. Low-E Coating: [Pyrolytic on second] [Pyrolytic on third] [Sputtered on second] [Sputtered on third] [Pyrolytic or sputtered on second or third] surface.
 4. Visible Light Transmittance: <Insert value> percent minimum.
 5. Winter Nighttime U-Factor: <Insert value> maximum.
 6. Summer Daytime U-Factor: <Insert value> maximum.
 7. Solar Heat Gain Coefficient: <Insert value> maximum.
 8. Provide safety glazing labeling.
- H. Glass Type [GL-<#>]: Reflective-coated, laminated spandrel glass with two plies of [heat-strengthened float glass] [fully tempered float glass] with inner ply Class 1 (clear).
1. Thickness of Each Glass Ply: [3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] [As indicated] <Insert thickness designation>.
 2. Interlayer Thickness: [0.030 inch (0.76 mm)] [0.060 inch (1.52 mm)] [0.090 inch (2.29 mm)].
 3. Coating Location: [First] [Second] [Third] surface.
 4. Winter Nighttime U-Factor: <Insert value> maximum.
 5. Summer Daytime U-Factor: <Insert value> maximum.

2.13 INSULATING-GLASS TYPES

A. Glass Type [GL-<#>]: Clear insulating glass.

1. Overall Unit Thickness: [1 inch (25 mm)] [5/8 inch (16 mm)] <Insert dimension>.
2. Thickness of Each Glass Lite: [3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] <Insert thickness designation>.
3. Outdoor Lite: [Float glass] [Heat-strengthened float glass] [Fully tempered float glass].
4. Interspace Content: [Air] [Argon].
5. Indoor Lite: [Float glass] [Heat-strengthened float glass] [Fully tempered float glass].
6. Winter Nighttime U-Factor: <Insert value> maximum.
7. Summer Daytime U-Factor: <Insert value> maximum.
8. Provide safety glazing labeling.

B. Glass Type [GL-<#>]: Ultraclear insulating glass.

1. Overall Unit Thickness: [1 inch (25 mm)] [5/8 inch (16 mm)] <Insert dimension>.
2. Thickness of Each Glass Lite: [3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] <Insert thickness designation>.
3. Outdoor Lite: Ultraclear [float glass] [heat-strengthened float glass] [fully tempered float glass].
4. Interspace Content: [Air] [Argon].
5. Indoor Lite: Ultraclear [float glass] [heat-strengthened float glass] [fully tempered float glass].
6. Winter Nighttime U-Factor: <Insert value> maximum.
7. Summer Daytime U-Factor: <Insert value> maximum.
8. Provide safety glazing labeling.

C. Glass Type [GL-<#>]: Pyrolytic-coated, self-cleaning, low-maintenance, clear insulating glass.

1. Overall Unit Thickness: [1 inch (25 mm)] [5/8 inch (16 mm)] <Insert dimension>.
2. Thickness of Each Glass Lite: [3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] <Insert thickness designation>.
3. Outdoor Lite: Pyrolytic-coated, self-cleaning, low-maintenance, clear [float glass] [heat-strengthened float glass] [fully tempered float glass].
4. Interspace Content: [Air] [Argon].
5. Indoor Lite: [Float glass] [Heat-strengthened float glass] [Fully tempered float glass].
6. Winter Nighttime U-Factor: <Insert value> maximum.
7. Summer Daytime U-Factor: <Insert value> maximum.
8. Provide safety glazing labeling.

D. Glass Type [GL-<#>]: Low-e-coated, clear insulating glass.

1. Overall Unit Thickness: [1 inch (25 mm)] [5/8 inch (16 mm)] <Insert dimension>.
2. Thickness of Each Glass Lite: [3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] <Insert thickness designation>.

3. Outdoor Lite: [**Float glass**] [**Heat-strengthened float glass**] [**Fully tempered float glass**] [**Ultraclear float glass**] [**Ultraclear heat-strengthened float glass**] [**Ultraclear fully tempered float glass**].
 4. Interspace Content: [**Air**] [**Argon**].
 5. Indoor Lite: [**Float glass**] [**Heat-strengthened float glass**] [**Fully tempered float glass**] [**Ultraclear float glass**] [**Ultraclear heat-strengthened float glass**] [**Ultraclear fully tempered float glass**].
 6. Low-E Coating: [**Pyrolytic on second**] [**Pyrolytic on third**] [**Sputtered on second**] [**Sputtered on third**] [**Pyrolytic or sputtered on second or third**] surface.
 7. Visible Light Transmittance: <Insert value> percent minimum.
 8. Winter Nighttime U-Factor: <Insert value> maximum.
 9. Summer Daytime U-Factor: <Insert value> maximum.
 10. Solar Heat Gain Coefficient: <Insert value> maximum.
 11. Provide safety glazing labeling.
- E. Glass Type [**GL-#>**]: Tinted insulating glass.
1. Overall Unit Thickness: [**1 inch (25 mm)**] [**5/8 inch (16 mm)**] <Insert dimension>.
 2. Thickness of Each Glass Lite: [**3.0 mm**] [**4.0 mm**] [**5.0 mm**] [**6.0 mm**] <Insert thickness designation>.
 3. Outdoor Lite: Tinted [**float glass**] [**heat-strengthened float glass**] [**fully tempered float glass**].
 4. Interspace Content: [**Air**] [**Argon**].
 5. Indoor Lite: Clear [**float glass**] [**heat-strengthened float glass**] [**fully tempered float glass**].
 6. Winter Nighttime U-Factor: <Insert value> maximum.
 7. Summer Daytime U-Factor: <Insert value> maximum.
 8. Solar Heat Gain Coefficient: <Insert value> maximum.
 9. Provide safety glazing labeling.
- F. Glass Type [**GL-#>**]: Low-e-coated, tinted insulating glass.
1. Overall Unit Thickness: [**1 inch (25 mm)**] [**5/8 inch (16 mm)**] <Insert dimension>.
 2. Thickness of Each Glass Lite: [**3.0 mm**] [**4.0 mm**] [**5.0 mm**] [**6.0 mm**] <Insert thickness designation>.
 3. Outdoor Lite: Tinted [**float glass**] [**heat-strengthened float glass**] [**fully tempered float glass**].
 4. Interspace Content: [**Air**] [**Argon**].
 5. Indoor Lite: Clear [**float glass**] [**heat-strengthened float glass**] [**fully tempered float glass**].
 6. Low-E Coating: [**Pyrolytic on second**] [**Pyrolytic on third**] [**Sputtered on second**] [**Sputtered on third**] [**Pyrolytic or sputtered on second or third**] surface.
 7. Visible Light Transmittance: <Insert value> percent minimum.
 8. Winter Nighttime U-Factor: <Insert value> maximum.
 9. Summer Daytime U-Factor: <Insert value> maximum.
 10. Solar Heat Gain Coefficient: <Insert value> maximum.
 11. Provide safety glazing labeling.

- G. Glass Type [GL-<#>]: Ceramic-coated, insulating vision glass.
1. Overall Unit Thickness: [1 inch (25 mm)] [5/8 inch (16 mm)] <Insert dimension>.
 2. Thickness of Each Glass Lite: [3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] <Insert thickness designation>.
 3. Outdoor Lite: [Heat-strengthened float glass] [Fully tempered float glass] [Ultraclear heat-strengthened float glass] [Ultraclear fully tempered float glass].
 4. Interspace Content: [Air] [Argon].
 5. Indoor Lite: [Float glass] [Heat-strengthened float glass] [Fully tempered float glass] [Ultraclear float glass] [Ultraclear heat-strengthened float glass] [Ultraclear fully tempered float glass].
 6. Coating Location: [Second] [Third] [Fourth] surface.
 7. Winter Nighttime U-Factor: <Insert value> maximum.
 8. Summer Daytime U-Factor: <Insert value> maximum.
 9. Solar Heat Gain Coefficient: <Insert value> maximum.
 10. Provide safety glazing labeling.
- H. Glass Type [GL-<#>]: Reflective-coated, clear insulating glass.
1. Overall Unit Thickness: [1 inch (25 mm)] [5/8 inch (16 mm)] <Insert dimension>.
 2. Thickness of Each Glass Lite: [3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] <Insert thickness designation>.
 3. Outdoor Lite: Clear [float glass] [heat-strengthened float glass] [fully tempered float glass].
 4. Interspace Content: [Air] [Argon].
 5. Indoor Lite: Clear [float glass] [heat-strengthened float glass] [fully tempered float glass].
 6. Coating Location: [First] [Second] [Third] surface.
 7. Winter Nighttime U-Factor: <Insert value> maximum.
 8. Summer Daytime U-Factor: <Insert value> maximum.
 9. Solar Heat Gain Coefficient: <Insert value> maximum.
 10. Provide safety glazing labeling.
- I. Glass Type [GL-<#>]: Reflective-coated, tinted insulating glass.
1. Overall Unit Thickness: [1 inch (25 mm)] [5/8 inch (16 mm)] <Insert dimension>.
 2. Thickness of Each Glass Lite: [3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] <Insert thickness designation>.
 3. Outdoor Lite: Tinted [float glass] [heat-strengthened float glass] [fully tempered float glass].
 4. Interspace Content: [Air] [Argon].
 5. Indoor Lite: Clear [float glass] [heat-strengthened float glass] [fully tempered float glass].
 6. Coating Location: [First] [Second] [Third] surface.
 7. Winter Nighttime U-Factor: <Insert value> maximum.
 8. Summer Daytime U-Factor: <Insert value> maximum.
 9. Solar Heat Gain Coefficient: <Insert value> maximum.
 10. Provide safety glazing labeling.

- J. Glass Type [GL-<#>]: **[Ceramic-coated] [Silicone-coated]**, insulating spandrel glass.
1. Overall Unit Thickness: [1 inch (25 mm)] <Insert dimension>.
 2. Thickness of Each Glass Lite: [5.0 mm] [6.0 mm] <Insert thickness designation>.
 3. Outdoor Lite: **[Float glass] [Heat-strengthened float glass] [Fully tempered float glass] [Ultraclear float glass] [Ultraclear heat-strengthened float glass] [Ultraclear fully tempered float glass]**.
 4. Interspace Content: [Air] [Argon].
 5. Indoor Lite: **[Float glass] [Heat-strengthened float glass] [Fully tempered float glass] [Ultraclear float glass] [Ultraclear heat-strengthened float glass] [Ultraclear fully tempered float glass]**.
 6. Coating Location: Fourth surface.
 7. Winter Nighttime U-Factor: <Insert value> maximum.
 8. Summer Daytime U-Factor: <Insert value> maximum.
- K. Glass Type [GL-<#>]: **[Ceramic-coated] [Silicone-coated]**, low-e, insulating spandrel glass.
1. Overall Unit Thickness: [1 inch (25 mm)] <Insert dimension>.
 2. Thickness of Each Glass Lite: [5.0 mm] [6.0 mm] <Insert thickness designation>.
 3. Outdoor Lite: **[Float glass] [Heat-strengthened float glass] [Fully tempered float glass] [Ultraclear float glass] [Ultraclear heat-strengthened float glass] [Ultraclear fully tempered float glass]**.
 4. Interspace Content: [Air] [Argon].
 5. Indoor Lite: **[Float glass] [Heat-strengthened float glass] [Fully tempered float glass] [Ultraclear float glass] [Ultraclear heat-strengthened float glass] [Ultraclear fully tempered float glass]**.
 6. Low-E Coating: **[Pyrolytic on second] [Pyrolytic on third] [Sputtered on second] [Sputtered on third] [Pyrolytic or sputtered on second or third]** surface.
 7. Opaque Coating Location: Fourth surface.
 8. Winter Nighttime U-Factor: <Insert value> maximum.
 9. Summer Daytime U-Factor: <Insert value> maximum.
- L. Glass Type [GL-<#>]: **[Ceramic-coated] [Silicone-coated]**, tinted, insulating spandrel glass.
1. Overall Unit Thickness: [1 inch (25 mm)] <Insert dimension>.
 2. Thickness of Each Glass Lite: [5.0 mm] [6.0 mm] <Insert thickness designation>.
 3. Outdoor Lite: Tinted **[float glass] [heat-strengthened float glass] [fully tempered float glass]**.
 4. Interspace Content: [Air] [Argon].
 5. Indoor Lite: Clear **[float glass] [heat-strengthened float glass] [fully tempered float glass]**.
 6. Coating Location: Fourth surface.
 7. Winter Nighttime U-Factor: <Insert value> maximum.
 8. Summer Daytime U-Factor: <Insert value> maximum.

2.14 INSULATING-LAMINATED-GLASS TYPES

A. Glass Type [GL-<#>]: Clear insulating laminated glass.

1. Overall Unit Thickness: [1-3/16 inch (30 mm)] [1 inch (25 mm)] [3/4 inch (19 mm)] <insert dimension>.
2. Thickness of Outdoor Lite: [3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] <Insert thickness designation>.
3. Outdoor Lite: [Heat-strengthened float glass] [Fully tempered float glass].
4. Interspace Content: [Air] [Argon].
5. Indoor Lite: Clear laminated glass with two plies of [float glass] [heat-strengthened float glass] [fully tempered float glass].
 - a. Thickness of Each Glass Ply: [3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] [As indicated] <Insert thickness designation>.
 - b. Interlayer Thickness: [0.030 inch (0.76 mm)] [0.060 inch (1.52 mm)] [0.090 inch (2.29 mm)].
6. Winter Nighttime U-Factor: <Insert value> maximum.
7. Summer Daytime U-Factor: <Insert value> maximum.
8. Solar Heat Gain Coefficient: <Insert value> maximum.
9. Provide safety glazing labeling.

B. Glass Type [GL-<#>]: Low-e-coated, clear insulating laminated glass.

1. Overall Unit Thickness: [1-3/16 inch (30 mm)] [1 inch (25 mm)] [3/4 inch (19 mm)] <insert dimension>.
2. Thickness of Outdoor Lite: [3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] <Insert thickness designation>.
3. Outdoor Lite: [Heat-strengthened float glass] [Fully tempered float glass].
4. Interspace Content: [Air] [Argon].
5. Indoor Lite: Clear laminated glass with two plies of [float glass] [heat-strengthened float glass] [fully tempered float glass].
 - a. Thickness of Each Glass Ply: [3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] [As indicated] <Insert thickness designation>.
 - b. Interlayer Thickness: [0.030 inch (0.76 mm)] [0.060 inch (1.52 mm)] [0.090 inch (2.29 mm)].
6. Low-E Coating: [Pyrolytic on second] [Pyrolytic on third] [Sputtered on second] [Sputtered on third] [Pyrolytic or sputtered on second or third] surface.
7. Visible Light Transmittance: <Insert value> percent minimum.
8. Winter Nighttime U-Factor: <Insert value> maximum.
9. Summer Daytime U-Factor: <Insert value> maximum.
10. Solar Heat Gain Coefficient: <Insert value> maximum.
11. Provide safety glazing labeling.

C. Glass Type [GL-<#>]: Tinted, insulating laminated glass.

1. Overall Unit Thickness: [1-3/16 inch (30 mm)] [1 inch (25 mm)] [3/4 inch (19 mm)] **<insert dimension>**.
2. Thickness of Outdoor Lite: [3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] **<Insert thickness designation>**.
3. Outdoor Lite: Tinted [heat-strengthened float glass] [fully tempered float glass].
4. Interspace Content: [Air] [Argon].
5. Indoor Lite: Clear laminated glass with two plies of [float glass] [heat-strengthened float glass] [fully tempered float glass].
 - a. Thickness of Each Glass Ply: [3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] [As indicated] **<Insert thickness designation>**.
 - b. Interlayer Thickness: [0.030 inch (0.76 mm)] [0.060 inch (1.52 mm)] [0.090 inch (2.29 mm)].
6. Winter Nighttime U-Factor: **<Insert value>** maximum.
7. Summer Daytime U-Factor: **<Insert value>** maximum.
8. Solar Heat Gain Coefficient: **<Insert value>** maximum.
9. Provide safety glazing labeling.

D. Glass Type [GL-<#>]: Low-e-coated, tinted, insulating laminated glass.

1. Overall Unit Thickness: [1-3/16 inch (30 mm)] [1 inch (25 mm)] [3/4 inch (19 mm)] **<insert dimension>**.
2. Thickness of Outdoor Lite: [3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] **<Insert thickness designation>**.
3. Outdoor Lite: Tinted [heat-strengthened float glass] [fully tempered float glass].
4. Interspace Content: [Air] [Argon].
5. Indoor Lite: Clear laminated glass with two plies of [float glass] [heat-strengthened float glass] [fully tempered float glass].
 - a. Thickness of Each Glass Ply: [3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] [As indicated] **<Insert thickness designation>**.
 - b. Interlayer Thickness: [0.030 inch (0.76 mm)] [0.060 inch (1.52 mm)] [0.090 inch (2.29 mm)].
6. Low-E Coating: [Pyrolytic on second] [Pyrolytic on third] [Sputtered on second] [Sputtered on third] [Pyrolytic or sputtered on second or third] surface.
7. Visible Light Transmittance: **<Insert value>** percent minimum.
8. Winter Nighttime U-Factor: **<Insert value>** maximum.
9. Summer Daytime U-Factor: **<Insert value>** maximum.
10. Solar Heat Gain Coefficient: **<Insert value>** maximum.
11. Provide safety glazing labeling.

E. Glass Type [GL-<#>]: Reflective-coated, clear, insulating laminated glass.

1. Overall Unit Thickness: [1-3/16 inch (30 mm)] [1 inch (25 mm)] **<Insert dimension>**.

2. Thickness of Outdoor Lite: **[6.0 mm]** <Insert thickness designation>.
3. Outdoor Lite: Clear **[heat-strengthened float glass]** **[fully tempered float glass]**.
4. Interspace Content: **[Air]** **[Argon]**.
5. Indoor Lite: Clear laminated glass with two plies of **[float glass]** **[heat-strengthened float glass]** **[fully tempered float glass]**.
 - a. Thickness of Each Glass Ply: **[3.0 mm]** **[4.0 mm]** **[5.0 mm]** **[6.0 mm]** **[As indicated]** <Insert thickness designation>.
 - b. Interlayer Thickness: **[0.030 inch (0.76 mm)]** **[0.060 inch (1.52 mm)]** **[0.090 inch (2.29 mm)]**.
6. Coating Location: **[First]** **[Second]** **[Third]** surface.
7. Winter Nighttime U-Factor: <Insert value> maximum.
8. Summer Daytime U-Factor: <Insert value> maximum.
9. Solar Heat Gain Coefficient: <Insert value> maximum.
10. Provide safety glazing labeling.

F. Glass Type **[GL-<#>]**: Reflective-coated, tinted, insulating laminated glass.

1. Overall Unit Thickness: **[1-3/16 inch (30 mm)]** **[1 inch (25 mm)]** <Insert dimension>.
2. Thickness of Outdoor Lite: **[6.0 mm]** <Insert thickness designation>.
3. Outdoor Lite: Tinted **[heat-strengthened float glass]** **[fully tempered float glass]**.
4. Interspace Content: **[Air]** **[Argon]**.
5. Indoor Lite: Clear laminated glass with two plies of **[float glass]** **[heat-strengthened float glass]** **[fully tempered float glass]**.
 - a. Thickness of Each Glass Ply: **[3.0 mm]** **[4.0 mm]** **[5.0 mm]** **[6.0 mm]** **[As indicated]** <Insert thickness designation>.
 - b. Interlayer Thickness: **[0.030 inch (0.76 mm)]** **[0.060 inch (1.52 mm)]** **[0.090 inch (2.29 mm)]**.
6. Coating Location: **[First]** **[Second]** **[Third]** surface.
7. Winter Nighttime U-Factor: <Insert value> maximum.
8. Summer Daytime U-Factor: <Insert value> maximum.
9. Solar Heat Gain Coefficient: <Insert value> maximum.
10. Provide safety glazing labeling.

2.15 FIRE-PROTECTION-RATED GLAZING TYPES

A. Glass Type **[GL-<#>]**: 20-minute fire-rated glazing without hose-stream test; **[monolithic ceramic glazing]** **[film-faced ceramic glazing]** **[laminated ceramic glazing]** **[fire-protection-rated tempered glass]** **[fire-protection-rated laminated glass]** **[or]** **[gel-filled, double glazing units]**.

1. Provide safety glazing labeling.

- B. Glass Type [GL-<#>]: 20-minute fire-rated glazing with hose-stream test; **[monolithic ceramic glazing] [film-faced ceramic glazing] [laminated ceramic glazing] [or] [gel-filled, double glazing units]**.
1. Provide safety glazing labeling.
- C. Glass Type [GL-<#>]: **[45-minute] [60-minute] [90-minute] [120-minute]** fire-rated glazing; **[monolithic ceramic glazing] [film-faced ceramic glazing] [laminated ceramic glazing] [laminated glass with intumescent interlayers] [or] [gel-filled, double glazing units]**.
1. Provide safety glazing labeling.
- D. Glass Type [GL-<#>]: **[45-minute] [60-minute] [90-minute] [120-minute]** fire-rated glazing with **450 deg F (250 deg C)** temperature rise limitation; **[laminated glass with intumescent interlayers] [or] [gel-filled, double glazing units]**.
1. Provide safety glazing labeling.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 2. Presence and functioning of weep systems.
 3. Minimum required face and edge clearances.
 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

- L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending

stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

- E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 LOCK-STRIP GASKET GLAZING

- A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system unless otherwise indicated.

3.8 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 088000

SECTION 088113 - DECORATIVE GLASS GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes the following decorative glass for interior applications:
 - 1. Patterned.
 - 2. Silk-screened.
 - 3. Acid etched.
 - 4. Sandblasted.
 - 5. Laminated.
 - 6. Glass with decorative film overlay.
 - 7. Glass with finished edges.
- B. Related Sections:
 - 1. Section 057300 "Decorative Metal Railings" for glass and plastic panels in metal railings and in glass- and plastic-supported railings.
 - 2. Section 088000 "Glazing" for standard glass products.
 - 3. Section 088300 "Mirrors" for mirror glass.
 - 4. Section 088400 "Plastic Glazing" for acrylic and polycarbonate glazing.
 - 5. Section 088853 "Security Glazing" for glazing intended to resist ballistic attacks, blunt- and sharp-tool attacks, thermal stress, chemical threats, or airblasts.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITION

- A. Glass Thickness: Indicated by thickness designations in millimeters according to ASTM C 1036.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or

installation; deterioration of glazing materials; or other defects in construction.

- B. Delegated Design: Design glass installed adjacent to walking surfaces, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
1. Differential deflection of adjacent unsupported edges shall not exceed glass thickness when subjected to **50 lbf/ft.** (730 N/m) applied horizontally to one panel at any point up to **42 inches** (1067 mm) above the adjacent walking surface.
 2. Base design on thickness at thinnest part of the glass.

1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
 2. Submit no fewer than **[eight (8)] <Insert number>** Samples of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 4. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.
 5. Testing will not be required if data based on previous testing of current sealant products and glazing materials match those submitted.

1.6 ACTION SUBMITTALS

- A. Product Data: For each decorative-glass and glazing product indicated.
1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
1. Product Data for Credit IEQ 4.1: For glazing sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
 2. Laboratory Test Reports for Credit IEQ 4: For glazing sealants used inside the weatherproofing system, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For decorative glass. Show fabrication and installation details. Include the following:

1. Size and location of penetrations.
2. Glazing method.
3. Mounting method.
4. Attachments to other work.
5. Full-size details of edge-finished profiles.

D. Glass Samples: For the following products, **12 inches** (300 mm) square:

1. Each type of decorative glass.
2. Each edge treatment on type of decorative glass.
3. Each decorative film overlay on type of decorative glass.
4. Each applied coating on type of decorative glass.

E. Glazing Accessory Samples: For **[sealants] [and] [colored spacers]**, in **12-inch** (300-mm) lengths. **[Install sealant Samples between two strips of material representative of the glazed system.]**

F. Product Schedule: For decorative glass. **[Use same designations indicated on Drawings.]**

G. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified **[Installer] [fabricator] [and] [sealant testing agency]**.
- B. Product Certificates: For each type of decorative glass, from manufacturer.
- C. Preconstruction Adhesion and Compatibility Test Reports: Based on evaluation and comprehensive tests performed by a qualified testing agency, for **[laminated glass] [glass with decorative film overlay]**.
- D. Warranty: Sample of special warranty.

1.8 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of decorative glass **[and each decorative film overlay] [and each applied coating]** to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under NGA's Certified Glass Installer Program.
- B. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- C. Source Limitations for Glass: Obtain each type of decorative glass from single source from single manufacturer.
- D. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer, for each product and installation method.
- E. Glazing Publications: Comply with published recommendations in [**GANA's "Laminated Glazing Reference Manual" and]**GANA's "Glazing Manual" unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
- F. Safety Glazing: Where safety glazing is indicated, comply with testing requirements in 16 CFR 1201 for Category II materials.
 - 1. Labeling: Permanently mark glazing with certification label of [**the SGCC] [or] [another certification agency acceptable to authorities having jurisdiction] [or] [manufacturer]**. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard that glass complies with.
- G. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockups in the location and of the size indicated or, if not indicated, as directed by DEN Project Manager.
 - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- H. Preinstallation Conference: Conduct conference at [**Project site] [location and time as determined by DEN Project Manager]**<Insert location>.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Protect decorative glass and glazing materials according to manufacturer's written instructions and as needed to prevent damage to surfaces and edges.
- B. Retain packaging and sequencing numbers for decorative-glass units.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install decorative glass until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary

HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

- B. Field Measurements: Verify actual dimensions of openings and construction contiguous with decorative glass by field measurements before fabrication.

1.12 WARRANTY

- A. Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: Minimum [five (5)] [ten (10)] <Insert number> years from date of Substantial Completion.

1.13 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with requirements indicated. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with requirements indicated. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

2.2 MONOLITHIC-GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

- B. Ultraclear Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I, complying with other requirements specified and with visible light transmission not less than **[90] [91]** **<Insert number>** percent.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AFG Industries, Inc.; Krystal Klear.
 - b. Bendheim Corporation; Low Iron + White.
 - c. Guardian Industries Corp.; UltraWhite.
 - d. Pilkington North America; Optiwhite.
 - e. PPG Industries, Inc.; Starphire.
 - f. SCHOTT Corporation; Amiran.
 - g. **<Insert manufacturer's name; product name or designation>**.
 - h. or approved equal.
- C. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.3 DECORATIVE GLASS TYPES

- A. Decorative Glass[**Type GL-<#>**]: Patterned glass; **[annealed] [heat strengthened] [fully tempered]**, Type II, Form 3; Quality-Q**[5] [6]**, Finish F**[1 (patterned one side)] [2 (patterned both sides)]**.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.
 2. Glass Thickness: **[4.0 mm] [5.0 mm] [6.0 mm] <Insert thickness designation>**.
 3. Pattern: **[P1 (linear)] [P2 (geometric)] [P3 (random)] [P4 (special)] [As indicated by manufacturer's designations] [Match DEN Project manager's samples] [As selected by DEN Project Manager from manufacturer's full range]**.
 4. Comply with requirements for safety glazing.
- B. Decorative Glass[**Type GL-<#>**]: Silk-screened glass with decorative **[ceramic frit applied and heat-fused to glass surface] [glass paint or ink applied to glass surface and cured]** according to manufacturer's standard process.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.

2. Glass Type: Clear [**heat-strengthened**] [**fully tempered**] float glass.
 3. Glass Thickness: [**4.0 mm**] [**5.0 mm**] [**6.0 mm**] <Insert thickness designation>.
 4. Comply with requirements for safety glazing.
 5. Colors and Patterns: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] [**As indicated**].
- C. Decorative Glass[**Type GL-<#>**]: Acid-etched glass with decorative pattern etched into glass with hydrofluoric and hydrochloric acids, evenly applied, according to manufacturer's standard process.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. <Insert, in separate subparagraphs, manufacturer's name; product name or designation>.
 - b. DEN Project Manager
 2. Glass Type: Clear [**fully tempered**] float glass.
 3. Glass Thickness: [**4.0 mm**] [**5.0 mm**] [**6.0 mm**] <Insert thickness designation>.
 4. Patterns: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] [**As indicated**].
 5. Silicone Back Coating: [**Recommended by glass fabricator**] <Insert manufacturer's name; product name or designation> for shop application.
 - a. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**].
- D. Decorative Glass[**Type GL-<#>**]: Sandblasted glass with decorative pattern applied uniformly, with abrasive particles forced through a high-pressure air nozzle, according to manufacturer's standard process.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. <Insert, in separate subparagraphs, manufacturer's name; product name or designation>.
 - b. or approved equal.
 2. Glass Type: Clear [**fully tempered**] float glass.
 3. Glass Thickness: [**Not less than**] [**4.0 mm**] [**5.0 mm**] [**6.0 mm**] <Insert thickness designation>.
 4. Patterns: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] [**As indicated**].
 5. Antifingerprint Coating: Protective coating [**recommended and provided by glass fabricator**] <Insert manufacturer's name; product name or designation>.

6. Acid-Etched Finish: Acid etch glass with hydrofluoric and hydrochloric acids, evenly applied and maintaining detail of sandblasted pattern, according to manufacturer's standard process.
- E. Decorative Glass[**Type GL-<#>**]: Laminated glass, ASTM C 1172. Use materials that have a proven record of not bubbling, discoloring, or losing physical and mechanical properties after fabrication and installation.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.
 2. Construction: Two plies of [**ultraclear**] [**heat-strengthened**] [**fully tempered**] [**ultraclear heat-strengthened**] [**ultraclear fully tempered**] float glass.
 3. Thickness of Each Glass Ply: [**3.0 mm**] [**4.0 mm**] [**5.0 mm**] [**6.0 mm**] **<Insert thickness designation>**.
 4. Construction: Laminate glass with [**PVB interlayer**] [**or**] [**cast-in-place and cured-transparent-resin interlayer**] to comply with interlayer manufacturer's written recommendations.
 5. Interlayer Thickness: [**0.030 inch** (0.76 mm)] [**0.060 inch** (1.52 mm)] [**0.090 inch** (2.29 mm)].
 6. Comply with requirements for safety glazing.
 7. Interlayer Material Color and Pattern: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**].
 8. Visible Light Transmittance of Interlayer: **<Insert number>** percent minimum.
 9. Sound Transmission Requirements: Sound transmission loss performance is tested according to ASTM E 90, determined by ASTM E 413, and rated for Sound Transmission Class (STC) plus or minus 1 of [**35**] [**40**] **<Insert rating>**.
- F. Decorative Glass[**Type GL-<#>**]: Glass with decorative film overlay. Use translucent, dimensionally stable, cast PVC film, **2-mil-** (0.05-mm-) minimum thickness, with pressure-sensitive, clear adhesive back for adhering to glass and releasable protective backing.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison, Graphics; Etchmark A5861-S.
 - b. FDC Graphic Films, Inc.; Intermediate Frosted Crystal Vinyl Film Series 3804, [**Silver**] **<Insert color>**.
 - c. FDC Graphic Films, Inc.; Premium Frosted Etched Glass Vinyl Film Series 3500.
 - d. 3M; Scotchcal Dusted Crystal.
 - e. 3M; Scotchcal Frosted Crystal, [**Clear**] **<Insert color>**.
 - f. **<Insert manufacturer's name; product name or designation>**.
 2. Glass Type: Clear [**heat-strengthened**] [**fully tempered**] float glass.
 3. Glass Thickness: [**4.0 mm**] [**5.0 mm**] [**6.0 mm**] **<Insert thickness designation>**.

4. Comply with requirements for safety glazing.
5. Use: Suitable for exterior and interior applications.
6. Outdoor Durability: Not less than **[five]** **<Insert number>** years.
7. Patterns: **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's samples]** **[As selected by DEN Project Manager from manufacturer's full range]** **[As indicated]**.

2.4 GLAZING MATERIALS

- A. Glazing Gaskets, Sealants, Tapes, and Miscellaneous Glazing Materials: As specified in Section 088000 "Glazing."
 1. Elastomeric Glazing Sealants: ASTM C 920, **<Insert sealant material>**.
 - a. Color: As selected by DEN Project Manager from manufacturer's full range.
- B. Joint Sealants: As specified in Section 079200 "Joint Sealants."

2.5 HARDWARE FOR GLASS INSTALLATION

- A. Hardware: **[Edge grips]** **[Glass panel to ceiling clamps/connectors]** **[Glass panel to floor clamps/connectors]** **[Glass panel to wall clamps/connectors]** **[Glass to glass panel clamp/connectors]** **[Panel support bars]** **[Stand-off display system with caps]** **[Swivel fittings]** **[Continuous top track]** **[Continuous floor track]** **<Insert hardware description>**.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CHMI Custom Hardware Manufacturing, Inc.; **<Insert product name or designation>**.
 - b. Laurence, C. R. Co., Inc.; **<Insert product name or designation>**.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
 2. Dimensions: **<Insert dimensions>**.
 3. Material and Finish: **<Insert manufacturer's material and finish name and designation>**.
- B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
- C. Gaskets and Wedges: Manufacturer's standard, compatible with decorative glass type indicated.
- D. Anchors and Inserts: Provide devices as required for hardware installation. Provide toothed or lead-shield expansion-bolt devices for drilled-in-place anchors. Provide **[galvanized]** **[stainless-steel]** anchors and inserts for applications on inside face of exterior walls and where indicated.

2.6 DECORATIVE-GLASS FABRICATION

- A. Fabricate decorative glass and provide other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written recommendations of product manufacturer and with referenced glazing standard.
- B. Edge Finishing: Fabricate finished edges to produce smooth, polished edges without chips, scratches, or warps.
 - 1. Finished Edge: **[Clean cut] [Chamfered/Seamed/Swiped] [Flat polished] [Rounded polished] [Beveled polished edge of width shown] [Clean cut or flat grind vertical edges of butt-glazed lites in a manner that produces square edges with slight kerfs] <Insert treatment>**.
 - 2. Edge-Finished Glass Adhesive: Clear, nonyellowing, as recommended by manufacturer.
- C. Lite Treatment: **[Drilled] [Notched] [Cut out] [Surface cut]** as indicated on Drawings with smooth, uniform edge.
- D. Decorative Film Overlay: Apply squarely aligned to glass edges, uniformly smooth, and free from tears, air bubbles, wrinkles, and rough edges, **[in single sheet completely overlaying] [in pattern indicated on Drawings to] [with graphic image as indicated on Drawings to]** the back face of clean glass, according to manufacturer's written instructions, including surface preparation and application temperature limitations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine decorative-glass framing members, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Minimum required face or edge clearances.
 - 3. Effective sealing between joints of decorative-glass framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

- B. Examine glazing units to locate orientation of outer surfaces[**as indicated on Drawings**]. Label or mark units as needed so that surface orientation is readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 INSTALLATION

- A. Set decorative-glass units in each series true in line with uniform orientation, pattern, draw, bow, and similar characteristics.
- B. Set glass lites with proper orientation so that each outer surface faces the direction [**indicated on Drawings**] <Insert orientation>.
- C. Set decorative glass in locations indicated on Drawings. Install glass with hardware and accessories according to hardware manufacturer's written instructions. Attach hardware securely to mounting surfaces[**and building structure**].
- D. Set decorative glass in locations indicated on Drawings and as specified in <Insert Section number>-<Insert Section title>

3.4 GLAZING, GENERAL

- A. Decorative Glass: Install glazing as specified in Section 088000 "Glazing."
- B. Comply with combined written instructions of manufacturers of gaskets, glass, sealants, tapes, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.
- C. Adjust glazing channel dimensions during installation as required by Project conditions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- D. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- E. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- F. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- G. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- H. Provide spacers for glass lites where length plus width is more than **50 inches** (1270 mm).

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances, and to comply with system performance requirements.
 2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- I. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.5 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels[**and between glass-to-glass joints**] to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants smooth.

3.6 CLEANING AND PROTECTION

- A. Protect decorative glass from damage immediately after installation by attaching crossed streamers to framing and held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- D. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 088113

SECTION 088300 - MIRRORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes the following types of silvered flat glass mirrors:
 - 1. Annealed monolithic glass mirrors.
 - 2. **[Film-backed] [Laminated] [Tempered]** glass mirrors qualifying as safety glazing.
- B. Related Sections:
 - 1. Section 088000 "Glazing" for glass with reflective coatings used for vision and spandrel lites.
 - 2. Section 102800 "Toilet, Bath, and Laundry Accessories" for metal-framed mirrors.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include data substantiating that materials comply with requirements.
 - 2. Mirrors. Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit IEQ 4: For adhesives, documentation indicating that they comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of

Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachments to other work.
- D. Samples: For each type of the following products:
 - 1. Mirrors: **12 inches** (300 mm) square, including edge treatment on two adjoining edges.
 - 2. Mirror Clips: Full size.
 - 3. Mirror Trim: **12 inches** (300 mm) long.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: For each type of mirror[**and mirror mastic**], from manufacturer.
- C. Preconstruction Test Reports: From mirror manufacturer indicating that mirror mastic was tested for compatibility and adhesion with mirror backing [**paint**] [**film**] and substrates on which mirrors are installed.
- D. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For mirrors to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- B. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.
- C. Source Limitations for Mirror Accessories: Obtain mirror glazing accessories from single source.
- D. Glazing Publications: Comply with the following published recommendations:
 - 1. GANA's "Glazing Manual" unless more stringent requirements are indicated.

Refer to this publication for definitions of glass and glazing terms not otherwise defined in this Section or in referenced standards.

2. GANA Mirror Division's "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."

- E. Safety Glazing Products: For **[film-backed]** **[laminated]** **[tempered]** mirrors, provide products complying with testing requirements in 16 CFR 1201 for Category II materials.
- F. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing **[paint]** **[film]** and substrates on which mirrors are installed.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which mirror manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1. Warranty Period: Minimum **[five (5)]** <Insert number> years from date of **[Substantial Completion]** **[manufacture]**.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 SILVERED FLAT GLASS MIRRORS

A. Glass Mirrors, General: ASTM C 1503[; **manufactured using copper-free, low-lead mirror coating process**].

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Arch Aluminum & Glass Co., Inc.
- b. Avalon Glass and Mirror Company.
- c. Binswanger Mirror; a division of Vitro America, Inc.
- d. D & W Incorporated
- e. Donisi Mirror Company.
- f. Gardner Glass, Inc.
- g. Gilded Mirrors, Inc.
- h. Guardian Industries.
- i. Head West.
- j. Independent Mirror Industries, Inc.
- k. Lenoir Mirror Company.
- l. Maran-Wurzell Glass & Mirror.
- m. National Glass Industries.
- n. Stroupe Mirror Co., Inc.
- o. Sunshine Mirror; Westshore Glass Corp.
- p. Virginia Mirror Company, Inc.
- q. Walker Glass Co., Ltd.
- r. **<Insert manufacturer's name>**.
- s. or approved equal.

B. Clear Glass: Mirror [**Select**] [**Glazing**] Quality[; **ultraclear (low-iron) float glass with a minimum 91 percent visible light transmission**].

1. Nominal Thickness: [**3.0 mm**] [**4.0 mm**] [**5.0 mm**] [**6.0 mm**] [**As indicated**] **<Insert thickness>**.

C. Tinted Glass: Mirror Glazing Quality.

1. Nominal Thickness: [**3.0 mm**] [**4.0 mm**] [**5.0 mm**] [**6.0 mm**] [**As indicated**] **<Insert thickness>**.

2. Tint Color: [**Blue**] [**Black**] [**Bronze**] [**Gold**] [**Gray**] [**Green**] [**Peach**] [**Pink**] **<Insert color>**.

D. Tempered [**Clear**] [**Tinted**] Glass: Mirror Glazing Quality, for blemish requirements; and comply with ASTM C 1048 for Kind FT, Condition A, tempered float glass before silver coating is applied.

1. Nominal Thickness: [**3.0 mm**] [**4.0 mm**] [**5.0 mm**] [**6.0 mm**] [**As indicated**] **<Insert thickness>**.

2. Tint Color: **[Blue] [Black] [Bronze] [Gold] [Gray] [Green] [Peach] [Pink] <Insert color>**.

E. Laminated Mirrors: ASTM C 1172, Kind LM.

1. Clear Glass for Outer Lite: Mirror **[Select] [Glazing] Quality[; ultraclear (low-iron) float glass with a minimum 91 percent visible light transmission]**.
2. Tinted Glass for Outer Lite: Mirror Glazing Quality.
 - a. Tint Color: **[Blue] [Black] [Bronze] [Gold] [Gray] [Green] [Peach] [Pink] <Insert color>**.
3. Nominal Thickness for Outer Lite: **[3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] [As indicated] <Insert thickness>**.
4. Glass for Inner Lite: Annealed float glass; ASTM C 1036, Type I (transparent flat glass), Quality-Q3; Class 1 (clear).
5. Glass for Inner Lite: Heat-treated float glass; ASTM C 1048 Type I; Quality-Q3; Class I (clear) Kind HS, Condition A.
6. Glass for Inner Lite: Tempered float glass; ASTM C 1048 Type I; Quality-Q3; Class I (clear), Kind FT, Condition A.
7. Nominal Thickness: **[3.0 mm] [4.0 mm] [5.0 mm] [6.0 mm] [As indicated] <Insert thickness>**.
8. Interlayer: Mirror manufacturer's standard **0.030-inch-** (0.76-mm-) thick, clear polyvinyl-butylal interlayer with a proven record of showing no tendency to delaminate from, or cause damage to, silver coating.

2.2 MISCELLANEOUS MATERIALS

- A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
- C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Franklin International; Titebond Division.
 - b. Laurence, C. R. Co., Inc.
 - c. Macco Adhesives; Liquid Nails Division.
 - d. OSI Sealants, Inc.
 - e. Palmer Products Corporation.
 - f. Pecora Corporation.
 - g. Royal Adhesives & Sealants; Gunther Mirror Mastics Division.
 - h. Sommer & Maca Industries, Inc.

- i. **<Insert manufacturer's name>**.
 - j. or approved equal.
2. Adhesive shall have a VOC content of not more than [70] **<Insert number>** g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

2.3 MIRROR HARDWARE

- A. Top and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.
1. Bottom Trim: J-channels formed with front leg and back leg not less than **3/8 and 7/8 inch** (9.5 and 22 mm) in height, respectively, and a thickness of not less than **[0.04 inch** (1.0 mm)] **[0.05 inch** (1.3 mm)].
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Laurence, C. R. Co., Inc.; CRL Standard "J" Channel.
 - 2) Sommer & Maca Industries, Inc.; Aluminum Shallow Nose "J" Moulding Lower Bar.
 - 3) Sommer & Maca Industries, Inc.; Heavy Gauge Aluminum Shallow Nose "J" Moulding Lower Bar.
 - 4) **<Insert manufacturer's name; product name or designation>**.
 - 5) or approved equal.
 2. Top Trim: J-channels formed with front leg and back leg not less than **5/8 and 1 inch** (16 and 25 mm) in height, respectively, and a thickness of not less than **[0.04 inch** (1.0 mm)] **[0.062 inch** (1.57 mm)].
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Laurence, C. R. Co., Inc.; CRL Deep "J" Channel.
 - 2) Sommer & Maca Industries, Inc.; Aluminum Deep Nose "J" Moulding Upper Bar.
 - 3) Sommer & Maca Industries, Inc.; Heavy Gauge Aluminum Deep Nose "J" Moulding Lower Bar.
 - 4) **<Insert manufacturer's name; product name or designation>**.
 - 5) or approved equal.

3. Finish: **[Clear] [Gold]** bright anodized.
 - B. Top Channel/Cleat and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.
 1. Bottom Trim: J-channels formed with front leg and back leg not less than **5/16 and 3/4 inch** (7.9 and 19 mm) in height, respectively.
 - a. Product: Subject to compliance with requirements, provide D638 FHA Type "J" Channel by Laurence, C. R. Co., Inc.
 2. Top Trim: Formed with front leg with a height of **5/16 inch** (7.9 mm) and back leg designed to fit into the pocket created by wall-mounted aluminum cleat.
 - a. Product: Subject to compliance with requirements, provide D 1638 Top Channel and D 1637M Mirror Mount System Cleat by Laurence, C. R. Co., Inc.
 3. Finish: **[Clear] [Gold]** bright anodized.
 - C. Mirror Bottom Clips: **[As indicated]** <Insert description or product designation, finish, and manufacturer's name>.
 - D. Mirror Top Clips: **[As indicated]** <Insert description or product designation, finish, and manufacturer's name>.
 - E. Plated Steel Hardware: Formed-steel shapes with plated finish indicated.
 1. Profile: As indicated.
 2. Finish: **<Insert manufacturer's finish designation and name>**.
 - F. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
 - G. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.
- 2.4 FABRICATION
- A. Mirror Sizes: To suit Project conditions, **[and before tempering]**, cut mirrors to final sizes and shapes.
 - B. Cutouts: Fabricate cutouts **[before tempering]** for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.

- C. Mirror Edge Treatment: **[Flat polished] [Rounded polished] [Flat high-polished] [Rounded high-polished] [Beveled polished edge of width shown]**.
1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
 2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.
- D. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint as recommended in writing by film-backing manufacturer to produce a surface free of bubbles, blisters, and other imperfections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.
- B. Verify compatibility with and suitability of substrates, including compatibility of mirror mastic with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

- A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

- A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
- B. Provide a minimum air space of **1/8 inch (3 mm)** between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.
- C. Wall-Mounted Mirrors: Install mirrors with **[mastic and]**mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
- a. Top and Bottom Aluminum J-Channels: Provide setting blocks **1/8 inch (3**

- mm) thick by 4 inches (100 mm) long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch (6.4 mm) wide by 3/8 inch (9.5 mm) long at bottom channel.
2. Top Channel/Cleat and Bottom Aluminum J-Channels: Fasten J-channel directly to wall and attach top trim to continuous cleat fastened directly to wall.
 3. Mirror Clips: Place a felt or plastic pad between mirror and each clip to prevent spalling of mirror edges. Locate clips **[where indicated] [so they are symmetrically placed and evenly spaced]**.
 4. Install mastic as follows:
 - a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
 - b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
 - c. After mastic is applied, align mirrors and press into place while maintaining a minimum air space of 1/8 inch (3 mm) between back of mirrors and mounting surface.

3.4 CLEANING AND PROTECTION

- A. Protect mirrors from breakage and contaminating substances resulting from construction operations.
- B. Do not permit edges of mirrors to be exposed to standing water.
- C. Maintain environmental conditions that will prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.
- D. Wash exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash mirrors as recommended in writing by mirror manufacturer.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 088300

SECTION 088853 - SECURITY GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes glazing for the following products and applications and of the following types:
 - 1. Products and applications specified in other Sections where glazing requirements are specified by reference to this Section:
 - a. **[Steel detention] [Steel]** doors.
 - b. Glazed entrances.
 - c. Storefront framing.
 - d. Interior borrowed lites.
 - e. Glazed curtain walls.
 - f. Sloped glazing.
 - g. **[Security] [Detention] [Aluminum] [Steel]** windows.
 - 2. Security Glazing Types:
 - a. Monolithic polycarbonate.
 - b. Laminated glass.
 - c. Laminated polycarbonate.
 - d. Glass-clad polycarbonate.
 - e. Laminated glass and polycarbonate.
 - f. Insulating security glazing.
 - g. Air-gap security glazing.
- B. Related Sections:
 - 1. Section 088000 "Glazing" for nonsecurity glazing in the form of monolithic glass, laminated glass, and insulating glass.
 - 2. Section 088400 "Plastic Glazing" for nonsecurity glazing in the form of monolithic and double-walled structured plastic sheets.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. Glazing Manufacturers: Firms that produce primary glass, monolithic plastic glazing, or fabricated security glazing, as defined in referenced glazing publications.
- B. Interspace: Space between lites of air-gap security glazing or insulating security glazing.

1.4 PERFORMANCE REQUIREMENTS

- A. General:
 - 1. Installed security glazing shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing; or other defects in construction.
 - 2. Installed security glazing shall withstand security-related loads and forces without damage to the glazing beyond that allowed by referenced standards.
- B. Delegated Design: Design security glazing, including comprehensive engineering analysis by a qualified professional engineer.
 - 1. Design Procedure for Glass: Design according to **[ASTM E 1300] [ICC's 2003 International Building Code]**.
 - 2. Design Wind Pressures: As indicated on Drawings.
 - 3. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
 - a. Wind Design Data: As indicated on Drawings.
 - b. Basic Wind Speed: **115 mph (50 m/s) <Insert value>**.
 - c. Importance Factor: **1.3 <Insert factor>**.
 - d. Exposure Category: **D**.
 - 4. Design Snow Loads: **[As indicated on Drawings] <Insert design snow load>**.
 - 5. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
 - 6. Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass to resist each of the following combinations of loads:
 - a. Outward design wind pressure minus the weight of the glass. Base design on glass type factors for short-duration load.
 - b. Inward design wind pressure plus the weight of the glass plus half of the design snow load. Base design on glass type factors for short-duration load.
 - c. Half of the inward design wind pressure plus the weight of the glass plus the design snow load. Base design on glass type factors for long-duration load.

7. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
8. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glazing framing members and glazing components.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each security glazing type, tape sealant, gasket, glazing accessory, and glazing-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to security glazing, tape sealants, gaskets, and glazing channel substrates.
3. Test no fewer than [eight] <Insert number> Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For sealants used inside the weatherproofing system, documentation indicating that they comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Security Glazing Samples: For each type of security glazing; **12 inches** (300 mm) square.
- D. Glazing Accessory Samples: For **[gaskets] [sealants] [and] [colored spacers]**, in **12-inch** (300-mm) lengths. **[Install sealant Samples between two strips of material representative in color of the adjoining framing system.]**
- E. Security Glazing Schedule: List security glazing types and thicknesses for each size opening and location. Use same designations indicated on Drawings. Indicate coordinated dimensions of security glazing and construction that receives security glazing, including clearances and glazing channel dimensions.
- F. Delegated-Design Submittal: For security glazing indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[installers] [manufacturers of insulating security glazing with sputter-coated, low-e coatings] [glazing testing agency] [and] [sealant testing agency]**.
- B. Product Certificates: For each type of product indicated, from manufacturer.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of **[security glazing] [glazing sealant] [and] [glazing gasket]**.
 - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Preconstruction adhesion and compatibility test reports.
- E. Warranties: Sample of special warranties.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating Security Glazing Units with Sputter-Coated, Low-E Coatings: A qualified insulating glazing manufacturer who is approved **[and certified]** by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glazing installers for this Project who are certified under the National Glass Association Glazier Certification Program.
- C. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

- D. Source Limitations for Security Glazing: Obtain security glazing from single source from single manufacturer using the same type of lites, plies, interlayers, and spacers for each security glazing type indicated.
1. Source Limitations for Tinted Glass: Obtain tinted glass from single source from single primary glass manufacturer for each tint color indicated.
- E. Source Limitations for Glazing [**Sealants**] [**and**] [**Gaskets**]: Obtain from single source from single manufacturer for each product and installation method.
- F. Glazing Publications: Comply with published recommendations of security glazing and glazing material manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. GANA Publications: [**GANA's "Laminated Glazing Reference Manual" and**] GANA's "Glazing Manual."
 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- G. Plastic Glazing Labeling: Identify plastic sheets with appropriate markings of applicable testing and inspecting agency, indicating compliance with required fire-test-response characteristics.
- H. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of [**the SGCC**] [**or another certification agency acceptable to authorities having jurisdiction**] [**or**] [**manufacturer**]. Label shall indicate manufacturer's name, type of glazing, thickness, and safety glazing standard with which glazing complies.
- I. Insulating Glazing Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- J. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Install security glazing in mockups specified in [**Section 084113 "Aluminum-Framed Entrances and Storefronts"**] [**Section 084413 "Glazed Aluminum Curtain Walls"**] [**Section 085113 "Aluminum Windows"**] [**Section 085653 "Security Windows"**] [**Section 087163 "Detention Windows"**] <Insert Section number>-<Insert Section title> to match glazing systems required for Project, including glazing methods.
 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

K. Preinstallation Conference: Conduct conference at **[Project site]** <**[location and time as determined by DEN Project Manager]**Insert location>.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for security glazing during and after installation.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect security glazing and glazing materials according to manufacturer's written instructions. Prevent damage from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating security glazing and with air-gap security glazing manufacturers' written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F (4.4 deg C).

1.11 COORDINATION

- A. Coordinate dimensions, including thickness, of security glazing with dimensions of construction that receives security glazing.

1.12 WARRANTY

- A. Manufacturer's Special Warranty for Coated Glass: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated glass that deteriorates within specified warranty period. Deterioration is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
1. Warranty Period: Minimum **[ten (10)]** <Insert number> years from date of Substantial Completion.

- B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated glass that deteriorates within specified warranty period. Deterioration is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
1. Warranty Period: Minimum **[five (5)] [ten (10)] <Insert number>** years from date of Substantial Completion.
- C. Manufacturer's Special Warranty for Polycarbonate Sheet: Manufacturer's standard form in which glazing manufacturer agrees to replace polycarbonate sheet that deteriorates within specified warranty period. Deterioration is defined as defects developed from normal use that are not attributed to maintaining and cleaning polycarbonate sheet contrary to manufacturer's written instructions. Defects include yellowing and loss of light transmission.
1. Warranty Period: Minimum **[ten (10)] <Insert number>** years from date of Substantial Completion.
- D. Manufacturer's Special Warranty for Laminated Polycarbonate: Manufacturer's standard form in which laminated polycarbonate manufacturer agrees to replace laminated polycarbonate that deteriorates within specified warranty period. Deterioration is defined as defects developed from normal use that are not attributed to maintaining and cleaning laminated polycarbonate contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glazing, blemishes exceeding those allowed by referenced standard, yellowing, and loss of light transmission.
1. Warranty Period: Minimum **[five (5)] [ten (10)] <Insert number>** years from date of Substantial Completion.
- E. Manufacturer's Special Warranty for Glass-Clad Polycarbonate: Manufacturer's standard form in which glass-clad polycarbonate manufacturer agrees to replace glass-clad polycarbonate that deteriorates within specified warranty period. Deterioration is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning glass-clad polycarbonate contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glazing, blemishes exceeding those allowed by referenced glass-clad polycarbonate standard, yellowing, and loss of light transmission.
1. Warranty Period: Minimum **[five (5)] [ten (10)] <Insert number>** years from date of Substantial Completion.
- F. Manufacturer's Special Warranty for Laminated Glass and Polycarbonate: Manufacturer's standard form in which laminated-glass-and-polycarbonate manufacturer agrees to replace laminated glass and polycarbonate that deteriorates within specified warranty period. Deterioration is defined as defects developed from

normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass and polycarbonate contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glazing, blemishes exceeding those allowed by referenced glass-clad polycarbonate standard, yellowing, and loss of light transmission.

1. Warranty Period: Minimum **[five (5)] [ten (10)] <Insert number>** years from date of Substantial Completion.

G. Manufacturer's Special Warranty on Insulating Security Glazing: Manufacturer's standard form in which insulating security glazing manufacturer agrees to replace insulating security glazing that deteriorates within specified warranty period. Deterioration is defined as defects in individual lites developed from normal use or failure of hermetic seal under normal use. Deterioration does not include defects in individual lites or failure of hermetic seal that is attributed to glass breakage or to maintaining and cleaning insulating security glazing contrary to manufacturer's written instructions.

1. Defects in coated glass lites include peeling, cracking, and other indications of deterioration in coating.
2. Defects in laminated-glass lites include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
3. Defects in glass-clad polycarbonate lites include edge separation, delamination materially obstructing vision through glazing, blemishes exceeding those allowed by referenced glass-clad polycarbonate standard, yellowing, and loss of light transmission.
4. Evidence of hermetic seal failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glazing.
5. Warranty Period: Minimum **[five (5)] [ten (10)] <Insert number>** years from date of Substantial Completion.

1.13 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 SECURITY GLAZING, GENERAL

- A. Thickness: Where thickness is indicated, it is a minimum. Provide security glazing in thicknesses as needed to comply with requirements indicated.
- B. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

- C. Fire-Test-Response Characteristics of Plastic Sheets: As determined by testing plastic sheets identical to those used in security glazing products by a qualified testing agency acceptable to authorities having jurisdiction.
1. Self-ignition temperature of **650 deg F** (343 deg C) or more when tested per ASTM D 1929 on plastic sheets in thicknesses indicated for the Work.
 2. Smoke-developed index of 450 or less when tested according to ASTM E 84, or smoke density of 75 or less when tested per ASTM D 2843 on plastic sheets in thicknesses indicated for the Work.
 3. Burning [**extent of 1 inch** (25 mm)] [**rate of 2.5 in./min.** (1.06 mm/s)] or less when tested per ASTM D 635 at a nominal thickness of **0.060 inch** (1.52 mm) or thickness indicated for the Work.
- D. Windborne-Debris-Impact Resistance: Provide exterior security glazing that passes [**basic**] [**enhanced**]-protection testing requirements in ASTM E 1996 for [**Wind Zone 1**] [**Wind Zone 2**] [**Wind Zone 3**] [**Wind Zone 4**] when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than security glazing indicated for use on the Project and shall be installed in same manner as indicated for use on the Project.
1. Large-Missile Test: For security glazing located within **30 feet** (9.1 m) of grade.
 2. Small-Missile Test: For security glazing located more than **30 feet** (9.1 m) above grade.
 3. Large-Missile Test: For all security glazing, regardless of height above grade.
- E. Thermal and Optical Performance Properties: Provide security glazing with performance properties specified, as indicated in manufacturer's published test data, based on products of construction indicated and on procedures indicated below:
1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as **Btu/sq. ft. x h x deg F** (W/sq. m x K).
 2. Solar-Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 2. For heat-strengthened float glass, comply with requirements for Kind HS.
 3. For fully tempered float glass, comply with requirements for Kind FT.
 4. For uncoated glass, comply with requirements for Condition A.

5. For coated vision glass, comply with requirements for Condition C (other coated glass).
- C. Chemically Strengthened Glass: Annealed float glass chemically strengthened to comply with ASTM C 1422, Surface Compression [**Level 1**] [**Level 2**] [**Level 3**] [**Level 4**] [**Level 5**] and Case Depth [**Level A**] [**Level B**] [**Level C**] [**Level D**] [**Level E**] [**Level F**].
- D. Reflective-Coated Vision Glass: ASTM C 1376, Kind CV (coated vision glass), coated by [**pyrolytic process**] [**vacuum deposition (sputter-coating) process**], and complying with other requirements specified.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name>**.
 - b. or approved equal.

2.3 LAMINATED GLASS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. **<Insert, in separate subparagraphs, manufacturer's name>**.
 2. or approved equal.
- B. Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 1. Construction: Laminate glass with [**polyvinyl butyral interlayer**] [**or**] [**cast-in-place and cured-transparent-resin interlayer**] to comply with interlayer manufacturer's written recommendations.
 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 3. Interlayer Color: Clear unless otherwise indicated.
- C. Windborne-Debris-Impact-Resistant Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, with "Windborne-Debris-Impact Resistance" Paragraph, and with other requirements specified.
 1. Construction: Laminate glass with[**one of**] the following to comply with interlayer manufacturer's written recommendations:
 - a. Polyvinyl butyral interlayer.
 - b. Polyvinyl butyral interlayers reinforced with polyethylene terephthalate film.
 - c. Ionoplast interlayer.
 - d. Cast-in-place and cured-transparent-resin interlayer.

- e. Cast-in-place and cured-transparent-resin interlayer reinforced with polyethylene terephthalate film.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

2.4 POLYCARBONATE SECURITY GLAZING

- A. Polycarbonate Sheet: ASTM C 1349, Appendix X1, Type II, coated, mar-resistant, UV-stabilized polycarbonate with coating on exposed surfaces and Type I, standard, UV-stabilized polycarbonate where no surfaces are exposed.
- B. Laminated Polycarbonate: Polycarbonate sheets laminated with clear urethane interlayer that complies with ASTM C 1349, Appendix X2, and has a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation. Provide laminated units that comply with requirements of ASTM C 1349 for maximum allowable laminating process blemishes and haze.
- C. Glass-Clad Polycarbonate: ASTM C 1349, and other requirements specified.
 1. Provide glass-clad polycarbonate that complies with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified.
- D. Laminated Glass and Polycarbonate: ASTM C 1349, and other requirements specified.
 1. Provide laminated glass and polycarbonate that complies with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified.

2.5 SPALL-RESISTANT FILM

- A. Spall-Resistant Film: Composite of clear polyvinyl butyral film and clear abrasion-resistant polyester film.
 1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. DuPont Glass Laminating Solutions, DuPont Company; SpallShield.
 - b. **<Insert manufacturer's name; product name or designation>.**
 - c. or approved equal.
- B. Laminating Process: Laminate spall-resistant film to glazing assemblies in factory to produce laminated lites free of foreign substances, air, and glass pockets.

2.6 INSULATING SECURITY GLAZING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. <Insert, in separate subparagraphs, manufacturer's name>.
2. or approved equal.

B. Insulating Security Glazing: Factory-assembled units consisting of sealed lites separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.

1. Sealing System: Dual seal, with [manufacturer's standard] [polyisobutylene and polysulfide] [polyisobutylene and silicone] [polyisobutylene and hot-melt butyl] [polyisobutylene and polyurethane] primary and secondary.
2. Spacer: [Manufacturer's standard spacer material and construction] [Aluminum with mill or clear anodic finish] [Aluminum with black, color anodic finish] [Aluminum with bronze, color anodic finish] [Aluminum with powdered metal paint finish in color selected by DEN Project Manager] [Galvanized steel] [Stainless steel] [Polypropylene-covered stainless steel in color selected by DEN Project Manager] [Thermally broken aluminum] [Nonmetallic laminate] [Nonmetallic tube] <Insert material>.
3. Desiccant: Molecular sieve or silica gel, or blend of both.

2.7 AIR-GAP SECURITY GLAZING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. <Insert, in separate subparagraphs, manufacturer's name>.
2. or approved equal.

B. Air-Gap Security Glazing: Factory-assembled units consisting of sealed lites separated by a dehydrated interspace and complying with other requirements specified.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
2. Spacer Specifications: Manufacturer's standard[**rigid**] spacer material and construction.

2.8 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from[**one of**] the following:

1. Neoprene complying with ASTM C 864.
2. EPDM complying with ASTM C 864.
3. Silicone complying with ASTM C 1115.
4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned [neoprene] [EPDM] [silicone] [or] [thermoplastic polyolefin rubber] gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.9 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including security glazing, seals of insulating security glazing and air-gap security glazing, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and security glazing manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Sealants used inside the weatherproofing system shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.
4. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
5. Colors of Exposed Glazing Sealants: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**].

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. [Dow Corning Corporation; 790.](#)
 - b. [GE Advanced Materials - Silicones; SilPruf LM SCS2700.](#)
 - c. [May National Associates, Inc.; Bondaflex Sil 290.](#)
 - d. [Pecora Corporation; 890.](#)
 - e. [Sika Corporation, Construction Products Division; SikaSil-C990.](#)
 - f. [Tremco Incorporated; Spectrem 1.](#)
 - g. **<Insert manufacturer's name; product name or designation>.**
 - h. or approved equal.
2. Applications: **<Describe types of glazing applications where this sealant is required>.**

C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. [BASF Construction Chemicals, LLC; Omniseal 50.](#)

- b. [Dow Corning Corporation](#); [756 SMS] [791] [795] [995].
 - c. [GE Advanced Materials - Silicones](#); [SilGlaze II SCS2800] [SilPruf NB SCS9000] [SilPruf SCS2000] [UltraPruf II SCS2900].
 - d. [May National Associates, Inc.; Bondaflex Sil 295](#).
 - e. [Pecora Corporation](#); [864] [895] [898].
 - f. [Polymeric Systems, Inc.; PSI-641](#).
 - g. [Sika Corporation, Construction Products Division; SikaSil-C995](#).
 - h. [Tremco Incorporated](#); [Spectrem 2] [Spectrem 3].
 - i. <Insert manufacturer's name; product name or designation>.
 - j. or approved equal.
2. Applications: <Describe types of glazing applications where this sealant is required>.
- D. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. [Dow Corning Corporation; 799](#).
 - b. [GE Advanced Materials - Silicones](#); [UltraGlaze SSG4000] [UltraGlaze SSG4000AC].
 - c. [May National Associates, Inc.](#); [Bondaflex Sil 200 GPN] [Bondaflex Sil 201 FC].
 - d. [Polymeric Systems, Inc.; PSI-631](#).
 - e. [Schnee-Morehead, Inc., an ITW company; SM5731 Poly-Glaze Plus](#).
 - f. [Tremco Incorporated](#); [Proglaze SSG] [Tremsil 600].
 - g. <Insert manufacturer's name; product name or designation>.
 - h. or approved equal.
 2. Applications: <Describe types of glazing applications where this sealant is required>.
- E. Glazing Sealant: Acid-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. [BASF Construction Chemicals, LLC; OmniPlus](#).
 - b. [Bostik, Inc.; Chem-Calk 1200](#).
 - c. [Dow Corning Corporation; 999-A](#).
 - d. [GE Advanced Materials - Silicones](#); [Contractors SCS1000] [Construction SCS1200].
 - e. [May National Associates, Inc.](#); [Sil 100 GC] [Sil 100 GP] [Sil 100 WF].
 - f. [Pecora Corporation; 860](#).
 - g. [Polymeric Systems, Inc.; PSI-601](#).
 - h. [Schnee-Morehead, Inc., an ITW company; SM5732 Polyglaze](#).
 - i. [Tremco Incorporated](#); [Proglaze] [Tremsil 200].
 - j. <Insert manufacturer's name; product name or designation>.
 - k. or approved equal.

2. Applications: **<Describe types of glazing applications where this sealant is required>**.

2.10 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and security glazing manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.11 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of security glazing and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by security glazing manufacturer to maintain security glazing lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit security glazing lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.12 FABRICATION OF SECURITY GLAZING

- A. Fabricate security glazing in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

2.13 LAMINATED-GLASS SECURITY GLAZING TYPES

- A. Security Glazing [**Type SG-<#>**]: [**Clear laminated glass**] [**Tinted laminated glass**] [**Clear reflective-coated laminated glass**] [**Tinted reflective-coated laminated glass**].
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.
 2. Forced-Entry Resistance: [**Class I**] [**Class II**] [**Class III**] [**Class IV**] [**Class V**] per ASTM F 1233.
 3. Forced-Entry Resistance: [**Level I**] [**Level II**] [**Level III**] [**Level IV**] [**Level V**] per HPW-TP-0500.03.
 4. Ballistic Resistance: [**Class/Level HG1**] [**Class/Level HG2**] [**Class/Level HG3**] [**Class/Level HG4**] [**Class/Level SMG**] [**Class/Level R1**] [**Class/Level R2**] [**Class/Level R3**] [**Class/Level R4-AP**] [**Class/Level SH1**] [**Class/Level SH2**] per ASTM F 1233.
 5. Ballistic Resistance: [**Level 1**] [**Level 2**] [**Level 3**] [**Level 4**] [**Level 5**] [**Level 6**] [**Level 7**] [**Level 8**] [**Level 1-SG**] [**Level 2-SG**] [**Level 3-SG**] [**Level 4-SG**] [**Level 5-SG**] [**Level 6-SG**] [**Level 7-SG**] [**Level 8-SG**] per UL 752.
 6. Blast Resistance:
 - a. Hazard Rating: [**No hazard**] [**Minimal hazard**] [**Very low hazard**] [**Low hazard**] [**High hazard**] per ASTM F 1642.
 - b. Performance Condition: [**1**] [**2**] [**3a**] [**3b**] [**4**] [**5**] per GSA-TS01.
 - c. Peak Pressure: **<Insert requirement>**.
 - d. Positive Phase Impulse: **<Insert requirement>**.
 7. Number of Plies: [**Two**] [**Three**].
 8. Overall Unit Thickness: **<Insert dimension>**.
 9. Outer Ply: [**3-mm**] [**5-mm**] [**6-mm**] **<Insert dimension>** [**float glass**] [**heat-strengthened float glass**] [**fully tempered float glass**] [**chemically strengthened float glass**].
 10. Core Ply: [**3-mm**] [**5-mm**] [**6-mm**] **<Insert dimension>** [**float glass**] [**heat-strengthened float glass**] [**fully tempered float glass**] [**chemically strengthened float glass**].
 11. Inner Ply: [**3-mm**] [**5-mm**] [**6-mm**] **<Insert dimension>** [**float glass**] [**heat-strengthened float glass**] [**fully tempered float glass**] [**chemically strengthened float glass**].

12. Interlayer Thickness: [0.030 inch (0.76 mm)] [0.060 inch (1.52 mm)] [0.090 inch (2.3 mm)].
 13. Glass Tint Color: [Blue] [Blue-green] [Bronze] [Green] [Gray] <Insert color>.
 14. Tinted Glass Location: Outer ply.
 15. Coating Color: [Gold] [Pewter] [Silver] <Insert color>.
 16. Coating Location: [Second] [Third] [Fifth] surface.
 17. Overall Visible Light Transmittance: <Insert single percentage or range>.
 18. Outdoor Visible Reflectance: <Insert number> percent maximum.
 19. Winter Nighttime U-Factor: <Insert value> maximum.
 20. Summer Daytime U-Factor: <Insert value> maximum.
 21. Solar Heat-Gain Coefficient: <Insert value> maximum.
 22. Provide safety glazing labeling.
- B. Security Glazing [**Type SG-#>**]: Tinted[**reflective-coated**] laminated glass with clear glass and tinted interlayer.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. <Insert, in separate subparagraphs, manufacturer's name; product name or designation>.
 - b. or approved equal.
 2. Forced-Entry Resistance: [Class I] [Class II] [Class III] [Class IV] [Class V] per ASTM F 1233.
 3. Forced-Entry Resistance: [Level I] [Level II] [Level III] [Level IV] [Level V] per HPW-TP-0500.03.
 4. Ballistic Resistance: [Class/Level HG1] [Class/Level HG2] [Class/Level HG3] [Class/Level HG4] [Class/Level SMG] [Class/Level R1] [Class/Level R2] [Class/Level R3] [Class/Level R4-AP] [Class/Level SH1] [Class/Level SH2] per ASTM F 1233.
 5. Ballistic Resistance: [Level 1] [Level 2] [Level 3] [Level 4] [Level 5] [Level 6] [Level 7] [Level 8] [Level 1-SG] [Level 2-SG] [Level 3-SG] [Level 4-SG] [Level 5-SG] [Level 6-SG] [Level 7-SG] [Level 8-SG] per UL 752.
 6. Blast Resistance:
 - a. Hazard Rating: [No hazard] [Minimal hazard] [Very low hazard] [Low hazard] [High hazard] per ASTM F 1642.
 - b. Performance Condition: [1] [2] [3a] [3b] [4] [5] per GSA-TS01.
 - c. Peak Pressure: <Insert requirement>.
 - d. Positive Phase Impulse: <Insert requirement>.
 7. Number of Plies: [Two] [Three].
 8. Overall Unit Thickness: <Insert dimension>.
 9. Outer Ply: [3-mm] [5-mm] [6-mm] <Insert dimension> [float glass] [heat-strengthened float glass] [fully tempered float glass] [chemically strengthened float glass].
 10. Core Ply: [3-mm] [5-mm] [6-mm] <Insert dimension> [float glass] [heat-strengthened float glass] [fully tempered float glass] [chemically strengthened float glass].

11. Inner Ply: [3-mm] [5-mm] [6-mm] <Insert dimension> [float glass] [heat-strengthened float glass] [fully tempered float glass] [chemically strengthened float glass].
12. Interlayer Thickness: [0.030 inch (0.76 mm)] [0.060 inch (1.52 mm)] [0.090 inch (2.3 mm)].
13. Interlayer Color: [Clear] [Blue-green] [Bronze light] [Gray] <Insert color>.
14. Coating Color: [Gold] [Pewter] [Silver] <Insert color>.
15. Coating Location: [Second] [Third] [Fifth] surface.
16. Overall Visible Light Transmittance: <Insert single percentage or range>.
17. Outdoor Visible Reflectance: <Insert number> percent maximum.
18. Winter Nighttime U-Factor: <Insert value> maximum.
19. Summer Daytime U-Factor: <Insert value> maximum.
20. Solar Heat-Gain Coefficient: <Insert value> maximum.
21. Provide safety glazing labeling.

2.14 MONOLITHIC POLYCARBONATE SECURITY GLAZING TYPES

- A. Security Glazing [Type SG-<#>]: Monolithic polycarbonate with mar-resistant coating on both surfaces.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. <Insert, in separate subparagraphs, manufacturer's name; product name or designation>.
 - b. or approved equal.
 2. Detention Security Grade: Grade 4 per ASTM F 1915 [cold-temperature impact test] [warm-temperature impact test] [and] [torch and small blunt impactor test].
 3. Thickness: [3/8 inch (9.25 mm)] [1/2 inch (12.7 mm)] <Insert thickness>.

2.15 LAMINATED-POLYCARBONATE SECURITY GLAZING TYPES

- A. Security Glazing [Type SG-<#>]: Laminated polycarbonate.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. <Insert, in separate subparagraphs, manufacturer's name; product name or designation>.
 - b. or approved equal.
 2. Detention Security Grade: [Grade 1] [Grade 2] [Grade 3] [Grade 4] per ASTM F 1915 [cold-temperature impact test] [warm-temperature impact test] [and] [torch and small blunt impactor test].
 3. Forced-Entry Resistance: [Class I] [Class II] [Class III] [Class IV] [Class V] per ASTM F 1233.
 4. Forced-Entry Resistance: [Level I] [Level II] [Level III] [Level IV] [Level V] per HPW-TP-0500.03.

5. Blast Resistance:
 - a. Hazard Rating: **[No hazard] [Minimal hazard] [Very low hazard] [Low hazard] [High hazard]** per ASTM F 1642.
 - b. Performance Condition: **[1] [2] [3a] [3b] [4] [5]** per GSA-TS01.
 - c. Peak Pressure: **<Insert requirement>**.
 - d. Positive Phase Impulse: **<Insert requirement>**.
6. Number of Plies: **[Two] [Three] [Four]**.
7. Overall Unit Thickness: **<Insert dimension>**.
8. Outer and Inner Plies: **[0.118-inch (4.57-mm)] [0.177-inch (2.97-mm)] [0.236-inch (5.99-mm)]** polycarbonate.
9. **[Core Ply] [Core Plies]**: **[0.118-inch (4.57-mm)] [0.177-inch (2.97-mm)] [0.236-inch (5.99-mm)]** polycarbonate.
10. Interlayer Thicknesses: **[0.025 inch (0.635 mm)] <Insert dimension>**.

2.16 GLASS-CLAD POLYCARBONATE SECURITY GLAZING TYPES

- A. Security Glazing **[Type SG-<#>]**: **[Clear symmetrical glass-clad polycarbonate] [Tinted symmetrical glass-clad polycarbonate] [Clear reflective-coated symmetrical glass-clad polycarbonate] [Tinted reflective-coated symmetrical glass-clad polycarbonate]**.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.
 2. Detention Security Grade: **[Grade 1] [Grade 2] [Grade 3] [Grade 4]** per ASTM F 1915 **[cold-temperature impact test] [warm-temperature impact test] [and] [torch and small blunt impactor test]**.
 3. Forced-Entry Resistance: **[Class I] [Class II] [Class III] [Class IV] [Class V]** per ASTM F 1233.
 4. Forced-Entry Resistance: **[Level I] [Level II] [Level III] [Level IV] [Level V]** per HPW-TP-0500.03.
 5. Ballistic Resistance: **[Class/Level HG1] [Class/Level HG2] [Class/Level HG3] [Class/Level HG4] [Class/Level SMG] [Class/Level R1] [Class/Level R2] [Class/Level R3] [Class/Level R4-AP] [Class/Level SH1] [Class/Level SH2]** per ASTM F 1233.
 6. Ballistic Resistance: **[Level 1] [Level 2] [Level 3] [Level 4] [Level 5] [Level 6] [Level 7] [Level 8] [Level 1-SG] [Level 2-SG] [Level 3-SG] [Level 4-SG] [Level 5-SG] [Level 6-SG] [Level 7-SG] [Level 8-SG]** per UL 752.
 7. Blast Resistance:
 - a. Hazard Rating: **[No hazard] [Minimal hazard] [Very low hazard] [Low hazard] [High hazard]** per ASTM F 1642.
 - b. Performance Condition: **[1] [2] [3a] [3b] [4] [5]** per GSA-TS01.
 - c. Peak Pressure: **<Insert requirement>**.

- d. Positive Phase Impulse: **<Insert requirement>**.
8. Overall Unit Thickness: **<Insert dimension>**.
9. Outer Ply: **[3-mm] [5-mm] [6-mm] <Insert dimension> [heat-strengthened] [chemically strengthened]** float glass.
10. Single Core: **[0.118-inch (4.57-mm)] [0.177-inch (2.97-mm)] [0.236-inch (5.99-mm)]** polycarbonate.
11. Multiple Core:
 - a. Outer Core Ply: **[0.118-inch (4.57-mm)] [0.177-inch (2.97-mm)] [0.236-inch (5.99-mm)]** polycarbonate.
 - b. **[Single Inner Core Ply] [Double Inner Core Plies]: [0.118-inch (4.57-mm)] [0.177-inch (2.97-mm)] [0.236-inch (5.99-mm)]** polycarbonate.
12. Inner Ply: **[3-mm] [5-mm] [6-mm] <Insert dimension> [heat-strengthened] [chemically strengthened]** float glass.
13. Interlayer Thickness: **[0.025 inch (0.635 mm)] [0.050 inch (0.127 mm)] <Insert dimension>**.
14. Glass Tint Color: **[Blue] [Blue-green] [Bronze] [Green] [Gray] <Insert color>**.
15. Tinted Glass Location: Outer ply.
16. Coating Color: **[Gold] [Pewter] [Silver] <Insert color>**.
17. Coating Location: **[Second] [Third] [Fifth]** surface.
18. Overall Visible Light Transmittance: **<Insert single percentage or range>**.
19. Outdoor Visible Reflectance: **<Insert number>** percent maximum.
20. Winter Nighttime U-Factor: **<Insert value>** maximum.
21. Summer Daytime U-Factor: **<Insert value>** maximum.
22. Solar Heat-Gain Coefficient: **<Insert value>** maximum.
23. Provide safety glazing labeling.

2.17 LAMINATED-GLASS-AND-POLYCARBONATE SECURITY GLAZING TYPES

- A. Security Glazing **[Type SG-<#>]**: Nonsymmetrical **[clear] [tinted] [reflective-coated]** laminated glass and polycarbonate with glass plies on the attack or threat side and polycarbonate plies on the witness side.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.
 2. Detention Security Grade: **[Grade 1] [Grade 2] [Grade 3] [Grade 4]** per ASTM F 1915 **[cold-temperature impact test] [warm-temperature impact test] [and] [torch and small blunt impactor test]**.
 3. Forced-Entry Resistance: **[Class I] [Class II] [Class III] [Class IV] [Class V]** per ASTM F 1233.
 4. Forced-Entry Resistance: **[Level I] [Level II] [Level III] [Level IV] [Level V]** per HPW-TP-0500.03.

5. Ballistic Resistance: **[Class/Level HG1] [Class/Level HG2] [Class/Level HG3] [Class/Level HG4] [Class/Level SMG] [Class/Level R1] [Class/Level R2] [Class/Level R3] [Class/Level R4-AP] [Class/Level SH1] [Class/Level SH2]** per ASTM F 1233.
6. Ballistic Resistance: **[Level 1] [Level 2] [Level 3] [Level 4] [Level 5] [Level 6] [Level 7] [Level 8] [Level 1-SG] [Level 2-SG] [Level 3-SG] [Level 4-SG] [Level 5-SG] [Level 6-SG] [Level 7-SG] [Level 8-SG]** per UL 752.
7. Blast Resistance:
 - a. Hazard Rating: **[No hazard] [Minimal hazard] [Very low hazard] [Low hazard] [High hazard]** per ASTM F 1642.
 - b. Performance Condition: **[1] [2] [3a] [3b] [4] [5]** per GSA-TS01.
 - c. Peak Pressure: **<Insert requirement>**.
 - d. Positive Phase Impulse: **<Insert requirement>**.
8. Overall Unit Thickness: **<Insert dimension>**.
9. Makeup:
 - a. Outer Glass Ply: **[3-mm] <Insert dimension>** heat-strengthened float glass.
 - b. Interlayer Thickness: **[0.025 inch (0.635 mm)] [0.050 inch (0.127 mm)] <Insert dimension>**.
 - c. First Inner Glass Ply: **[12-mm] <Insert dimension>** float glass.
 - d. Interlayer Thickness: **[0.025 inch (0.635 mm)] [0.050 inch (0.127 mm)] <Insert dimension>**.
 - e. Second Inner Glass Ply: **[10-mm] <Insert dimension>** float glass.
 - f. Interlayer Thickness: **[0.025 inch (0.635 mm)] [0.050 inch (0.127 mm)] <Insert dimension>**.
 - g. Inner Polycarbonate Ply: **[0.118-inch (4.57-mm)] [0.177-inch (2.97-mm)] [0.236-inch (5.99-mm)]** Type I (standard, UV-stabilized) polycarbonate.
 - h. Interlayer Thickness: **[0.025 inch (0.635 mm)] [0.050 inch (0.127 mm)] <Insert dimension>**.
 - i. Outer Polycarbonate Ply: **[0.118-inch (4.57-mm)] [0.177-inch (2.97-mm)] [0.236-inch (5.99-mm)]** Type II (coated, mar-resistant, UV-stabilized) polycarbonate.
10. Glass Tint Color: **[Blue] [Blue-green] [Bronze] [Green] [Gray] <Insert color>**.
11. Tinted Glass Location: Outer glass ply.
12. Coating Color: **[Gold] [Pewter] [Silver] <Insert color>**.
13. Coating Location: **[Second] [Third] [Fifth]** surface.
14. Overall Visible Light Transmittance: **<Insert single percentage or range>**.
15. Outdoor Visible Reflectance: **<Insert number>** percent maximum.
16. Winter Nighttime U-Factor: **<Insert value>** maximum.
17. Summer Daytime U-Factor: **<Insert value>** maximum.
18. Solar Heat-Gain Coefficient: **<Insert value>** maximum.
19. Provide safety glazing labeling.

2.18 INSULATING SECURITY GLAZING TYPES

- A. Security Glazing [**Type SG-<#>**]: [**Clear insulating security glazing**] [**Tinted insulating security glazing**] [**Reflective-coated, clear insulating security glazing**] [**Reflective-coated, tinted insulating security glazing**]. Outdoor lite is monolithic glass and indoor lite is glass-clad polycarbonate.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.
 2. Detention Security Grade: [**Grade 1**] [**Grade 2**] [**Grade 3**] [**Grade 4**] per ASTM F 1915 [**cold-temperature impact test**] [**warm-temperature impact test**] [**and torch and small blunt impactor test**].
 3. Overall Unit Thickness: **<Insert dimension>**.
 4. Outdoor Lite: [**Float glass**] [**Heat-strengthened float glass**] [**Fully tempered float glass**].
 5. Indoor Lite: Glass-clad polycarbonate.
 - a. Outer Ply: [**3-mm**] [**5-mm**] [**6-mm**] **<Insert dimension>** [**heat-strengthened**] [**chemically strengthened**] [**fully tempered**] float glass.
 - b. Single Core: [**0.118-inch (4.57-mm)**] [**0.177-inch (2.97-mm)**] [**0.236-inch (5.99-mm)**] polycarbonate.
 - c. Multiple Core:
 - 1) Outer Core Ply: [**0.118-inch (4.57-mm)**] [**0.177-inch (2.97-mm)**] [**0.236-inch (5.99-mm)**] polycarbonate.
 - 2) [**Single Inner Core Ply**] [**Double Inner Core Plies**]: [**0.118-inch (4.57-mm)**] [**0.177-inch (2.97-mm)**] [**0.236-inch (5.99-mm)**] polycarbonate.
 - d. Inner Ply: [**3-mm**] [**5-mm**] [**6-mm**] **<Insert dimension>** [**heat-strengthened**] [**chemically strengthened**] [**fully tempered**] float glass.
 6. Interspace Content: [**Air**] [**Argon**].
 7. Interspace Dimension: **<Insert dimension>**.
 8. Glass Tint Color: [**Blue**] [**Blue-green**] [**Bronze**] [**Green**] [**Gray**] **<Insert color>**.
 9. Tinted Glass Location: Outdoor lite.
 10. Coating Color: [**Gold**] [**Pewter**] [**Silver**] **<Insert color>**.
 11. Coating Location: [**Second**] [**Third**] [**Fifth**] surface.
 12. Overall Visible Light Transmittance: **<Insert number>** percent minimum.
 13. Outdoor Visible Reflectance: **<Insert value>** percent maximum.
 14. Winter Nighttime U-Factor: **<Insert value>** maximum.
 15. Summer Daytime U-Factor: **<Insert value>** maximum.
 16. Solar Heat-Gain Coefficient: **<Insert value>** maximum.
 17. Provide safety glazing labeling.

- B. Security Glazing [**Type SG- $\langle\#\rangle$**]: [**Low-e-coated, clear insulating security glazing**] [**Low-e-coated, tinted insulating security glazing**]. Outdoor lite is monolithic glass and indoor lite is glass-clad polycarbonate.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **\langle Insert, in separate subparagraphs, manufacturer's name; product name or designation \rangle .**
 - b. or approved equal.
 2. Detention Security Grade: [**Grade 1**] [**Grade 2**] [**Grade 3**] [**Grade 4**] per ASTM F 1915 [**cold-temperature impact test**] [**warm-temperature impact test**] [**and**] [**torch and small blunt impactor test**].
 3. Overall Unit Thickness: **\langle Insert dimension \rangle .**
 4. Outdoor Lite: [**Float glass**] [**Heat-strengthened float glass**] [**Fully tempered float glass**].
 5. Indoor Lite: Glass-clad polycarbonate.
 - a. Outer Ply: [**3-mm**] [**5-mm**] [**6-mm**] **\langle Insert dimension \rangle** [**heat-strengthened**] [**chemically strengthened**] [**fully tempered**] float glass.
 - b. Single Core: [**0.118-inch (4.57-mm)**] [**0.177-inch (2.97-mm)**] [**0.236-inch (5.99-mm)**] polycarbonate.
 - c. Multiple Core:
 - 1) Outer Core Ply: [**0.118-inch (4.57-mm)**] [**0.177-inch (2.97-mm)**] [**0.236-inch (5.99-mm)**] polycarbonate.
 - 2) [**Single Inner Core Ply**] [**Double Inner Core Plies**]: [**0.118-inch (4.57-mm)**] [**0.177-inch (2.97-mm)**] [**0.236-inch (5.99-mm)**] polycarbonate.
 - d. Inner Ply: [**3-mm**] [**5-mm**] [**6-mm**] **\langle Insert dimension \rangle** [**heat-strengthened**] [**chemically strengthened**] [**fully tempered**] float glass.
 6. Interspace Content: [**Air**] [**Argon**].
 7. Interspace Dimension: **\langle Insert dimension \rangle .**
 8. Glass Tint Color: [**Blue**] [**Blue-green**] [**Bronze**] [**Green**] [**Gray**] **\langle Insert color \rangle .**
 9. Tinted Glass Location: Outer lite.
 10. Low-E Coating: [**Pyrolytic on second surface**] [**Pyrolytic on third surface**] [**Sputtered on second surface**] [**Sputtered on third surface**].
 11. Overall Visible Light Transmittance: **\langle Insert number \rangle** percent minimum.
 12. Winter Nighttime U-Factor: **\langle Insert value \rangle** maximum.
 13. Summer Daytime U-Factor: **\langle Insert value \rangle** maximum.
 14. Solar Heat-Gain Coefficient: **\langle Insert value \rangle** maximum.
 15. Provide safety glazing labeling.
- C. Security Glazing [**Type SG- $\langle\#\rangle$**]: [**Clear insulating security glazing**] [**Tinted insulating security glazing**] [**Reflective-coated, clear insulating security glazing**]

[Reflective-coated, tinted insulating security glazing]. Outdoor lite is laminated glass and indoor lite is glass-clad polycarbonate with spall-resistant film on inside face.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.
2. Detention Security Grade: **[Grade 1] [Grade 2] [Grade 3] [Grade 4]** per ASTM F 1915 **[cold-temperature impact test] [warm-temperature impact test] [and] [torch and small blunt impactor test]**.
3. Forced-Entry Resistance: **[Class I] [Class II] [Class III] [Class IV] [Class V]** per ASTM F 1233.
4. Forced-Entry Resistance: **[Level I] [Level II] [Level III] [Level IV] [Level V]** per HPW-TP-0500.03.
5. Ballistic Resistance: **[Class/Level HG1] [Class/Level HG2] [Class/Level HG3] [Class/Level HG4] [Class/Level SMG] [Class/Level R1] [Class/Level R2] [Class/Level R3] [Class/Level R4-AP] [Class/Level SH1] [Class/Level SH2]** per ASTM F 1233.
6. Ballistic Resistance: **[Level 1] [Level 2] [Level 3] [Level 4] [Level 5] [Level 6] [Level 7] [Level 8] [Level 1-SG] [Level 2-SG] [Level 3-SG] [Level 4-SG] [Level 5-SG] [Level 6-SG] [Level 7-SG] [Level 8-SG]** per UL 752.
7. Blast Resistance:
 - a. Hazard Rating: **[No hazard] [Minimal hazard] [Very low hazard] [Low hazard] [High hazard]** per ASTM F 1642.
 - b. Performance Condition: **[1] [2] [3a] [3b] [4] [5]** per GSA-TS01.
 - c. Peak Pressure: **<Insert requirement>**.
 - d. Positive Phase Impulse: **<Insert requirement>**.
8. Overall Unit Thickness: **<Insert dimension>**.
9. Outdoor Lite: Laminated glass with **[two plies of heat-strengthened float glass] [three plies of heat-strengthened float glass] [two outer plies of heat-strengthened float glass and two inner plies of annealed float glass]**.
 - a. Outer Ply Thickness: **[3 mm] [5 mm] [6 mm] <Insert dimension>**.
 - b. Core Ply Thickness: **[3 mm] [5 mm] [6 mm] <Insert dimension>**.
 - c. Inner Ply Thickness: **[3 mm] [5 mm] [6 mm] <Insert dimension>**.
 - d. Interlayer Thickness: **[0.030 inch (0.76 mm)] [0.060 inch (1.52 mm)] [0.090 inch (2.3 mm)]**.
10. Indoor Lite: Glass-clad polycarbonate faced with a **0.037-inch- (0.94-mm-)** thick, spall-resistant polyester film laminated to indoor face.
 - a. Outer Ply: **[3-mm] [5-mm] [6-mm] <Insert dimension> [heat-strengthened] [chemically strengthened]** float glass.
 - b. Single Core: **[0.118-inch (4.57-mm)] [0.177-inch (2.97-mm)] [0.236-inch (5.99-mm)]** polycarbonate.
 - c. Multiple Core:

- 1) Outer Core Ply: [0.118-inch (4.57-mm)] [0.177-inch (2.97-mm)] [0.236-inch (5.99-mm)] polycarbonate.
 - 2) [Single Inner Core Ply] [Double Inner Core Plies]: [0.118-inch (4.57-mm)] [0.177-inch (2.97-mm)] [0.236-inch (5.99-mm)] polycarbonate.
- d. Inner Ply: [3-mm] [5-mm] [6-mm] <Insert dimension> [heat-strengthened] [chemically strengthened] float glass.
11. Interspace Content: [Air] [Argon].
 12. Interspace Dimension: <Insert dimension>.
 13. Glass Tint Color: [Blue] [Blue-green] [Bronze] [Green] [Gray] <Insert color>.
 14. Tinted Glass Location: [Outer] [Inner] ply of outdoor lite.
 15. Coating Color: [Gold] [Pewter] [Silver] <Insert color>.
 16. Coating Location: [Second] [Third] [Fifth] surface.
 17. Overall Visible Light Transmittance: <Insert number> percent minimum.
 18. Outdoor Visible Reflectance: <Insert number> percent maximum.
 19. Winter Nighttime U-Factor: <Insert value> maximum.
 20. Summer Daytime U-Factor: <Insert value> maximum.
 21. Solar Heat-Gain Coefficient: <Insert value> maximum.
 22. Provide safety glazing labeling.

D. Security Glazing [Type SG-<#>]: [Low-e-coated, clear insulating security glazing] [Low-e-coated, tinted insulating security glazing]. Outdoor lite is laminated glass and indoor lite is glass-clad polycarbonate with spall-resistant film on inside face.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. <Insert, in separate subparagraphs, manufacturer's name; product name or designation>.
 - b. or approved equal.
2. Detention Security Grade: [Grade 1] [Grade 2] [Grade 3] [Grade 4] per ASTM F 1915 [cold-temperature impact test] [warm-temperature impact test] [and] [torch and small blunt impactor test].
3. Forced-Entry Resistance: [Class I] [Class II] [Class III] [Class IV] [Class V] per ASTM F 1233.
4. Forced-Entry Resistance: [Level I] [Level II] [Level III] [Level IV] [Level V] per HPW-TP-0500.03.
5. Ballistic Resistance: [Class/Level HG1] [Class/Level HG2] [Class/Level HG3] [Class/Level HG4] [Class/Level SMG] [Class/Level R1] [Class/Level R2] [Class/Level R3] [Class/Level R4-AP] [Class/Level SH1] [Class/Level SH2] per ASTM F 1233.
6. Ballistic Resistance: [Level 1] [Level 2] [Level 3] [Level 4] [Level 5] [Level 6] [Level 7] [Level 8] [Level 1-SG] [Level 2-SG] [Level 3-SG] [Level 4-SG] [Level 5-SG] [Level 6-SG] [Level 7-SG] [Level 8-SG] per UL 752.
7. Blast Resistance:
 - a. Hazard Rating: [No hazard] [Minimal hazard] [Very low hazard] [Low hazard] [High hazard] per ASTM F 1642.

- b. Performance Condition: [1] [2] [3a] [3b] [4] [5] per GSA-TS01.
 - c. Peak Pressure: <Insert requirement>.
 - d. Positive Phase Impulse: <Insert requirement>.
8. Overall Unit Thickness: <Insert dimension>.
9. Outdoor Lite: Laminated glass with [two plies of heat-strengthened float glass] [three plies of heat-strengthened float glass] [two outer plies of heat-strengthened float glass and two inner plies of annealed float glass].
 - a. Outer Ply Thickness: [3 mm] [5 mm] [6 mm] <Insert dimension>.
 - b. Core Ply Thickness: [3 mm] [5 mm] [6 mm] <Insert dimension>.
 - c. Inner Ply Thickness: [3 mm] [5 mm] [6 mm] <Insert dimension>.
 - d. Interlayer Thickness: [0.030 inch (0.76 mm)] [0.060 inch (1.52 mm)] [0.090 inch (2.3 mm)].
10. Indoor Lite: Glass-clad polycarbonate faced with a 0.037-inch- (0.94-mm-) thick, spall-resistant polyester film laminated to indoor face.
 - a. Outer Ply: [3-mm] [5-mm] [6-mm] <Insert dimension> [heat-strengthened] [chemically strengthened] float glass.
 - b. Inner Ply: [3-mm] [5-mm] [6-mm] <Insert dimension> [heat-strengthened] [chemically strengthened] float glass.
 - c. Single Core: [0.118-inch (4.57-mm)] [0.177-inch (2.97-mm)] [0.236-inch (5.99-mm)] polycarbonate.
 - d. Multiple Core:
 - 1) Outer Core Ply: [0.118-inch (4.57-mm)] [0.177-inch (2.97-mm)] [0.236-inch (5.99-mm)] polycarbonate.
 - 2) [Single Inner Core Ply] [Double Inner Core Plies]: [0.118-inch (4.57-mm)] [0.177-inch (2.97-mm)] [0.236-inch (5.99-mm)] polycarbonate.
 - e. Inner Ply: [3-mm] [5-mm] [6-mm] <Insert dimension> [heat-strengthened] [chemically strengthened] float glass.
11. Interspace Content: [Air] [Argon].
12. Interspace Dimension: <Insert dimension>.
13. Glass Tint Color: [Blue] [Blue-green] [Bronze] [Green] [Gray] <Insert color>.
14. Tinted Glass Location: Outer lite.
15. Low-E Coating: [Pyrolytic on second surface] [Pyrolytic on third surface] [Sputtered on second surface] [Sputtered on third surface].
16. Overall Visible Light Transmittance: <Insert number> percent minimum.
17. Winter Nighttime U-Factor: <Insert value> maximum.
18. Summer Daytime U-Factor: <Insert value> maximum.
19. Solar Heat-Gain Coefficient: <Insert value> maximum.
20. Provide safety glazing labeling.

2.19 AIR-GAP SECURITY GLAZING TYPES

- A. Security Glazing [**Type SG-<#>**]: [**Clear air-gap security glazing**] [**Tinted air-gap security glazing**] [**Clear reflective-coated air-gap security glazing**] [**Tinted reflective-coated air-gap security glazing**]. Outdoor lite is laminated glass and indoor lite is laminated polycarbonate.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.
 2. Forced-Entry Resistance: [**Class I**] [**Class II**] [**Class III**] [**Class IV**] [**Class V**] per ASTM F 1233.
 3. Forced-Entry Resistance: [**Level I**] [**Level II**] [**Level III**] [**Level IV**] [**Level V**] per HPW-TP-0500.03.
 4. Ballistic Resistance: [**Class/Level HG1**] [**Class/Level HG2**] [**Class/Level HG3**] [**Class/Level HG4**] [**Class/Level SMG**] [**Class/Level R1**] [**Class/Level R2**] [**Class/Level R3**] [**Class/Level R4-AP**] [**Class/Level SH1**] [**Class/Level SH2**] per ASTM F 1233.
 5. Ballistic Resistance: [**Level 1**] [**Level 2**] [**Level 3**] [**Level 4**] [**Level 5**] [**Level 6**] [**Level 7**] [**Level 8**] [**Level 1-SG**] [**Level 2-SG**] [**Level 3-SG**] [**Level 4-SG**] [**Level 5-SG**] [**Level 6-SG**] [**Level 7-SG**] [**Level 8-SG**] per UL 752.
 6. Blast Resistance:
 - a. Hazard Rating: [**No hazard**] [**Minimal hazard**] [**Very low hazard**] [**Low hazard**] [**High hazard**] per ASTM F 1642.
 - b. Performance Condition: [**1**] [**2**] [**3a**] [**3b**] [**4**] [**5**] per GSA-TS01.
 - c. Peak Pressure: **<Insert requirement>**.
 - d. Positive Phase Impulse: **<Insert requirement>**.
 7. Overall Unit Thickness: **<Insert dimension>**.
 8. Outdoor Lite: Laminated glass with [**two**] [**three**] plies of [**float glass**] [**heat-strengthened float glass**] [**fully tempered float glass**] [**chemically strengthened float glass**].
 - a. Outer Ply Thickness: [**3 mm**] [**5 mm**] [**6 mm**] **<Insert dimension>**.
 - b. Core Ply Thickness: [**3 mm**] [**5 mm**] [**6 mm**] **<Insert dimension>**.
 - c. Inner Ply Thickness: [**3 mm**] [**5 mm**] [**6 mm**] **<Insert dimension>**.
 - d. Interlayer Thickness: [**0.030 inch (0.76 mm)**] [**0.060 inch (1.52 mm)**] [**0.090 inch (2.3 mm)**].
 9. Indoor Lite: Laminated polycarbonate with [**two**] [**three**] [**four**] polycarbonate plies.
 - a. Overall Unit Thickness: **<Insert dimension>**.
 - b. Outer and Inner Plies: [**0.118-inch (4.57-mm)**] [**0.177-inch (2.97-mm)**] [**0.236-inch (5.99-mm)**] polycarbonate.

- c. **[Core Ply] [Core Plies]:** [0.118-inch (4.57-mm)] [0.177-inch (2.97-mm)] [0.236-inch (5.99-mm)] polycarbonate.
 - d. Interlayer Thicknesses: [0.025 inch (0.635 mm)] **<Insert dimension>**.
 10. Air-Gap Dimension: **<Insert dimension>**.
 11. Glass Tint Color: **[Blue] [Blue-green] [Bronze] [Green] [Gray]** **<Insert color>**.
 12. Tinted Glass Location: **[Outer] [Inner]** ply of outdoor lite.
 13. Coating Color: **[Gold] [Pewter] [Silver]** **<Insert color>**.
 14. Coating Location: **[Second] [Third] [Fifth]** surface.
 15. Overall Visible Light Transmittance: **<Insert number>** percent minimum.
 16. Outdoor Visible Reflectance: **<Insert number>** percent maximum.
 17. Winter Nighttime U-Factor: **<Insert value>** maximum.
 18. Summer Daytime U-Factor: **<Insert value>** maximum.
 19. Solar Heat-Gain Coefficient: **<Insert value>** maximum.
 20. Provide safety glazing labeling.
- B. Security Glazing **[Type SG-<#>: [Low-e-coated, clear air-gap security glazing] [Low-e-coated, tinted air-gap security glazing].** Outdoor lite is laminated glass and indoor lite is laminated polycarbonate.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 - b. or approved equal.
 2. Forced-Entry Resistance: **[Class I] [Class II] [Class III] [Class IV] [Class V]** per ASTM F 1233.
 3. Forced-Entry Resistance: **[Level I] [Level II] [Level III] [Level IV] [Level V]** per HPW-TP-0500.03.
 4. Ballistic Resistance: **[Class/Level HG1] [Class/Level HG2] [Class/Level HG3] [Class/Level HG4] [Class/Level SMG] [Class/Level R1] [Class/Level R2] [Class/Level R3] [Class/Level R4-AP] [Class/Level SH1] [Class/Level SH2]** per ASTM F 1233.
 5. Ballistic Resistance: **[Level 1] [Level 2] [Level 3] [Level 4] [Level 5] [Level 6] [Level 7] [Level 8] [Level 1-SG] [Level 2-SG] [Level 3-SG] [Level 4-SG] [Level 5-SG] [Level 6-SG] [Level 7-SG] [Level 8-SG]** per UL 752.
 6. Blast Resistance:
 - a. Hazard Rating: **[No hazard] [Minimal hazard] [Very low hazard] [Low hazard] [High hazard]** per ASTM F 1642.
 - b. Performance Condition: **[1] [2] [3a] [3b] [4] [5]** per GSA-TS01.
 - c. Peak Pressure: **<Insert requirement>**.
 - d. Positive Phase Impulse: **<Insert requirement>**.
 7. Overall Unit Thickness: **<Insert dimension>**.
 8. Outdoor Lite: Laminated glass with **[two] [three]** plies of **[float glass] [heat-strengthened float glass] [fully tempered float glass] [chemically strengthened float glass]**.

- a. Outer Ply Thickness: **[3 mm] [5 mm] [6 mm] <Insert dimension>**.
 - b. Core Ply Thickness: **[3 mm] [5 mm] [6 mm] <Insert dimension>**.
 - c. Inner Ply Thickness: **[3 mm] [5 mm] [6 mm] <Insert dimension>**.
 - d. Interlayer Thickness: **[0.030 inch (0.76 mm)] [0.060 inch (1.52 mm)] [0.090 inch (2.3 mm)]**.
9. Indoor Lite: Laminated polycarbonate with **[two] [three] [four]** polycarbonate plies.
- a. Overall Unit Thickness: **<Insert dimension>**.
 - b. Outer and Inner Plies: **[0.118-inch (4.57-mm)] [0.177-inch (2.97-mm)] [0.236-inch (5.99-mm)]** polycarbonate.
 - c. **[Core Ply] [Core Plies]: [0.118-inch (4.57-mm)] [0.177-inch (2.97-mm)] [0.236-inch (5.99-mm)]** polycarbonate.
 - d. Interlayer Thicknesses: **[0.025 inch (0.635 mm)] <Insert dimension>**.
10. Air-Gap Dimension: **<Insert dimension>**.
11. Glass Tint Color: **[Blue] [Blue-green] [Bronze] [Green] [Gray] <Insert color>**.
12. Tinted Glass Location: **[Outer] [Inner]** ply of outdoor lite.
13. Low-E Coating: **[Pyrolytic on second surface] [Pyrolytic on third surface] [Sputtered on second surface] [Sputtered on third surface]**.
14. Overall Visible Light Transmittance: **<Insert number>** percent minimum.
15. Winter Nighttime U-Factor: **<Insert value>** maximum.
16. Summer Daytime U-Factor: **<Insert value>** maximum.
17. Solar Heat-Gain Coefficient: **<Insert value>** maximum.
18. Provide safety glazing labeling.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing for security glazing, with Installer present, for compliance with the following:
 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 2. Presence and functioning of weep system.
 3. Minimum required face or edge clearances.
 4. Effective sealing between joints of framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving security glazing immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of security glazing, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect edges of security glazing from damage during handling and installation. Remove damaged security glazing from Project site and legally dispose of off Project site. Damaged security glazing includes units with edge or face damage or other imperfections that, when installed, could weaken security glazing, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications unless otherwise required by glazing unit manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by security glazing manufacturers for installing lites.
- F. Provide spacers for security glazing lites where the length plus width is larger than 50 inches (1270 mm).
 - 1. Locate spacers directly opposite each other on both inside and outside faces of security glazing. Install correct size and spacing to preserve required face clearances unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with performance requirements.
 - 2. Provide 1/8-inch (3-mm) minimum bite of spacers on glazing lites and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent security glazing from moving sideways in glazing channel, as recommended in writing by security glazing manufacturer and according to requirements in referenced glazing publications.
- H. Set security glazing in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set coated security glazing with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by security glazing, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until just before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center security glazing in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket securely in place between glazing unit and frame or fixed stop, with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center security glazing in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in security glazing. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center security glazing in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression

gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in security glazing. Seal gasket joints with sealant recommended by gasket manufacturer.

- E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between security glazing and glazing stops to maintain face clearances and to prevent sealant from extruding into glazing channel and blocking weep systems. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to security glazing and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from security glazing.

3.7 PROTECTION AND CLEANING

- A. Protect exterior security glazing from damage immediately after installation by attaching crossed streamers to framing held away from glazing unit. Do not apply markers to security glazing surfaces. Remove nonpermanent labels, and clean surfaces.
- B. Protect security glazing from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with security glazing, remove substances immediately as recommended in writing by security glazing manufacturer.
- C. Examine security glazing surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by security glazing manufacturer.
- D. Remove and replace security glazing that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, or vandalism during construction period.
- E. Wash security glazing on exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash security glazing as recommended in writing by security glazing manufacturer.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 088853

SECTION 089000 - LOUVERS AND VENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Fixed, **[extruded-aluminum]** **[and]** **[formed-metal]** louvers.
2. Adjustable, **[extruded-aluminum]** **[and]** **[formed-metal]** louvers.
3. Adjustable, **[extruded-aluminum]** **[and]** **[formed-metal]** insulated louvers.
4. Fixed, formed-metal acoustical louvers.
5. Wall vents (brick vents).

- B. Related Sections:

1. Section 042000 "Unit Masonry" for building wall vents (brick vents) into masonry.
2. Section 081113 "Hollow Metal Doors and Frames" for louvers in hollow-metal doors.
3. Section 081416 "Flush Wood Doors" for louvers in flush wood doors.
4. Section 099113 "Exterior Painting" for field painting louvers.
5. Section 221513 "General-Service Compressed-Air Piping" for connecting pneumatic-operated adjustable louvers.
6. Division 23 Sections for control systems for louvers and vents..

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.
- C. Vertical Louver: Louver with vertical blades; i.e., the axes of the blades are vertical.

- D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
- E. Storm-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural[**and seismic**] performance requirements and design criteria indicated.
- B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise, or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
 - 1. Wind Loads: Determine loads based on pressures as indicated on Drawings.
 - 2. Wind Loads: Determine loads based on a uniform pressure of [20 lbf/sq. ft. (957 Pa)] [30 lbf/sq. ft. (1436 Pa)] **<Insert design wind pressure>**, acting inward or outward.
 - 3. Wind Loads: Determine loads based on pressures indicated below:
 - a. Corner Zone: Within **<Insert distance>** of building corners, uniform pressure of **<Insert design wind pressure>**, acting inward, and **<Insert design wind pressure>**, acting outward.
 - b. Other Than Corner Zone: Uniform pressure of **<Insert design wind pressure>**, acting inward, and **<Insert design wind pressure>**, acting outward.
- C. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to [SEI/ASCE 7] **<Insert requirement>**.
 - 1. Design earthquake spectral response acceleration, short period (Sds) for Project is **<Insert value>**.
 - 2. Component Importance Factor is [1.5] [1.0].
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.
 - 1. Temperature Change (Range): [120 deg F (67 deg C), **ambient**; 180 deg F (100 deg C)] **<Insert temperature range>**, material surfaces.
- E. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided,

except for length and width according to AMCA 500-L.

- F. Acoustic Performance: Provide acoustical louvers complying with ratings specified, as demonstrated by testing manufacturer's stock units identical to those specified, except for length and width for **[airborne sound-transmission loss according to ASTM E 90] [outdoor-indoor sound-transmission loss according to ASTM E 966]**.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
 2. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
 2. Show mullion profiles and locations.
 3. Wiring Diagrams: For power, signal, and control wiring for motorized adjustable louvers.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of metal finish required.
- E. Delegated-Design Submittal: For louvers indicated to comply with structural[**and seismic**] performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

1.7 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."
 - 3. AWS D1.6, "Structural Welding Code - Stainless Steel."
- C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.
- D. UL and NEMA Compliance: Provide motors and related components for motor-operated louvers that are listed and labeled by UL and comply with applicable NEMA standards.

1.9 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Extrusions: **ASTM B 221** (ASTM B 221M), Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: **ASTM B 209** (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Aluminum Castings: ASTM B 26/B 26M, Alloy 319.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, [**G60** (Z180)] [**G90** (Z275)] zinc coating, mill phosphatized.
- E. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, [**No. 2B finish**] [**No. 2D finish**] [**No. 4 finish, with grain running parallel to length of blades and frame members**]

[No. 4 finish, with grain running perpendicular to length of blades and frame members] [No. 4 finish, with grain running perpendicular to length of blades and parallel to length of frame members] [No. 6 finish].

- F. Fasteners: Use types and sizes to suit unit installation conditions.
1. Use **[Phillips flat-head] [hex-head or Phillips pan-head] [tamper-resistant]** screws for exposed fasteners unless otherwise indicated.
 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 3. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
 4. For fastening stainless steel, use 300 series stainless-steel fasteners.
 5. For color-finished louvers, use fasteners with heads that match color of louvers.
- G. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
- H. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

- A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.
1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern **[unless horizontal mullions are indicated] [where indicated]**.
 2. Horizontal Mullions: Provide horizontal mullions at joints **[unless continuous vertical assemblies are indicated] [where indicated]**.
- C. Maintain equal louver blade spacing[, **including separation between blades and frames at head and sill,**] to produce uniform appearance.
- D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
1. Frame Type: **[Channel] [Exterior flange] [Interior flange]** unless otherwise indicated.
- E. Include supports, anchorages, and accessories required for complete assembly.

- F. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or **72 inches** (1830 mm) o.c., whichever is less.
1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
 2. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
 3. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.
 4. Exterior Corners: Prefabricated corner units with mitered **[and welded blades]** **[blades with concealed close-fitting splices]** and with **[fully recessed]** **[semirecessed]** mullions at corners.
- G. Provide **[subsills made of same material as louvers]** **[or]** **[extended sills]** for recessed louvers.
- H. Join frame members to each other and to fixed louver blades with fillet **[welds concealed from view]** **[welds, threaded fasteners, or both, as standard with louver manufacturer]** unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal Storm-Resistant Louver **<Insert drawing designation, e.g., LV-1>**:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a Mestek company.
 - b. Air Flow Company, Inc.
 - c. Airolite Company, LLC (The).
 - d. All-Lite Architectural Products.
 - e. American Warming and Ventilating, Inc.; a Mestek company.
 - f. Arrow United Industries; a division of Mestek, Inc.
 - g. Construction Specialties, Inc.
 - h. Greenheck Fan Corporation.
 - i. Industrial Louvers, Inc.
 - j. NCA Manufacturing, Inc.
 - k. Nystrom Building Products.
 - l. Reliable Products, Inc.
 - m. Ruskin Company; Tomkins PLC.
 - n. United Enertech Corp.

3. Frame and Blade Nominal Thickness: Not less than [0.080 inch (2.03 mm)] [0.060 inch (1.52 mm) **for blades and 0.080 inch (2.03 mm) for frames**].
 4. Louver Performance Ratings:
 - a. Free Area: Not less than [5.0 sq. ft. (0.46 sq. m)] [6.0 sq. ft. (0.56 sq. m)] [7.0 sq. ft. (0.65 sq. m)] **<Insert free area>** for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
 - b. Air Performance: Not more than [0.10-inch wg (25-Pa)] **<Insert pressure>** static pressure drop at [600-fpm (3.0-m/s)] [700-fpm (3.6-m/s)] [800-fpm (4.1-m/s)] **<Insert velocity>** free-area [exhaust] [intake] velocity.
 - c. Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rainfall rate of [3 inches (75 mm) **per hour and a wind speed of 29 mph (13 m/s)**] [8 inches (200 mm) **per hour and a wind speed of 50 mph (22.4 m/s)**] at a core-area intake velocity of [300 fpm (1.5 m/s)] [400 fpm (2.0 m/s)] [500 fpm (2.5 m/s)] **<Insert velocity>**.
 5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
- C. Horizontal, Drainable-Blade Louver **<Insert drawing designation, e.g., LV-1>**:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a Mestek company.
 - b. Air Flow Company, Inc.
 - c. Airolite Company, LLC (The)).
 - d. All-Lite Architectural Products.
 - e. American Warming and Ventilating, Inc.; a Mestek company.
 - f. Arrow United Industries; a division of Mestek, Inc.
 - g. Carnes Company, Inc.
 - h. Cesco Products; a division of Mestek, Inc.
 - i. Construction Specialties, Inc.
 - j. Dowco Products Group; Safe-Air of Illinois, Inc.
 - k. Greenheck Fan Corporation.
 - l. Industrial Louvers, Inc.
 - m. Louvers & Dampers, Inc.; a division of Mestek, Inc.
 - n. Metal Form Manufacturing Inc.
 - o. NCA Manufacturing, Inc.
 - p. Nystrom Building Products.
 - q. Reliable Products, Inc.
 - r. Ruskin Company; Tomkins PLC.
 - s. United Enertech Corp.
 - t. Vent Products Company, Inc.
 - u. **<Insert manufacturer's name>**.
 - v. or approved equal.
 2. Louver Depth: [4 inches (100 mm)] [6 inches (150 mm)] **<Insert depth>**.
 3. Frame and Blade Nominal Thickness: Not less than [0.080 inch (2.03 mm)] [0.060 inch (1.52 mm) **for blades and 0.080 inch (2.03 mm) for frames**].
 4. Mullion Type: Exposed.

5. Louver Performance Ratings:
 - a. Free Area: Not less than [7.0 sq. ft. (0.65 sq. m)] [7.5 sq. ft. (0.70 sq. m)] [8.0 sq. ft. (0.74 sq. m)] [8.5 sq. ft. (0.79 sq. m)] <Insert free area> for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
 - b. Point of Beginning Water Penetration: Not less than [900 fpm (4.6 m/s)] [950 fpm (4.8 m/s)] [1000 fpm (5.1 m/s)] [1050 fpm (5.3 m/s)] [1100 fpm (5.6 m/s)] <Insert velocity>.
 - c. Air Performance: Not more than [0.10-inch wg (25-Pa)] <Insert pressure> static pressure drop at [700-fpm (3.6-m/s)] [750-fpm (3.8-m/s)] [800-fpm (4.1-m/s)] [850-fpm (4.3-m/s)] <Insert velocity> free-area [exhaust] [intake] velocity.
 - d. Air Performance: Not more than [0.15-inch wg (37-Pa)] <Insert pressure> static pressure drop at [900-fpm (4.6-m/s)] [950-fpm (4.8-m/s)] [1000-fpm (5.1-m/s)] <Insert velocity> free-area [exhaust] [intake] velocity.
 6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
- D. Horizontal, Continuous-Line, Drainable-Blade Louver <Insert drawing designation, e.g., LV-1>: Drainable-blade louver with blade gutters (drains) in rear two-thirds of blades only and with semirecessed mullions capable of collecting and draining water from blades.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Airolite Company, LLC (The).
 - b. Arrow United Industries; a division of Mestek, Inc.
 - c. Construction Specialties, Inc.
 - d. Greenheck Fan Corporation.
 - e. Ruskin Company; Tomkins PLC.
 - f. <Insert manufacturer's name>.
 - g. or approved equal.
 2. Louver Depth: [6 inches (150 mm)] <Insert depth>.
 3. Frame and Blade Nominal Thickness: Not less than 0.080 inch (2.03 mm).
 4. Louver Performance Ratings:
 - a. Free Area: Not less than [7.8 sq. ft. (0.72 sq. m)] <Insert free area> for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
 - b. Point of Beginning Water Penetration: Not less than [850 fpm (4.3 m/s)] <Insert velocity>.
 - c. Air Performance: Not more than [0.10-inch wg (25-Pa)] <Insert pressure> static pressure drop at [800-fpm (4.1-m/s)] <Insert velocity> free-area [exhaust] [intake] velocity.
- E. Horizontal, Sightproof, Drainable-Blade Louver <Insert drawing designation, e.g., LV-1>:
1. Manufacturers: Subject to compliance with requirements, provide products by

one of the following:

- a. Air Balance Inc.; a Mestek company.
 - b. Air Flow Company, Inc.
 - c. Airolite Company, LLC (The).
 - d. All-Lite Architectural Products.
 - e. American Warming and Ventilating, Inc.; a Mestek company.
 - f. Arrow United Industries; a division of Mestek, Inc.
 - g. Construction Specialties, Inc.
 - h. Dowco Products Group; Safe-Air of Illinois, Inc.
 - i. Greenheck Fan Corporation.
 - j. Industrial Louvers, Inc.
 - k. Louvers & Dampers, Inc.; a division of Mestek, Inc.
 - l. NCA Manufacturing, Inc.
 - m. Nystrom Building Products.
 - n. Reliable Products, Inc.
 - o. Ruskin Company; Tomkins PLC.
 - p. United Enertech Corp.
 - q. **<Insert manufacturer's name>**.
 - r. or approved equal.
2. Louver Depth: [5 inches (125 mm)] **<Insert depth>**.
 3. Frame and Blade Nominal Thickness: Not less than [0.080 inch (2.03 mm)] [0.060 inch (1.52 mm) **for blades and 0.080 inch (2.03 mm) for frames**].
 4. Mullion Type: Exposed.
 5. Louver Performance Ratings:
 - a. Free Area: Not less than [8.3 sq. ft. (0.77 sq. m)] **<Insert free area>** for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
 - b. Point of Beginning Water Penetration: Not less than [750 fpm (3.8 m/s)] [950 fpm (4.8 m/s)] **<Insert velocity>**.
 - c. Air Performance: Not more than [0.10-inch wg (25-Pa)] **<Insert pressure>** static pressure drop at [550-fpm (2.8-m/s)] **<Insert velocity>** free-area [exhaust] [intake] velocity.

F. Horizontal, Nondrainable-Blade Louver **<Insert drawing designation, e.g., LV-1>**:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a Mestek company.
 - b. Air Flow Company, Inc.
 - c. Airolite Company, LLC (The).
 - d. All-Lite Architectural Products.
 - e. American Warming and Ventilating, Inc.; a Mestek company.
 - f. Arrow United Industries; a division of Mestek, Inc.
 - g. Carnes Company, Inc.
 - h. Cesco Products; a division of Mestek, Inc.
 - i. Construction Specialties, Inc.
 - j. Dowco Products Group; Safe-Air of Illinois, Inc.

- k. Greenheck Fan Corporation.
 - l. Louvers & Dampers, Inc.; a division of Mestek, Inc.
 - m. Metal Form Manufacturing Inc.
 - n. NCA Manufacturing, Inc.
 - o. Nystrom Building Products.
 - p. Reliable Products, Inc.
 - q. Ruskin Company; Tomkins PLC.
 - r. United Enertech Corp.
 - s. Vent Products Company, Inc.
 - t. **<Insert manufacturer's name>**.
 - u. or approved equal.
2. Louver Depth: [2 inches (50 mm)] [4 inches (100 mm)] [6 inches (150 mm)] **<Insert depth>**.
3. Blade Profile: [**Plain blade without**] [**Blade with**] center baffle.
4. Frame and Blade Nominal Thickness: Not less than [0.080 inch (2.03 mm)] [0.060 inch (1.52 mm) **for blades and 0.080 inch (2.03 mm) for frames**].
5. Mullion Type: [**Exposed**] [**Semirecessed**] [**Fully recessed**].
6. Louver Performance Ratings:
- a. Free Area: Not less than [7.5 sq. ft. (0.70 sq. m)] [8.0 sq. ft. (0.74 sq. m)] [8.5 sq. ft. (0.79 sq. m)] **<Insert free area>** for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
 - b. Point of Beginning Water Penetration: Not less than [700 fpm (3.6 m/s)] [750 fpm (3.8 m/s)] [800 fpm (4.1 m/s)] [850 fpm (4.3 m/s)] [900 fpm (4.6 m/s)] [950 fpm (4.8 m/s)] **<Insert velocity>**.
 - c. Air Performance: Not more than [0.10-inch wg (25-Pa)] **<Insert pressure>** static pressure drop at [650-fpm (3.3-m/s)] [700-fpm (3.6-m/s)] [750-fpm (3.8-m/s)] **<Insert velocity>** free-area [exhaust] [intake] velocity.
- G. Vertical, Sightproof, Louver **<Insert drawing designation, e.g., LV-1>**:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - b. Air Balance Inc.; a Mestek company.
 - c. Air Flow Company, Inc.
 - d. Airolite Company, LLC (The).
 - e. American Warming and Ventilating, Inc.; a Mestek company.
 - f. Arrow United Industries; a division of Mestek, Inc.
 - g. Cesco Products; a division of Mestek, Inc.
 - h. Construction Specialties, Inc.
 - i. Dowco Products Group; Safe-Air of Illinois, Inc.
 - j. Greenheck Fan Corporation.
 - k. Industrial Louvers, Inc.
 - l. Ruskin Company; Tomkins PLC.
 - m. United Enertech Corp.
 - n. **<Insert manufacturer's name>**.
 - o. or approved equal.
2. Louver Depth: [4 inches (100 mm)] **<Insert depth>**.

3. Blade Profile: [**Chevron**] [**Y**] [**Labyrinth**]-shaped blade.
4. Frame and Blade Nominal Thickness: Not less than [**0.080 inch** (2.03 mm)] [**0.060 inch** (1.52 mm) **for blades and 0.080 inch** (2.03 mm) **for frames**].
5. Blade Spacing: [**2 inches** (50 mm)] [**4 inches** (100 mm)] **<Insert spacing>** o.c.
6. Mullion Type: [**Exposed**] [**Semirecessed**] [**Fully recessed**].

2.4 FIXED, FORMED-METAL LOUVERS

A. Horizontal, Drainable-Blade Louver **<Insert drawing designation, e.g., LV-1>**:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a Mestek company.
 - b. Air Flow Company, Inc.
 - c. Airolite Company, LLC (The).
 - d. American Warming and Ventilating, Inc.; a Mestek company.
 - e. Arrow United Industries; a division of Mestek, Inc.
 - f. Cesco Products; a division of Mestek, Inc.
 - g. Construction Specialties, Inc.
 - h. Dowco Products Group; Safe-Air of Illinois, Inc.
 - i. Greenheck Fan Corporation.
 - j. Industrial Louvers, Inc.
 - k. Metal Form Manufacturing Inc.
 - l. NCA Manufacturing, Inc.
 - m. Ruskin Company; Tomkins PLC.
 - n. United Enertech Corp.
 - o. Vent Products Company, Inc.
 - p. **<Insert manufacturer's name>**.
 - q. or approved equal.
2. Louver Depth: [**4 inches** (100 mm)] [**6 inches** (150 mm)] **<Insert depth>**.
3. Frame and Blade Material and Nominal Thickness: Galvanized-steel sheet, not less than [**0.052 inch** (1.32 mm) **for frames and 0.040 inch** (1.02 mm) **for blades**] [**0.052 inch** (1.32 mm)] [**0.064 inch** (1.63 mm)].
4. Frame and Blade Material and Nominal Thickness: Stainless-steel sheet, not less than [**0.050 inch** (1.27 mm)] [**0.062 inch** (1.59 mm)].
5. Mullion Type: Exposed.
6. Louver Performance Ratings:
 - a. Free Area: Not less than [**7.0 sq. ft.** (0.65 sq. m)] [**7.5 sq. ft.** (0.70 sq. m)] [**8.0 sq. ft.** (0.74 sq. m)] [**8.5 sq. ft.** (0.79 sq. m)] **<Insert free area>** for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
 - b. Point of Beginning Water Penetration: Not less than [**800 fpm** (4.1 m/s)] [**850 fpm** (4.3 m/s)] [**900 fpm** (4.6 m/s)] [**950 fpm** (4.8 m/s)] [**1000 fpm** (5.1 m/s)] **<Insert velocity>**.
 - c. Air Performance: Not more than [**0.10-inch wg** (25-Pa)] **<Insert pressure>** static pressure drop at [**700-fpm** (3.6-m/s)] [**750-fpm** (3.8-m/s)] [**800-fpm**

- (4.1-m/s)] [850-fpm (4.3-m/s)] <Insert velocity> free-area [exhaust] [intake] velocity.
- d. Air Performance: Not more than [0.15-inch wg (37-Pa)] <Insert pressure> static pressure drop at [900-fpm (4.6-m/s)] [950-fpm (4.8-m/s)] [1000-fpm (5.1-m/s)] <Insert velocity> free-area velocity.
7. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
- B. Horizontal, Nondrainable-Blade Louver <Insert drawing designation, e.g., LV-1>:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- Air Balance Inc.; a Mestek company.
 - Air Flow Company, Inc.
 - Airolite Company, LLC (The).
 - American Warming and Ventilating, Inc.; a Mestek company.
 - Arrow United Industries; a division of Mestek, Inc.
 - Cesco Products; a division of Mestek, Inc.
 - Construction Specialties, Inc.
 - Dowco Products Group; Safe-Air of Illinois, Inc.
 - Greenheck Fan Corporation.
 - Industrial Louvers, Inc.
 - Metal Form Manufacturing Inc.
 - NCA Manufacturing, Inc.
 - Ruskin Company; Tomkins PLC.
 - United Enertech Corp.
 - Vent Products Company, Inc.
 - <Insert manufacturer's name>.
 - or approved equal.
2. Louver Depth: [4 inches (100 mm)] [6 inches (150 mm)] <Insert depth>.
3. Blade Profile: [Plain blade without] [Blade with] center baffle.
4. Frame and Blade Material and Nominal Thickness: Galvanized-steel sheet, not less than [0.052 inch (1.32 mm) for frames and 0.040 inch (1.02 mm) for blades] [0.052 inch (1.32 mm)] [0.064 inch (1.63 mm)].
5. Frame and Blade Material and Nominal Thickness: Stainless-steel sheet, not less than [0.050 inch (1.27 mm)] [0.062 inch (1.59 mm)].
6. Mullion Type: [Exposed] [Semirecessed] [Fully recessed].
7. Louver Performance Ratings:
- Free Area: Not less than [6.5 sq. ft. (0.60 sq. m)] [7.0 sq. ft. (0.65 sq. m)] [7.5 sq. ft. (0.70 sq. m)] [8.0 sq. ft. (0.74 sq. m)] <Insert free area> for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
 - Point of Beginning Water Penetration: Not less than [550 fpm (2.8 m/s)] [600 fpm (3.0 m/s)] [650 fpm (3.3 m/s)] [700 fpm (3.6 m/s)] <Insert velocity>.
 - Air Performance: Not more than [0.10-inch wg (25-Pa)] <Insert pressure> static pressure drop at [550-fpm (2.8-m/s)] [600-fpm (3.0-m/s)] [650-fpm (3.3-m/s)] [700-fpm (3.6-m/s)] <Insert velocity> free-area [exhaust] [intake] velocity.

2.5 ADJUSTABLE, EXTRUDED-ALUMINUM LOUVERS

- A. Louver Construction and Operation: Provide adjustable louvers with extruded-aluminum frames and blades not less than **0.080-inch** (2.03-mm) nominal thickness, and with operating mechanisms to suit louver sizes.
1. Hand operation with push bars.
 2. Crank operation with removable-crank operator in sill or jamb.
 3. Chain operation with tension spring, wall clip, pull chain, and **160 deg F** (71 deg C) fusible link.
 4. Motor operation with [**2-position, spring-return application (with power on, motor opens louver; with power off, spring closes louver); 110-V, 60-Hz motor and limit switch**] [**2-direction, 110-V, 60-Hz motor and limit switches**]; equipped with [**frame-mounted switch**] [**remote-mounted switch with indicator light**] [**terminals for controlling devices**].
 5. Pneumatic piston operation for use with **80- to 100-psi** (550- to 690-kPa) compressed air for [**2-position**] [**modulating**] operation; power open, power close[**with spring-return fail-safe**].
- B. Dual-Blade, Drainable-Blade, Adjustable Louver <**Insert drawing designation, e.g., LV-1**>: Fixed drainable blades and adjustable plain blades combined in single frame.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a Mestek company.
 - b. Air Flow Company, Inc.
 - c. Airolite Company, LLC (The).
 - d. All-Lite Architectural Products.
 - e. American Warming and Ventilating, Inc.; a Mestek company.
 - f. Arrow United Industries; a division of Mestek, Inc.
 - g. Carnes Company, Inc.
 - h. Cesco Products; a division of Mestek, Inc.
 - i. Construction Specialties, Inc.
 - j. Dowco Products Group; Safe-Air of Illinois, Inc.
 - k. Greenheck Fan Corporation.
 - l. Industrial Louvers, Inc.
 - m. Louvers & Dampers, Inc.; a division of Mestek, Inc.
 - n. NCA Manufacturing, Inc.
 - o. Metal Form Manufacturing Inc.
 - p. Reliable Products, Inc.
 - q. Ruskin Company; Tomkins PLC.
 - r. United Enertech Corp.
 - s. Vent Products Company, Inc.
 - t. <**Insert manufacturer's name**>.
 - u. or approved equal.
 2. Louver Depth: [**4 inches** (100 mm)] [**6 inches** (150 mm)] <**Insert depth**>, overall.
 3. Louver Performance Ratings:

- a. Free Area: Not less than [6.0 sq. ft. (0.56 sq. m)] [6.5 sq. ft. (0.60 sq. m)] [7.0 sq. ft. (0.65 sq. m)] [7.5 sq. ft. (0.70 sq. m)] [8.0 sq. ft. (0.74 sq. m)] **<Insert free area>** for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
 - b. Point of Beginning Water Penetration: Not less than [750 fpm (3.8 m/s)] [800 fpm (4.1 m/s)] [850 fpm (4.3 m/s)] [900 fpm (4.6 m/s)] [950 fpm (4.8 m/s)] [1000 fpm (5.1 m/s)] **<Insert velocity>**.
 - c. Air Performance: Not more than [0.10-inch wg (25-Pa)] **<Insert pressure>** static pressure drop at [750-fpm (3.8-m/s)] [800-fpm (4.1-m/s)] [850-fpm (4.3-m/s)] [900-fpm (4.6-m/s)] **<Insert velocity>** free-area [exhaust] [intake] velocity.
 - d. Air Leakage: Not more than [1.5 cfm/sq. ft. (7.6 L/s per sq. m)] **<Insert air-leakage rating>** of louver gross area at a differential static pressure of 0.15-inch wg (37 Pa) with adjustable louver blades closed.
4. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
- C. Single-Blade, Adjustable Louver **<Insert drawing designation, e.g., LV-1>**:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a Mestek company.
 - b. Air Flow Company, Inc.
 - c. Airolite Company, LLC (The).
 - d. All-Lite Architectural Products.
 - e. American Warming and Ventilating, Inc.; a Mestek company.
 - f. Arrow United Industries; a division of Mestek, Inc.
 - g. Carnes Company, Inc.
 - h. Cesco Products; a division of Mestek, Inc.
 - i. Construction Specialties, Inc.
 - j. Dowco Products Group; Safe-Air of Illinois, Inc.
 - k. Greenheck Fan Corporation.
 - l. Industrial Louvers, Inc.
 - m. Louvers & Dampers, Inc.; a division of Mestek, Inc.
 - n. Metal Form Manufacturing Inc.
 - o. NCA Manufacturing, Inc.
 - p. Reliable Products, Inc.
 - q. Ruskin Company; Tomkins PLC.
 - r. United Enertech Corp.
 - s. Vent Products Company, Inc.
 - t. **<Insert manufacturer's name>**.
 - u. or approved equal.
 2. Louver Depth: [4 inches (100 mm)] [6 inches (150 mm)] **<Insert depth>**.
 3. Blade Type: [Drainable] [Plain].
 4. Accessories: Equip louvers as follows:
 - a. Vinyl blade-edge gaskets for each louver blade.
 - b. [Stainless-steel jamb seals] [or] [vinyl blade-end gaskets].

5. Louver Performance Ratings:
 - a. Free Area: Not less than [6.5 sq. ft. (0.60 sq. m)] [7.0 sq. ft. (0.65 sq. m)] [7.5 sq. ft. (0.70 sq. m)] [8.0 sq. ft. (0.74 sq. m)] **<Insert free area>** for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
 - b. Point of Beginning Water Penetration: Not less than [500 fpm (2.5 m/s)] [600 fpm (3.0 m/s)] [700 fpm (3.6 m/s)] [800 fpm (4.1 m/s)] [900 fpm (4.6 m/s)] [1000 fpm (5.1 m/s)] **<Insert velocity>**.
 - c. Air Performance: Not more than [0.10-inch wg (25-Pa)] **<Insert pressure>** static pressure drop at [500-fpm (2.5-m/s)] [600-fpm (3.0-m/s)] [700-fpm (3.6-m/s)] [800-fpm (4.1-m/s)] [900-fpm (4.6-m/s)] **<Insert velocity>** free-area [exhaust] [intake] velocity.
 - d. Air Leakage: Not more than [3.5 cfm/sq. ft. (17.8 L/s per sq. m)] **<Insert air-leakage rating>** of louver gross area at a differential static pressure of 0.15-inch wg (37 Pa) with adjustable louver blades closed.
6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.6 ADJUSTABLE, FORMED-METAL LOUVERS

- A. Louver Operation: Provide adjustable louvers with operating mechanisms to suit louver sizes.
 1. Hand operation with push bars.
 2. Crank operation with removable-crank operator in sill or jamb.
 3. Chain operation with tension spring, wall clip, pull chain, and 160 deg F (71 deg C) fusible link.
 4. Motor operation with [2-position, spring-return application (with power on, motor opens louver; with power off, spring closes louver); 110-V, 60-Hz motor and limit switch] [2-direction, 110-V, 60-Hz motor and limit switches]; equipped with [frame-mounted switch] [remote-mounted switch with indicator light] [terminals for controlling devices].
 5. Pneumatic piston operation for use with 80- to 100-psi (550- to 690-kPa) compressed air for [2-position] [modulating] operation; power open, power close [with spring-return fail-safe].
- B. Dual-Blade, Drainable-Blade, Adjustable Louver **<Insert drawing designation, e.g., LV-1>**: Fixed drainable blades and adjustable plain blades combined in single frame.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dowco Products Group; Safe-Air of Illinois, Inc.
 - b. Metal Form Manufacturing Inc.
 - c. Ruskin Company; Tomkins PLC.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
 2. Louver Depth: [4 inches (100 mm)] [6 inches (150 mm)] **<Insert depth>**, overall.

3. Frame and Blade Material and Nominal Thickness: Galvanized-steel sheet, not less than [0.052 inch (1.32 mm) **for frames and 0.040 inch (1.02 mm) for blades**] [0.052 inch (1.32 mm)] [0.064 inch (1.63 mm)].
 4. Frame and Blade Material and Nominal Thickness: Stainless-steel sheet, not less than [0.050 inch (1.27 mm)] [0.062 inch (1.59 mm)].
 5. Louver Performance Ratings:
 - a. Free Area: Not less than <Insert free area> for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
 - b. Point of Beginning Water Penetration: Not less than <Insert velocity>.
 - c. Air Performance: Not more than <Insert pressure> static pressure drop at <Insert velocity> free-area [exhaust] [intake] velocity.
 - d. Air Leakage: Not more than [1.5 cfm/sq. ft. (7.6 L/s per sq. m)] <Insert air-leakage rating> of louver gross area at a differential static pressure of 0.15-inch wg (37 Pa) with adjustable louver blades closed.
 6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
- C. Single-Blade, Adjustable Louver <Insert drawing designation, e.g., LV-1>:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a Mestek company.
 - b. Air Flow Company, Inc.
 - c. Airolite Company, LLC (The).
 - d. American Warming and Ventilating, Inc.; a Mestek company.
 - e. Arrow United Industries; a division of Mestek, Inc.
 - f. Carnes Company, Inc.
 - g. Cesco Products; a division of Mestek, Inc.
 - h. Dowco Products Group; Safe-Air of Illinois, Inc.
 - i. Greenheck Fan Corporation.
 - j. Industrial Louvers, Inc.
 - k. Louvers & Dampers, Inc.; a division of Mestek, Inc.
 - l. Metal Form Manufacturing Inc.
 - m. NCA Manufacturing, Inc.
 - n. Ruskin Company; Tomkins PLC.
 - o. United Enertech Corp.
 - p. Vent Products Company, Inc.
 - q. <Insert manufacturer's name>.
 - r. or approved equal.
 2. Louver Depth: [4 inches (100 mm)] [6 inches (150 mm)] <Insert depth>.
 3. Blade Type: [Drainable] [Plain].
 4. Frame and Blade Material and Nominal Thickness: Galvanized-steel sheet, not less than [0.052 inch (1.32 mm) **for frames and 0.040 inch (1.02 mm) for blades**] [0.052 inch (1.32 mm)] [0.064 inch (1.63 mm)].
 5. Frame and Blade Material and Nominal Thickness: Stainless-steel sheet, not less than [0.050 inch (1.27 mm)] [0.062 inch (1.59 mm)].
 6. Accessories: Equip louvers as follows:

- a. Vinyl blade-edge gaskets for each louver blade.
 - b. **[Stainless-steel jamb seals] [or] [vinyl blade-end gaskets].**
7. Louver Performance Ratings:
- a. Free Area: Not less than **[6.5 sq. ft. (0.60 sq. m)] [7.0 sq. ft. (0.65 sq. m)] [7.5 sq. ft. (0.70 sq. m)] [8.0 sq. ft. (0.74 sq. m)] <Insert free area>** for **48-inch-** (1220-mm-) wide by **48-inch-** (1220-mm-) high louver.
 - b. Point of Beginning Water Penetration: Not less than **[500 fpm (2.5 m/s)] [600 fpm (3.0 m/s)] [700 fpm (3.6 m/s)] [800 fpm (4.1 m/s)] [900 fpm (4.6 m/s)] [1000 fpm (5.1 m/s)] <Insert velocity>**.
 - c. Air Performance: Not more than **[0.10-inch wg (25-Pa)] <Insert pressure>** static pressure drop at **[500-fpm (2.5-m/s)] [600-fpm (3.0-m/s)] [700-fpm (3.6-m/s)] [800-fpm (4.1-m/s)] [900-fpm (4.6-m/s)] <Insert velocity>** free-area **[exhaust] [intake]** velocity.
 - d. Air Leakage: Not more than **[3.5 cfm/sq. ft. (17.8 L/s per sq. m)] <Insert air-leakage rating>** of louver gross area at a differential static pressure of **0.15-inch wg (37 Pa)** with adjustable louver blades closed.
8. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.7 ADJUSTABLE, INSULATED LOUVERS

- A. Louver Operation: Provide adjustable louvers with operating mechanisms to suit louver sizes.
1. Hand operation with push bars.
 2. Crank operation with removable-crank operator in sill or jamb.
 3. Chain operation with tension spring, wall clip, pull chain, and **160 deg F (71 deg C)** fusible link.
 4. Motor operation with **[2-position, spring-return application (with power on, motor opens louver; with power off, spring closes louver); 110-V, 60-Hz motor and limit switch] [2-direction, 110-V, 60-Hz motor and limit switches];** equipped with **[frame-mounted switch] [remote-mounted switch with indicator light] [terminals for controlling devices].**
 5. Pneumatic piston operation for use with **80- to 100-psi (550- to 690-kPa)** compressed air for **[2-position] [modulating]** operation; power open, power close **[with spring-return fail-safe].**
- B. Adjustable, Insulated, Extruded-Aluminum Louver **<Insert drawing designation, e.g., LV-1>**: Single-blade, adjustable louver with gasketed, insulated blades. Frames and blade frames have urethane thermal break. Frames are extruded aluminum, not less than **0.080-inch (2.03-mm)** nominal thickness. Blade facings are aluminum sheet, not less than **0.032-inch (0.81-mm)** nominal thickness.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Airolite Company, LLC (The).

- b. Construction Specialties, Inc.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.
 2. Louver Depth: [6 inches (150 mm)] [9 inches (225 mm)]
 3. Insulation: [Extruded-polystyrene foam, 2 inches (50 mm) thick] [Foamed-in-place polyurethane].
- C. Adjustable, Insulated, Formed-Metal Louver **<Insert drawing designation, e.g., LV-1>**: Single-blade, adjustable louver with gasketed, insulated blades.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrow United Industries; a division of Mestek, Inc.
 - b. Carnes Company, Inc.
 - c. Dowco Products Group; Safe-Air of Illinois, Inc.
 - d. Vent Products Company, Inc.
 - e. **<Insert manufacturer's name>**.
 - f. or approved equal.
 2. Louver Depth: [6 inches (150 mm)] [8 inches (200 mm)] **<Insert depth>**.
 3. Frame Material and Nominal Thickness: Galvanized-steel sheet, not less than [0.052 inch (1.32 mm)] [0.064 inch (1.63 mm)].
 4. Frame Material and Nominal Thickness: Stainless-steel sheet, not less than [0.050 inch (1.27 mm)] [0.062 inch (1.59 mm)].
 5. Blade Material and Nominal Thickness: Galvanized-steel sheet, not less than [0.028 inch (0.71 mm)] [0.040 inch (1.02 mm)] [0.052 inch (1.32 mm)] [0.064 inch (1.63 mm)].
 6. Blade Material and Nominal Thickness: Stainless-steel sheet, not less than [0.025 inch (0.64 mm)] [0.038 inch (0.95 mm)] [0.050 inch (1.27 mm)] [0.062 inch (1.59 mm)].
 7. Insulation: [Extruded-polystyrene foam, 1 inch (25 mm) thick] [Rigid, glass-fiber-board insulation, 1 inch (25 mm) thick] [Foamed-in-place polyurethane, 1/2 inch (13 mm) thick] **<Insert insulation description and thickness>**.

2.8 FIXED, ACOUSTICAL LOUVERS

- A. Fixed, Formed-Metal Acoustical Louver **<Insert drawing designation, e.g., LV-1>**: Louver with formed-metal blades filled on interior with mineral-fiber, rigid-board, acoustical insulation retained by perforated metal sheet of same material and finish as blade.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a Mestek company.
 - b. Air Flow Company, Inc.

- c. Airolite Company, LLC (The).
 - d. All-Lite Architectural Products.
 - e. American Warming and Ventilating, Inc.; a Mestek company.
 - f. Arrow United Industries; a division of Mestek, Inc.
 - g. Construction Specialties, Inc.
 - h. Dowco Products Group; Safe-Air of Illinois, Inc.
 - i. Greenheck Fan Corporation.
 - j. Industrial Louvers, Inc.
 - k. Louvers & Dampers, Inc.; a division of Mestek, Inc.
 - l. Metal Form Manufacturing Inc.
 - m. NCA Manufacturing, Inc.
 - n. Reliable Products, Inc.
 - o. Ruskin Company; Tomkins PLC.
 - p. United Enertech Corp.
 - q. **<Insert manufacturer's name>**.
 - r. or approved equal.
2. Louver Depth: [6 inches (150 mm)] [8 inches (200 mm)] [12 inches (300 mm)] **<Insert depth>**.
 3. Frame Material: Extruded-aluminum or aluminum sheet, not less than 0.080-inch (2.03-mm) nominal thickness.
 4. Frame Material: Galvanized-steel sheet, not less than [0.052-inch (1.32-mm)] [0.064-inch (1.63-mm)] nominal thickness.
 5. Blade Material: Aluminum sheet, not less than [0.063-inch (1.60-mm)] [0.080-inch (2.03-mm)] nominal thickness.
 6. Blade Material: Galvanized-steel sheet, not less than [0.034-inch (0.86-mm)] [0.040-inch (1.02-mm)] [0.052-inch (1.32-mm)] nominal thickness.
 7. Blade Shape: [Straight] [Airfoil] [Chevron].
 8. Blade Angle: 45 degrees unless otherwise indicated.
 9. Blade Spacing: 6 inches (150 mm) o.c. for 6-inch- (150-mm-) deep louvers.
 10. Blade Spacing: [6 inches (150 mm)] [8 inches (200 mm)] o.c. for 8-inch- (200-mm-) deep louvers.
 11. Blade Spacing: [9 inches (225 mm)] [12 inches (300 mm)] o.c. for 12-inch- (300-mm-) deep louvers.
 12. Free Area: Not less than 4 sq. ft. (0.37 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
 13. Airborne Sound-Transmission Loss: STC [10] **<Insert value>** per ASTM E 413, determined by testing per ASTM E 90.
 14. Outdoor-Indoor Sound-Transmission Loss: OITC [10] **<Insert value>** per ASTM E 1332, determined by testing per ASTM E 966.

2.9 LOUVER SCREENS

- A. General: Provide screen at [each exterior louver] [louvers indicated].
 1. Screen Location for Fixed Louvers: Interior face.
 2. Screen Location for Adjustable Louvers: [Interior] [Exterior] face unless otherwise indicated.

3. Screening Type: **[Bird screening] [Bird screening except where insect screening is indicated] [Insect screening]**.
- B. Secure screen frames to louver frames with **[stainless-steel machine screws] [machine screws with heads finished to match louver]**, spaced a maximum of **6 inches** (150 mm) from each corner and at **12 inches** (300 mm) o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
1. Metal: Same kind and form of metal as indicated for louver to which screens are attached.**[Reinforce extruded-aluminum screen frames at corners with clips.]**
 2. Finish: **[Same finish as louver frames to which louver screens are attached] [Mill finish unless otherwise indicated]**.
 3. Type: **[Rewirable frames with a driven spline or insert] [Non-rewirable, U-shaped frames]**.
- D. Louver Screening for Aluminum Louvers:
1. Bird Screening: Aluminum, **1/2-inch-** (13-mm-) square mesh, **0.063-inch** (1.60-mm) wire.
 2. Bird Screening: Stainless steel, **1/2-inch-** (13-mm-) square mesh, **0.047-inch** (1.19-mm) wire.
 3. Bird Screening: Flattened, expanded aluminum, **3/4 by 0.050 inch** (19 by 1.27 mm) thick.
 4. Insect Screening: Aluminum, **18-by-16** (1.4-by-1.6-mm) mesh, **0.012-inch** (0.30-mm) wire.
 5. Insect Screening: Stainless steel, **18-by-18** (1.4-by-1.4-mm) mesh, **0.009-inch** (0.23-mm) wire.
- E. Louver Screening for Galvanized-Steel Louvers:
1. Bird Screening: Galvanized steel, **1/2-inch-** (13-mm-) square mesh, **0.041-inch** (1.04-mm) wire.
 2. Bird Screening: Stainless steel, **1/2-inch-** (13-mm-) square mesh, **0.047-inch** (1.19-mm) wire.
 3. Insect Screening: Galvanized steel, **18-by-14** (1.4-by-1.8-mm) mesh, **0.011-inch** (0.28-mm) wire.
 4. Insect Screening: Stainless steel, **18-by-18** (1.4-by-1.4-mm) mesh, **0.009-inch** (0.23-mm) wire.
- F. Louver Screening for Stainless-Steel Louvers:
1. Bird Screening: Stainless steel, **1/2-inch-** (13-mm-) square mesh, **0.047-inch** (1.19-mm) wire.
 2. Insect Screening: Stainless steel, **18-by-18** (1.4-by-1.4-mm) mesh, **0.009-inch** (0.23-mm) wire.

2.10 BLANK-OFF PANELS

- A. Uninsulated, Blank-Off Panels: Metal sheet attached to back of louver.
1. Aluminum sheet for aluminum louvers, not less than **0.050-inch** (1.27-mm) nominal thickness.
 2. Galvanized-steel sheet for galvanized-steel louvers, not less than [**0.040-inch** (1.02-mm)] [**0.052-inch** (1.32-mm)] nominal thickness.
 3. Stainless-steel sheet for stainless-steel louvers, not less than [**0.038-inch** (0.95-mm)] [**0.050-inch** (1.27-mm)] nominal thickness, with grain running in same direction as grain of louver blades.
 4. Panel Finish: [**Same finish applied to louvers**] [**Same type of finish applied to louvers, but black color**].
 5. Attach blank-off panels with [**clips**] [**sheet metal screws**] <Insert method>.
- B. Insulated, Blank-Off Panels: Laminated panels consisting of insulating core surfaced on back and front with metal sheets and attached to back of louver.
1. Thickness: [**1 inch** (25 mm)] [**2 inches** (50 mm)].
 2. Metal Facing Sheets: Aluminum sheet, not less than **0.032-inch** (0.81-mm) nominal thickness.
 3. Metal Facing Sheets: Galvanized-steel sheet, not less than **0.028-inch** (0.71-mm) nominal thickness.
 4. Metal Facing Sheets: Stainless-steel sheet, not less than **0.031-inch** (0.79-mm) nominal thickness.
 5. Insulating Core: [**Rigid, glass-fiber-board insulation**] [**or**] [**extruded-polystyrene foam**] <Insert insulation material>.
 6. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard [**extruded-aluminum-channel frames, not less than 0.080-inch** (2.03-mm) **nominal thickness**] [**channel frames**], with corners mitered and with same finish as panels.
 7. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
 8. Panel Finish: [**Same finish applied to louvers**] [**Same type of finish applied to louvers, but black color**].
 9. Attach blank-off panels with [**clips**] [**sheet metal screws**] <Insert method>.

2.11 WALL VENTS (BRICK VENTS)

- A. Extruded-Aluminum Wall Vents:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Flow Company, Inc.
 - b. Aiolite Company, LLC (The).
 - c. Arrow United Industries; a division of Mestek, Inc.
 - d. Construction Specialties, Inc.
 - e. Dowco Products Group; Safe-Air of Illinois, Inc.

- f. Greenheck Fan Corporation.
 - g. Hohmann & Barnard, Inc.
 - h. Industrial Louvers, Inc.
 - i. Louvers & Dampers, Inc.; a division of Mestek, Inc.
 - j. Metal Form Manufacturing Inc.
 - k. Nystrom Building Products.
 - l. Reliable Products, Inc.
 - m. Ruskin Company; Tomkins PLC.
 - n. Sunvent Industries; Division of Sylro Sales Corp.
 - o. United Enertech Corp.
 - p. **<Insert manufacturer's name>**.
 - q. or approved equal.
2. Extruded-aluminum louvers and frames, not less than **0.125-inch** (3.18-mm) nominal thickness, assembled by welding; with **18-by-14-** (1.4-by-1.8-mm-) mesh, aluminum insect screening on inside face; incorporating weep holes, continuous drip at sill, and integral waterstop on inside edge of sill; of load-bearing design and construction.
 3. Dampers: Aluminum blades and frames mounted on inside of wall vents; operated from exterior with Allen wrench in socket-head cap screw. Fabricate operating mechanism from Type 304 stainless-steel components.
 4. Finish: **[Mill finish]** **<Insert finish>**.

B. Cast-Aluminum Wall Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Airolite Company, LLC (The).
 - b. Greenheck Fan Corporation.
 - c. Hohmann & Barnard, Inc.
 - d. Ruskin Company; Tomkins PLC.
 - e. Sunvent Industries; Division of Sylro Sales Corp.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
2. One-piece, cast-aluminum louvers and frames; with **18-by-14-** (1.4-by-1.8-mm-) mesh, aluminum insect screening on inside face; incorporating integral waterstop on inside edge of sill; of load-bearing design and construction.
3. Dampers: Aluminum blades and frames mounted on inside of wall vents; operated from exterior with Allen wrench in socket-head cap screw. Fabricate operating mechanism from Type 304 stainless-steel components.
4. Finish: Mill finish.

2.12 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.13 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
- C. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.
1. Color: [**Champagne**] [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] <Insert color>.
 2. Color: [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**].
- D. Conversion-Coated Finish: AA-C12C42 (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating).
- E. Conversion-Coated and Factory-Primed Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below).
1. Organic Coating: Air-dried primer of not less than **2-mil** (0.05-mm) dry film thickness.
- F. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils** (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.
- G. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with [**AAMA 2604**] [**AAMA 2605**] and containing not less than [**50**] [**70**] percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.
- H. High-Performance Organic Finish: [**3**] [**4**]-coat fluoropolymer finish complying with AAMA 2605 and containing not less than [**50**] [**70**] percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.

2.14 GALVANIZED-STEEL SHEET FINISHES

- A. Finish louvers after assembly.
- B. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and repair according to ASTM A 780.
- C. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of **1 mil** (0.025 mm) for topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of **2 mils** (0.05 mm).
 - 1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>.**

2.15 STAINLESS-STEEL SHEET FINISHES

- A. Repair sheet finish by grinding and polishing irregularities, weld spatter, scratches, and forming marks to match surrounding finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.

- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- F. Protect unpainted galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.
- B. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- C. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- D. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by DEN Project Manager, remove damaged units and replace with new units.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 089000

SECTION 092116.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Gypsum board shaft wall assemblies.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each component of gypsum board shaft wall assembly.
 - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: Submit shop drawings for special components and installations not fully dimensioned or detailed in manufacturer's product data.
- C. Include placing drawings for framing members showing size and gage designations, number, type, location and spacing. Indicate supplemental strapping, bracing, splices, bridging, accessories, and details required for proper installation, including stud head expansion.
- D. Samples: Submit one foot long sample of each type of stud, head and runner channels, expansion head track, fasteners, anchors.
- E. Certificate from manufacturer stating that all materials are per contract requirements and providing proof of minimum five (5) years experience manufacturing products required of similar size.
- F. Certificate from installer evidencing a minimum five (5) years successful experience installing this type of work on projects.
- G. Mock-up: Provide a mock-up of components of this section. Coordinate all work.
- H. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content,

- documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
 3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured[**and regionally extracted and manufactured**] materials. Include statement indicating cost for each regionally manufactured material.
 - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
 - b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
 4. Laboratory Test Reports for Credit EQ 4: For gypsum board shaft wall systems, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- 1.4 INFORMATIONAL SUBMITTALS
- A. Evaluation Reports: For [**shaft wall assemblies**] [**firestop tracks**], from ICC-ES.
- 1.5 CLOSEOUT SUBMITTALS
- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".
- 1.6 QUALITY ASSURANCE
- A. Fire Rated Assemblies: Where framing units are components of assemblies indicated for a fire resistance rating, including those required for compliance with governing regulations, provide units that have been approved by governing authorities having jurisdiction.
 - B. Pre-installation conference: Prior to installation of work, meet at the project site or other mutually agreed location with installer, contractor, DEN Project Manager and other job related contractors.

- C. Warranty: Installer to warrant system for two (2) years, including framing and finish.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or with gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, or mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

D. CONSTRUCTION WASTE MANAGEMENT

- 1. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.
- C. Low-Emitting Materials: Gypsum shaft wall assemblies shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- 2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES <Insert drawing designation>
- A. Fire-Resistance Rating: [As indicated] [1 hour] [2 hours] [3 hours] [4 hours] <Insert rating>.
 - B. STC Rating: [As indicated] [51, minimum] <Insert rating>.
 - C. Studs: Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated.
 - 1. Depth: [As indicated] [2-1/2 inches (64 mm)] [4 inches (102 mm)] [6 inches (152 mm)].
 - 2. Minimum Base-Metal Thickness: [As indicated] [0.033 inch (0.84 mm)] <Insert value>.
 - D. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least [2 inches (51 mm)] <Insert dimension> long and matching studs in depth.
 - 1. Minimum Base-Metal Thickness: [As indicated] [Matching steel studs] [0.021 inch (0.53 mm)] [0.033 inch (0.84 mm)] <Insert value>.
 - E. Firestop Tracks: Provide firestop track at head of shaft wall on each floor level.
 - F. Elevator Hoistway Entrances: Manufacturer's standard J-profile jamb strut with long-leg length of 3 inches (76 mm), matching studs in depth, and not less than [0.033 inch (0.84 mm)] <Insert dimension> thick.
 - G. Room-Side Finish: [As indicated] [Gypsum board] [Gypsum veneer plaster] [Cementitious backer units] <Insert finish>.
 - H. Shaft-Side Finish: [As indicated] [Gypsum shaftliner board, Type X] [Gypsum shaftliner board, moisture- and mold-resistant Type X] [As indicated by fire-resistance-rated assembly design designation] <Insert finish>.
 - I. Insulation: Sound attenuation blankets.
- 2.3 PANEL PRODUCTS
- A. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent by weight.
 - B. Regional Materials: Gypsum panel products shall be manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.
 - C. Regional Materials: Gypsum panel products shall be manufactured within 500 miles (800 km) of Project site.

- D. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
- E. Gypsum Shaftliner Board, Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with paper faces.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. American Gypsum; Shaft Liner.
 - b. CertainTeed Corp.; ProRoc Shaftliner.
 - c. Georgia-Pacific Gypsum LLC, Subsidiary of Georgia Pacific; ToughRock Fireguard Shaftliner.
 - d. Lafarge North America, Inc.; Firecheck Type X Shaftliner.
 - e. National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner.
 - f. PABCO Gypsum; Pabcore Shaftliner Type X.
 - g. Temple-Inland Inc.; Fire-Rated SilentGuard Gypsum Shaftliner System.
 - h. USG Corporation; Sheetrock Brand Gypsum Liner Panel.
 - i. **<Insert manufacturer>**
 - j. or approved equal.
 2. Thickness: **1 inch** (25.4 mm).
 3. Long Edges: Double bevel.
- F. Gypsum Shaftliner Board, Moisture- and Mold-Resistant Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with moisture- and mold-resistant core and surfaces.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; ProRoc Moisture and Mold Resistant Shaftliner.
 - b. Georgia-Pacific Gypsum LLC, Subsidiary of Georgia Pacific; Dens-Glass Ultra Shaftliner.
 - c. Lafarge North America, Inc.; Firecheck Moldcheck Type X Shaftliner.
 - d. National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner XP.
 - e. PABCO Gypsum; Pabcore Mold Curb Shaftliner Type X.
 - f. Temple-Inland Inc.; Fire-Rated SilentGuard TS Mold-Resistant Gypsum Shaftliner System.
 - g. USG Corporation; Sheetrock Brand Mold Tough Gypsum Liner Panel.
 - h. **<Insert manufacturer>**
 - i. or approved equal.
 2. Thickness: **1 inch** (25.4 mm).
 3. Long Edges: Double bevel.
 4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- G. Gypsum Board: As specified in Section 092900 "Gypsum Board."
- H. Gypsum Base for Gypsum Veneer Plaster: As specified in Section 092613 "Gypsum Veneer Plastering."

- I. Cementitious Backer Units: As specified in [**Section 092900 "Gypsum Board."**] [**Section 093000 "Tiling."**]

2.4 NON-LOAD-BEARING STEEL FRAMING

- A. Recycled Content of Steel: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [**25**] <Insert number> percent.
- B. Steel Framing Members: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 1. Protective Coating: [**Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40 (Z120)**] [**ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized**] [**ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized**] unless otherwise indicated.
- C. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fire Trak Corp.; Fire Trak System[**attached to studs with Fire Trak Posi Klip**].
 - b. Grace Construction Products; FlameSafe FlowTrak System.
 - c. Metal-Lite, Inc.; The System.
 - d. Steel Network Inc. (The); [**VertiClip SLD**] [**VertiTrack VTD**] Series.
 - e. <Insert manufacturer>
 - f. or approved equal.

2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with manufacturer's written recommendations.
- B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in [**Section 092900 "Gypsum Board"**] [**Section 092613 "Gypsum Veneer Plastering"**] that comply with gypsum board shaft wall assembly manufacturer's written recommendations for application indicated.
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
- D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
 1. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability

- to sustain, without failure, a load equal to 5 times design load, as determined by testing according to ASTM E 488 conducted by a qualified testing agency.
2. Powder-Actuated Anchors: Powder-actuated fasteners are not permitted and shall not be used.
- E. Sound Attenuation Blankets: As specified in [**Section 092900 "Gypsum Board."**] [**Section 092613 "Gypsum Veneer Plastering."**]
- F. Acoustical Sealant: As specified in [**Section 092900 "Gypsum Board."**] [**Section 092613 "Gypsum Veneer Plastering."**]

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to which gypsum board shaft wall assemblies attach or abut, with Installer present, including hollow-metal frames, elevator hoistway doorframes, cast-in anchors, and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Section 078100 "Applied Fireproofing."
- B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and ASTM C 754 other than stud-spacing requirements.
- B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.

- C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted doorstops, and similar items that cannot be supported directly by shaft wall assembly framing.
1. Elevator Hoistway: At elevator hoistway-entrance doorframes, provide jamb struts on each side of doorframe.
 2. Reinforcing: Where handrails directly attach to gypsum board shaft wall assemblies, provide galvanized steel reinforcing strip with [0.033-inch (0.84-mm)] **<Insert dimension>** minimum thickness of base metal (uncoated), accurately positioned and secured behind at least one layer of face panel.
- D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.
- E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.
- F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- G. Control Joints: Install control joints [**at locations indicated on Drawings**] [**according to ASTM C 840 and in specific locations approved by DEN Project Manager**] while maintaining fire-resistance rating of gypsum board shaft wall assemblies.
- H. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.
- I. Cant Panels: At projections into shaft [**exceeding 4 inches** (102 mm)] [**where indicated**], install 1/2- or 5/8-inch- (13- or 16-mm-) thick gypsum board cants covering tops of projections.
1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at **24 inches** (610 mm) o.c. with screws fastened to shaft wall framing.
 2. Where steel framing is required to support gypsum board cants, install framing at **24 inches** (610 mm) o.c. and extend studs from the projection to shaft wall framing.
- J. Installation Tolerance: Install each framing member so fastening surfaces vary not more than **1/8 inch** (3 mm) from the plane formed by faces of adjacent framing.

3.4 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

- B. Remove and replace panels that are wet, moisture damaged, or mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 092116.23

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
 - 2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

- B. Related Requirements:

- 1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.
 - 2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for fire-resistance-rated vertical shaft and horizontal enclosures, including metal framing.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include data substantiating that materials comply with requirements.

- B. LEED Submittals:

- 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.

1.4 INFORMATION SUBMITTALS

- A. Evaluation Reports: For [**dimpled steel studs and runners**] [**firestop tracks**], from

ICC-ES.

1.5 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Mockups: Reference Section 092900 for mockups of gypsum board assemblies.
- B. Single-Source Responsibility for Steel Framing: Obtain steel framing members for gypsum board assemblies from a single manufacturer, whenever possible, unless otherwise indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Neatly stack materials to prevent damage.

1.8 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25] <Insert number> percent.

2.2 FRAMING SYSTEMS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25] <Insert number> percent.
- B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 2. Protective Coating: [ASTM A 653/A 653M, G40 (Z120)] [ASTM A 653/A 653M, G60 (Z180)] [Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40 (Z120)], hot-dip galvanized, unless otherwise indicated.
- C. Studs and Runners: ASTM C 645. [Use either steel studs and runners or dimpled steel studs and runners.]
1. Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: [As indicated on Drawings] [0.027 inch (0.68 mm)] [0.033 inch (0.84 mm)].
 - b. Depth: [As indicated on Drawings] [3-5/8 inches (92 mm)] [6 inches (152 mm)] [4 inches (102 mm)] [2-1/2 inches (64 mm)] [1-5/8 inches (41 mm)].
 2. Dimpled Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: [As indicated on Drawings] [0.025 inch (0.64 mm)].
 - b. Depth: [As indicated on Drawings] [3-5/8 inches (92 mm)] [6 inches (152 mm)] [4 inches (102 mm)] [2-1/2 inches (64 mm)] [1-5/8 inches (41 mm)].
- D. Slip-Type Head Joints: Where indicated, provide [one of] the following:
1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
 2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
 3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Products: Subject to compliance with requirements, provide one of the following:

- 1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
 - 2) MBA Building Supplies; [**FlatSteel Deflection Track**] [**Slotted Deflecto Track**].
 - 3) Steel Network Inc. (The); [**VertiClip SLD**] [**VertiTrack VTD**] Series.
 - 4) Superior Metal Trim; Superior Flex Track System (SFT).
 - 5) Telling Industries; [**Vertical Slip Track**] [**Vertical Slip Track II**].
 - 6) or approved equal.
- E. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fire Trak Corp.; Fire Trak System[**attached to studs with Fire Trak Posi Klip**].
 - b. Grace Construction Products; FlameSafe FlowTrak System.
 - c. Metal-Lite, Inc.; The System.
 - d. **<Insert manufacturer>**
 - e. or approved equal.
- F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Metal Thickness: [**As indicated on Drawings**] [**0.027 inch** (0.68 mm)] [**0.033 inch** (0.84 mm)] **<Insert thickness>**.
- G. Cold-Rolled Channel Bridging: Steel, **0.053-inch** (1.34-mm) minimum base-metal thickness, with minimum **1/2-inch-** (13-mm-) wide flanges.
1. Depth: [**As indicated on Drawings**] [**1-1/2 inches** (38 mm)] **<Insert depth>**.
 2. Clip Angle: Not less than **1-1/2 by 1-1/2 inches** (38 by 38 mm), **0.068-inch-** (1.72-mm-) thick, galvanized steel.
- H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base-Metal Thickness: [**As indicated on Drawings**] [**0.033 inch** (0.84 mm)] **<Insert thickness>**.
 2. Depth: [**As indicated on Drawings**] [**7/8 inch** (22.2 mm)] [**1-1/2 inches** (38.1 mm)].
- I. Resilient Furring Channels: **1/2-inch-** (13-mm-) deep, steel sheet members designed to reduce sound transmission.
1. Configuration: [**Asymmetrical**] [**or**] [**hat shaped**].
- J. Cold-Rolled Furring Channels: **0.053-inch** (1.34-mm) uncoated-steel thickness, with minimum **1/2-inch-** (13-mm-) wide flanges.
1. Depth: [**As indicated on Drawings**] [**3/4 inch** (19 mm)] **<Insert depth>**.

2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of **0.033 inch** (0.8 mm).
 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, **0.062-inch-** (1.59-mm-) diameter wire, or double strand of **0.048-inch-** (1.21-mm-) diameter wire.
- K. Z-Shaped Furring: With slotted or nonslotted web, face flange of **1-1/4 inches** (31.8 mm), wall attachment flange of **7/8 inch** (22 mm), minimum uncoated-metal thickness of **0.018 inch** (0.45 mm), and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, **0.062-inch-** (1.59-mm-) diameter wire, or double strand of **0.048-inch-** (1.21-mm-) diameter wire.
- B. Hanger Attachments to Concrete:
1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to **[5] <Insert number>** times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
 - a. Type: [**Cast-in-place anchor, designed for attachment to concrete forms**] [**Postinstalled, chemical anchor**] [**Postinstalled, expansion anchor**].
 2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to **[10] <Insert number>** times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
 - a. Powder-actuated fasteners shall be used only where allowed in advance by DEN Operations.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, **0.16 inch** (4.12 mm) in diameter.
- D. Flat Hangers: Steel sheet, [**in size indicated on Drawings**] [**1 by 3/16 inch** (25 by 5 mm) **by length indicated**] **<Insert size>**.
- E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of **0.053 inch** (1.34 mm) and minimum **1/2-inch-** (13-mm-) wide flanges.
 1. Depth: [**As indicated on Drawings**] [**2-1/2 inches** (64 mm)] [**2 inches** (51 mm)] [**1-1/2 inches** (38 mm)].
- F. Furring Channels (Furring Members):
1. Cold-Rolled Channels: **0.053-inch** (1.34-mm) uncoated-steel thickness, with

2. minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
Steel Studs and Runners: ASTM C 645.
 - a. Minimum Base-Metal Thickness: [**As indicated on Drawings**] [0.027 inch (0.68 mm)] [0.033 inch (0.84 mm)].
 - b. Depth: [**As indicated on Drawings**] [3-5/8 inches (92 mm)] [6 inches (152 mm)] [4 inches (102 mm)] [2-1/2 inches (64 mm)] [1-5/8 inches (41 mm)].
 3. Dimpled Steel Studs and Runners: ASTM C 645.
 - a. Minimum Base-Metal Thickness: [**As indicated on Drawings**] [0.025 inch (0.64 mm)].
 - b. Depth: [**As indicated on Drawings**] [3-5/8 inches (92 mm)] [6 inches (152 mm)] [4 inches (102 mm)] [2-1/2 inches (64 mm)] [1-5/8 inches (41 mm)].
 4. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
 - a. Minimum Base-Metal Thickness: [**As indicated on Drawings**] [0.033 inch (0.84 mm)] <Insert thickness>.
 5. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.
 - a. Configuration: [**Asymmetrical**] [or] [**hat shaped**].
- G. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
 - b. Chicago Metallic Corporation; Drywall Grid System.
 - c. USG Corporation; Drywall Suspension System.
 - d. <Insert manufacturer>
 - e. or approved equal.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide[**one of**] the following:
1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.

2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, **1/8 inch** (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than **24 inches** (610 mm) o.c.
 2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.
 1. Gypsum Plaster Assemblies: Also, comply with requirements in ASTM C 841 that apply to framing installation.
 2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
 3. Gypsum Veneer Plaster Assemblies: Also, comply with requirements in ASTM C 844 that apply to framing installation.

4. Gypsum Board Assemblies: Also, comply with requirements in ASTM C 840 that apply to framing installation.
 - B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with recommendations of gypsum board manufacturer or, if none available, with the most current edition of United States Gypsum Co. "Gypsum Construction Handbook."
 - C. Install bracing at terminations in assemblies.
 - D. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement. Comply with details shown on Drawings.
 - E. Where building structure abuts ceiling perimeter or penetrates ceiling.
 1. Where partition framing and wall furring abut structure, except at floor.
 2. Provide slip- or cushioned-type joints as detailed to attain lateral support and avoid axial loading.
 - F. Install deflection track top runner to attain lateral support and avoid axial loading.
 - G. Install deflection and firestop track top runner at fire-resistance-rated assemblies where indicated.
 - H. Attach jamb studs at openings to tracks using manufacturer's standard stud clip.
 - I. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.
- 3.4 INSTALLING FRAMED ASSEMBLIES
- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
 - B. Install studs so flanges within framing system point in same direction.
 1. Space studs as follows:
 - a. Single-Layer Application: [16 inches (406 mm)] [24 inches (610 mm)] [400 mm] [600 mm] o.c. unless otherwise indicated.
 - b. Multilayer Application: [16 inches (406 mm)] [24 inches (610 mm)] [400 mm] [600 mm] o.c. unless otherwise indicated.
 - c. Tile Backing Panels: [16 inches (406 mm)] [400 mm] o.c. unless otherwise indicated.
 - C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on doorframes; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum **1/2-inch** (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
 6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs **6 inches** (150 mm) o.c.
- D. Direct Furring:
1. Screw to wood framing.
 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced **24 inches** (610 mm) o.c.
- E. Z-Furring Members:
1. Erect insulation (specified in Section 072100 "Thermal Insulation") vertically and hold in place with Z-furring members spaced [**24 inches** (610 mm)] [**600 mm**] o.c.
 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced **24 inches** (610 mm) o.c.
 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space

second member no more than **12 inches** (305 mm) from corner and cut insulation to fit.

- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than **1/8 inch** (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards and seismic requirements for assembly types and other assembly components indicated.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within **[performance limits established by referenced installation standards]** <Insert deflection limit>.
 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Do not attach hangers to steel roof deck.
 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems [**with hangers used for support**] **<Insert requirements>**.
- F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- G. Installation Tolerances: Install suspension systems that are level to within [**1/8 inch in 12 feet** (3 mm in 3.6 m)] **<Insert dimensions>** measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.6 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: DEN Project Manager will conduct an above-ceiling observation prior to installation of gypsum board ceilings and report any deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
 - 1. Notify DEN Project Manager minimum [**seven (7)**] **<Insert number>** days in advance of the date and the time when the Project, or part of the Project, will be ready for an above-ceiling observation.
 - 2. Prior to notifying DEN Project Manager, complete the following in areas to receive gypsum board ceilings:
 - a. Installation of 80% of lighting fixtures, powered for operation.
 - b. Installation, insulation, and leak and pressure testing of water piping systems.
 - c. Installation of air duct systems.
 - d. Installation of air devices.
 - e. Installation of mechanical system control air tubing.
 - f. Installation of ceiling support framing.
 - g. **<Insert requirements.>**

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this section. The cost of the work described in this section shall be included in the applicable unit price item, work order or lump sum bid item.

END OF SECTION 092216

SECTION 092713 - GLASS-FIBER-REINFORCED PLASTER FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes factory-molded, glass-fiber-reinforced plaster fabrications for interior applications.
- B. Related Requirements:
 - 1. **[Section 061000 "Rough Carpentry"] [Section 061053 "Miscellaneous Rough Carpentry"]** for blocking, nailers, shims, and carpentry supporting glass-fiber-reinforced plaster fabrications.
 - 2. **[Section 092216 "Non-Structural Metal Framing"] <Insert Section>** for steel framing, blocking, and bracing supporting glass-fiber-reinforced plaster fabrications.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, weights, dimensions of individual components and profiles, and finishes.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Data for Credit EQ 4.1: For adhesives, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit EQ 4: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and assembly of glass-fiber-reinforced plaster fabrications.
3. Indicate requirements for joint treatment.

D. Samples: For each exposed product and for each color and texture specified.

1. Linear Moldings: **24-inch-** (610-mm-) long section with finished joint. Show complete pattern.
2. Nonlinear Shapes: [**Full-size unit**] <Insert requirements>.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to glass-fiber-reinforced plaster fabrications and to building structure.
3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, moldings, and other fixtures.

1.5 CLOSEOUT SUBMITTALS

A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

A. Mockups: Build mockups to set quality standards for fabrication and installation.

1. Build mockup of each type of glass-fiber-reinforced plaster fabrication.
2. Paint mockups to match final decoration scheduled or indicated and to comply with requirements specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C 1467/C 1467M.

1.8 FIELD CONDITIONS

A. Environmental Conditions:

1. Comply with ASTM C 1467/C 1467M.
2. Do not deliver or install glass-fiber-reinforced plaster fabrications until building is enclosed, wet work is complete, and HVAC system is operating and continuously maintaining temperature and relative humidity at levels intended for building occupants.

B. Conditioning: Acclimatize glass-fiber-reinforced plaster fabrications to ambient temperature and humidity of spaces in which they will be installed. Remove packaging and move units into installation spaces not less than 48 hours before installing them.

C. Field Measurements: Where glass-fiber-reinforced plaster fabrications are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.9 CONSTRUCTION WASTE MANAGEMENT

A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GLASS-FIBER-REINFORCED PLASTER FABRICATIONS

A. Fabrications: Molded, glass-fiber-reinforced plaster units complying with ASTM C 1381/C 1381M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Architectural Reproductions Inc.
- b. Casting Designs, Inc.
- c. DEC Architectural Composites; Division of DEC Associates, Inc.
- d. Felber Ornamental Plastering Corporation.
- e. First Class Building Products, Inc.
- f. Formglas Inc.
- g. Melton Classics, Inc.
- h. Plastrglas, Incorporated.
- i. Stromberg Architectural Products, Inc.
- j. <Insert manufacturer's name>.
- k. or approved equal.

B. Embedments: [**Cold-rolled steel channels with ASTM 653/A 653M, G60** (Z180)]

hot-dip galvanized coating] [As standard with glass-fiber-reinforced plaster fabrication manufacturer and as required for reinforcement and for anchorage to substrates and framing] <Insert requirements>.

- C. Finish: [**Smooth for paint finish**] [**Smooth for gloss paint finish**] <Insert finish>.

2.2 AUXILIARY MATERIALS

- A. Adhesives: As recommended in glass-fiber-reinforced plaster fabrication manufacturer's written instructions[.] [**and as follows:**]

1. Adhesive shall have VOC content of [**50**] <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- B. Steel Drill Screws: Of sufficient length and size to securely fasten glass-fiber-reinforced plaster fabrications to framing members, and as follows:

1. Screws complying with ASTM C 1002 for fastening glass-fiber-reinforced plaster fabrications to steel members less than **0.033 inch** (0.84 mm) thick.
2. Screws complying with ASTM C 1002 for fastening glass-fiber-reinforced plaster fabrications to wood members.
3. Screws complying with ASTM C 954 for fastening glass-fiber-reinforced plaster fabrications to steel members from **0.033 to 0.112 inch** (0.84 to 2.84 mm) thick.

- C. Joint-Treatment Materials: ASTM C 475/C 475M.

- D. Control Joints: ASTM C 1047, one-piece control joint with V-shaped slot and removable strip covering the slot opening.

1. Material: [**Steel sheet zinc-coated by hot-dip process**] [**Rolled zinc**].

2.3 FABRICATION

- A. Fabricate glass-fiber-reinforced plaster units to comply with ASTM C 1381/C 1381M, with smooth-finished surfaces; repair hollows, voids, scratches, and other surface imperfections. Fabricate units in lengths and sizes that will minimize number of joints between abutting units.
- B. Embedments: Incorporate embedments into units to develop the full strength of glass-fiber-reinforced plaster fabrications. Cover embedments with not less than **3/16-inch** (5-mm) thickness of glass-fiber-reinforced plaster composite.
- C. Connection Hardware: Designed and fabricated to support and connect glass-fiber-reinforced plaster fabrications to hangers, support framing, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GLASS-FIBER-REINFORCED PLASTER INSTALLATION

- A. Comply with ASTM C 1467/C 1467M.
- B. Install glass-fiber-reinforced plaster fabrications level, plumb, true, and aligned with adjacent materials. Use concealed shims where required for alignment.
- C. Attach glass-fiber-reinforced plaster fabrications to framing and substrates with steel drill screws unless otherwise indicated. Do not use pneumatic staple guns. Countersink screw heads below adjoining finished surface.
 - 1. Predrill fastener holes in units. Clean fastener holes to remove dirt and oil.
 - 2. Locate fasteners not less than **5/16 inch** (7.9 mm) from edges or ends of units.
- D. Where glass-fiber-reinforced plaster fabrications are joined to form composite units, join fabrications with adhesive. Band or brace units together until adhesive cures.
- E. Install control joints between glass-fiber-reinforced plaster fabrications where indicated.
- F. Use joint-treatment materials to finish glass-fiber-reinforced plaster fabrications to produce surfaces ready to receive primers and paint finishes specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting." For Level 5 in first subparagraph below, ASTM C 840 requires an overall skim coat of joint compound, which may be inappropriate for textured or ornamented units. ASTM C 1467/C 1467M requires Level 5 finish where glass-fiber-reinforced plaster units are subject to critical lighting or where gloss or semigloss final decoration is scheduled.
 - 1. Finish joints between units, other than control joints, and countersunk fastener heads to comply with ASTM C 840 for **[Level 4] [Level 5]** and to match surface texture of units.
 - 2. Repair hollows, voids, scratches, and other surface imperfections on units.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 092713

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Interior gypsum board.
2. Exterior gypsum board for ceilings and soffits.
3. Tile backing panels.
4. Texture finishes.

- B. Related Requirements:

1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
2. Section 092216 "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.
3. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
4. Section 092613 "Gypsum Veneer Plastering" for gypsum base for veneer plaster and for other components of gypsum-veneer-plaster finishes.
5. Section 093000 "Tiling" for cementitious backer units installed as substrates for ceramic tile.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include data substantiating that materials comply with requirements.

- B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
 3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured[**and regionally extracted and manufactured**] materials. Include statement indicating cost for each regionally manufactured material.
 - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
 - b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
 4. Product Data for Credit IEQ 4.1: For adhesives used to laminate gypsum board panels to substrates, documentation including printed statement of VOC content.
 5. Laboratory Test Reports for Credit IEQ 4: For adhesives used to laminate gypsum board panels to substrates, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings showing locations, details, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.
- D. Submit shop drawing showing locations, layout, and details of all metal trim.
- E. Samples: For the following products:
1. Trim Accessories: Full-size Sample in **12-inch-** (300-mm-) long length for each trim accessory indicated.
 2. Textured Finishes: [**Manufacturer's standard size**] **<Insert size>** for each textured finish indicated and on same backing indicated for Work.
- 1.4 CLOSEOUT SUBMITTALS
- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".
- 1.5 QUALITY ASSURANCE
- A. Single-Source Responsibility for Panel Products: Obtain each type of gypsum board

and other panel products from a single manufacturer.

- B. Single-Source Responsibility for Finishing Materials: Obtain finishing materials either from the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.
- C. Fire-Test-Response Characteristics: Where fire-resistance-rated gypsum board assemblies are indicated, provide gypsum board assemblies that comply with the following requirements:
1. Fire-Resistance Ratings: As indicated by GA File Numbers in GA-600 "Fire Resistance Design Manual" or design designations in UL "Fire Resistance Directory" or in the listing of another testing and inspecting agency acceptable to authorities having jurisdiction.
 2. Gypsum board assemblies indicated are identical to assemblies tested for fire resistance according to ASTM E119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
 3. Deflection and Firestop Track: Top runner provided in fire-resistance-rated assemblies indicated is labeled and listed by UL, Intertek Testing Services, or another testing and inspecting agency acceptable to authorities having jurisdiction.
- D. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Install mockups for the following:
 - a. Each level of gypsum board finish indicated for use in exposed locations.
 - b. Each texture finish indicated.
 2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
 3. Simulate finished lighting conditions for review of mockups.
 4. Locate mockups on-site in the location and of the size indicated or, if not indicated, as directed by DEN Project Manager.
 5. Notify DEN Project Manager one (1) week in advance of the dates and times when mockups will be constructed.
 6. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 7. When directed, demolish and remove mockups from Project site.
 8. Subject to compliance with requirements and approval by DEN Project Manager, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

- B. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are fully enclosed and conditioned on a 24-hour basis.
- C. Required Room Temperatures for Gypsum Panel Work:
 - 1. For nonadhesive attachment of gypsum board to framing, maintain not less than 40 degrees F (4 degrees C).
 - 2. For adhesive attachment and finishing of gypsum board, maintain not less than 50 degrees F (10 degrees C) for 48 hours before application and continuously after until dry.
 - 3. Do not exceed 95 degrees F (35 degrees C) when using temporary heat sources.
- D. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.
- E. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.
- F. Protect all installed panels from moisture damage. Replace all panels that become wet or damaged.
- G. CONSTRUCTION WASTE MANAGEMENT
 - 1. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to

ASTM E 119 by an independent testing agency.

- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Low-Emitting Materials: For ceiling and wall assemblies, provide materials and construction identical to those tested in assembly and complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 GYPSUM BOARD, GENERAL

- A. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
- B. Regional Materials: Gypsum panel products shall be manufactured within **500 miles (800 km)** of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles (800 km)** of Project site.
- C. Regional Materials: Gypsum panel products shall be manufactured within **500 miles (800 km)** of Project site.
- D. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Gypsum.
 - 2. CertainTeed Corp.
 - 3. Georgia-Pacific Gypsum LLC.
 - 4. Lafarge North America Inc.
 - 5. National Gypsum Company.
 - 6. PABCO Gypsum.
 - 7. Temple-Inland.
 - 8. USG Corporation.
 - 9. **<Insert manufacturer>**
 - 10. or approved equal.
- B. Gypsum Wallboard: ASTM C 1396/C 1396M.
 - 1. Thickness: [5/8" (15.9 mm)], Type X, unless otherwise indicated.
 - 2. Long Edges: [**Tapered**] [**Tapered and featured (rounded or beveled) for prefilling**].

- C. Gypsum Board, Type X: ASTM C 1396/C 1396M.
1. Thickness: **5/8 inch** (15.9 mm).
 2. Long Edges: **[Tapered] [Tapered and featured (rounded or beveled) for prefilling]**.
- D. Flexible Gypsum Board: ASTM C 1396/C 1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.
1. Thickness: **1/4 inch** (6.4 mm).
 2. Long Edges: Tapered.
- E. Antia-Sag Gypsum Ceiling Board: ASTM C 1396/C 1396M.
1. Thickness: **1/2 inch** (12.7 mm).
 2. Long Edges: Tapered.
 3. Type: Anti-sag.
- F. Foil-Backed Gypsum Board: ASTM C 1396/C 1396M.
1. Core: **[As indicated on Drawings] [3/8 inch** (9.5 mm), **regular type] [1/2 inch** (12.7 mm), **regular type] [5/8 inch** (15.9 mm), **Type X] [Type C as required by fire-resistance-rated assembly indicated on Drawings]**.
 2. Long Edges: **[Tapered] [Tapered and featured (rounded or beveled) for prefilling]**.
- G. Abuse-Resistant Gypsum Board: ASTM C 1629/C 1629M, **[Level 1] [Level 2] [Level 3]**.
1. Core: **[As indicated on Drawings] [1/2 inch** (12.7 mm), **regular type] [5/8 inch** (15.9 mm), **Type X]**.
 2. Long Edges: Tapered.
 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- H. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
1. Core: **[As indicated] [1/2 inch** (12.7 mm), **regular type] [5/8 inch** (15.9 mm), **Type X]**.
 2. Long Edges: Tapered.
 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 SPECIALTY GYPSUM BOARD

- A. Gypsum Board, Type C: ASTM C 1396/C 1396M. Manufactured to have increased fire-resistive capability. Brand and type of gypsum board to be comply with requirements of designated fire-rated assemblies.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. American Gypsum; Firebloc Type C.
 - b. CertainTeed Corp.; ProRoc Type C.
 - c. Georgia-Pacific Gypsum LLC; Fireguard C.
 - d. Lafarge North America Inc.; Firecheck Type C.
 - e. National Gypsum Company; Gold Bond Fire-Shield C.
 - f. PABCO Gypsum; Flame Curb Type Super C.
 - g. Temple-Inland; Type TG-C.
 - h. USG Corporation; Firecode C Core.
 - i. **<Insert manufacturer>**
 - j. or approved equal.
 2. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
 3. Long Edges: Tapered.
- B. Glass-Mat Interior Gypsum Board: ASTM C 1658/C 1658M. With fiberglass mat laminated to both sides. Specifically designed for interior use.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Georgia-Pacific Gypsum LLC; DensArmour Plus.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
 2. Core: **[As indicated]** [1/2 inch (12.7 mm), **regular type**] [1/2 inch (12.7 mm), **Type C**] [5/8 inch (15.9 mm), **Type X**] [5/8 inch (15.9 mm), **abuse resistant**].
 3. Long Edges: Tapered.
 4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- C. Acoustically Enhanced Gypsum Board: ASTM C 1396/C 1396M. Multilayer products constructed of two layers of gypsum boards sandwiching a viscoelastic sound-absorbing polymer core.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. National Gypsum Company; Sound Break.
 - b. Quiet Solution, Quiet Rock.
 - c. **<Insert manufacturer>**
 - d. or approved equal
 2. Core: **[As indicated]** [1/2 inch (12.7 mm), **regular type**] [1/2 inch (12.7 mm), **Type X**] [5/8 inch (15.9 mm), **regular type**] [5/8 inch (15.9 mm), **Type X**] [1-3/8 inch (35 mm), **regular type**].
 3. Long Edges: Tapered.
- D. Skim-Coated Gypsum Board: ASTM C 1396/C 1396M. Manufactured with a factory-applied skim coat.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Lafarge North America Inc.; Rapid Deco L5.
 - b. or approved equal.
2. Core: **[As indicated]** [1/2 inch (12.7 mm), regular type] [5/8 inch (15.9 mm), Type X].
3. Long Edges: Tapered.

2.5 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

- A. Exterior Gypsum Soffit Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum.
 - b. CertainTeed Corp.
 - c. Georgia-Pacific Gypsum LLC.
 - d. Lafarge North America Inc.
 - e. National Gypsum Company.
 - f. PABCO Gypsum.
 - g. Temple-Inland.
 - h. USG Corporation.
 - i. **<Insert manufacturer>**
 - j. or approved equal.
 2. Core: **[As indicated]** [1/2 inch (12.7 mm), regular type] [5/8 inch (15.9 mm), Type X].
- B. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; GlasRoc Sheathing.
 - b. Georgia-Pacific Gypsum LLC; Dens-Glass Gold.
 - c. National Gypsum Company; Gold Bond, e(2)XP.
 - d. USG Corporation; Securock Glass Mat Sheathing.
 - e. **<Insert manufacturer>**
 - f. or approved equal.
 2. Core: **[As indicated]** [1/2 inch (12.7 mm), regular type] [5/8 inch (15.9 mm), Type X].
- C. Cellulose Fiber-Reinforced Gypsum Sheathing Board: ASTM C 1278/C 1278M, gypsum sheathing, with manufacturer's standard edges.
 1. Products: Subject to compliance with requirements, provide one of the following:

- a. USG Corporation; Fiberock Aqua-Tough.
 - b. <Insert manufacturer>
 - c. or approved equal.
2. Type and Thickness: [**Regular, 1/2 inch** (13 mm)] [**Type X, 5/8 inch** (15.9 mm)] thick.
 3. Size: [**48 by 96 inches** (1219 by 2438 mm)] [**48 by 108 inches** (1219 by 2743 mm)] [**48 by 120 inches** (1219 by 3048 mm)] [**1200 by 2400 mm**] [**1200 by 2750 mm**] [**1200 by 3050 mm**].

2.6 TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; GlasRoc Tile Backer.
 - b. Georgia-Pacific Gypsum LLC; DensShield Tile Backer.
 - c. <Insert manufacturer>
 - d. or approved equal.
 2. Core: [**As indicated on Drawings**] [**1/2 inch** (12.7 mm), **regular type**] [**5/8 inch** (15.9 mm), **Type X**].
 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- B. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. C-Cure; C-Cure Board 990.
 - b. CertainTeed Corp.; FiberCement [**Underlayment**] [**BackerBoard**].
 - c. FinPan, Inc.; [**Util-A-Crete Concrete Backer Board**] [**EZ Backer**] [**ProTEC**].
 - d. James Hardie Building Products, Inc.; [**Hardiebacker**] [**Hardiebacker 500**].
 - e. National Gypsum Company, Permabase Cement Board.
 - f. USG Corporation; DUROCK Cement Board.
 - g. <Insert manufacturer>
 - h. or approved equal.
 2. Thickness: [**1/2 inch** (12.7 mm)] [**5/8 inch** (15.9 mm)] [**As indicated**].
 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- C. Water-Resistant Gypsum Backing Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.
 1. Manufacturers: Subject to compliance with requirements, provide products by

one of the following:

- a. American Gypsum.
 - b. CertainTeed Corp.
 - c. Georgia-Pacific Gypsum LLC.
 - d. Lafarge North America Inc.
 - e. PABCO Gypsum.
 - f. Temple-Inland.
 - g. USG Corporation.
 - h. **<Insert manufacturer>**
 - i. or approved equal.
2. Core: **[As indicated on Drawings] [1/2 inch (12.7 mm), regular type] [5/8 inch (15.9 mm), Type X] [Type C as required by fire-resistance-rated assembly indicated on Drawings].**

2.7 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: **[Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet] [Galvanized or aluminum-coated steel sheet or rolled zinc] [Plastic] [Paper-faced galvanized steel sheet].**
2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: U-bead with face and back flanges; face flange formed to be left without application of joint compound. Use where indicated.
 - f. Expansion (control) joint: One-piece control joint formed with V-shaped slot and removable strip covering slot opening.
 - g. Curved-Edge Cornerbead: With notched or flexible flanges.
 - h. As indicated or required to achieve design intent.

B. Exterior Trim: ASTM C 1047.

1. Material: Formed from steel sheet zinc coated by hot-dip process or rolled zinc complying with ASTM C1047, in shapes indicated below by reference to Fig. 1 designations in ASTM C1047.
2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.
 - d. As indicated or required to achieve design intent.

- C. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fry Reglet Corp.
 - b. Gordon, Inc.
 - c. Pittcon Industries.
 - d. MM Systems, Inc.
 - e. **<Insert manufacturer>**
 - f. or approved equal.
 2. Aluminum: Alloy and temper with not less than the strength and durability properties of **ASTM B 221** (ASTM B 221M), Alloy 6063-T5.
 3. Finish:
 - a. Primed Finish: Manufacturer's standard corrosion-resistant primer compatible with joint compound and finish materials specified.
 - b. Class II, Clear Anodic Finish: AA-C12C22A31 (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating with a minimum thickness of 0.01 mm).
 - c. Class II, Color Anodic Finish: AA-C12C22A32/A34 (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, integrally colored or electrolytically deposited color and a minimum coating thickness of 0.01 mm).
 - d. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel according to paint manufacturer's specifications for cleaning, conversion coating, and applying organic coating.
 - e. Organic Coating: Manufacturer's standard thermosetting coating system with a minimum dry film thickness of 0.8 to 1.2 mils (0.02 to 0.03 mm).
 - f. Color: **<As selected by DEN Project Manager from manufacturer's standard colors.> <Match color as provided by DEN Project Manager>**.

2.8 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
1. Interior Gypsum Board: Paper.
 2. Exterior Gypsum Soffit Board: Paper.
 3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 4. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints[, **rounded or beveled panel edges,**] and damaged surface areas, use setting-type taping compound.
 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use [**setting-type taping**] [**drying-type, all-purpose**] compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 3. Fill Coat: For second coat, use [**setting-type, sandable topping**] [**drying-type, all-purpose**] compound.
 4. Finish Coat: For third coat, use [**setting-type, sandable topping**] [**drying-type, all-purpose**] compound.
 5. Skim Coat: For final coat of Level 5 finish, use [**setting-type, sandable topping compound**] [**drying-type, all-purpose compound**] [**high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish**].
- D. Joint Compound for Exterior Applications:
1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
 2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.
- E. Joint Compound for Tile Backing Panels:
1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
 2. Cementitious Backer Units: As recommended by backer unit manufacturer.
 3. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.9 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
1. Laminating adhesive shall have a VOC content of [**50**] **<Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Laminating adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from **0.033 to 0.112 inch** (0.84 to 2.84 mm) thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
 2. Recycled Content of Blankets: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
- E. Acoustical Joint Sealant: Manufacturer's standard nonsag, nondrying, nonhardening, gunnable, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Accumetric LLC; BOSS 824 Acoustical Sound Sealant.
 - b. Grabber Construction Products; Acoustical Sealant GSC.
 - c. Pecora Corporation; [**AC-20 FTR**] [**AIS-919**].
 - d. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
 - e. USG Corporation; SHEETROCK Acoustical Sealant.
 - f. Tremco, Inc.; Tremco Acoustical Sealant.
 - g. Contech Brands; Chemrex, Inc.; PL Acoustical Sealant.
 - h. **<Insert manufacturer>**
 - i. or approved equal.
 2. Acoustical joint sealant shall have a VOC content of [**250**] **<Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Acoustical joint sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. Separation Between Steel Framing and Exterior Walls:
1. Asphalt-Saturated Organic Felt: ASTM D226, Type I (No. 15 asphalt felt), nonperforated.
 2. Foam Gaskets: Closed-cell vinyl foam adhesive-backed strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit metal stud size indicated.
- G. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."
- H. Vapor Retarder: As specified in Section 072100 "Thermal Insulation."

2.10 TEXTURE FINISHES

- A. Primer: As recommended by textured finish manufacturer.
- B. Polystyrene Aggregate Ceiling Finish: Water-based, job-mixed, polystyrene aggregate finish with flame-spread and smoke-developed indexes of not more than 25 when tested according to ASTM E 84.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Georgia-Pacific Gypsum LLC; ToughRock Ceiling Textures/Polystyrene.
 - b. National Gypsum Company; ProForm Perfect Spray.
 - c. USG Corporation; SHEETROCK Ceiling Spray Texture, QT.
 - d. **<Insert manufacturer>**
 - e. or approved equal.
 2. Texture: **[Fine] [Medium] [Coarse]**.
- C. Aggregate Finish: Water-based, job-mixed, aggregated, drying-type texture finish for spray application.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; ProRoc Wall and Ceiling Spray Texture.
 - b. Georgia-Pacific Gypsum LLC; ToughRock Ceiling Textures/Vermiculite.
 - c. USG Corporation; SHEETROCK Wall and Ceiling Spray Texture (Aggregated).
 - d. **<Insert manufacturer>**
 - e. or approved equal.
 2. Texture: **[Light spatter] [Spatter knock-down] <Insert texture>**.
- D. Non-Aggregate Finish: Pre-mixed, vinyl texture finish for spray application.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; ProRoc Easi-Tex Spray Texture.
 - b. National Gypsum Company; Perfect Spray EM Texture.
 - c. USG Corporation; BEADEX FasTex Wall and Ceiling Spray Texture.
 - d. **<Insert manufacturer>**
 - e. or approved equal.
 2. Texture: **[Orange Peel] [Spatter] [Spatter knock-down] <Insert texture>**.
- E. Acoustical Finish: Water-based, chemical-setting or drying-type, job-mixed texture finish for spray application.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. International Cellulose Corp.; SonaSpray "fc."
 - b. USG Corporation; USG Acoustical Plaster Finish.

- c. **<Insert manufacturer>**
 - d. or approved equal.
2. Application Thickness: [1/2 inch (12.7 mm)] **<Insert thickness>**.
3. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: [25] **<Insert value>** or less.
 - b. Smoke-Developed Index: [50] [450] **<Insert value>** or less.
4. NRC: [0.55] **<Insert NRC>** according to ASTM C 423.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to which gypsum board assemblies attach or abut, installed hollow metal frames, cast-in-anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected, and required environmental conditions have been achieved.

3.2 PREPARATION

- A. Ceiling Anchorages: Coordinate installation of ceiling suspension systems with installation of overhead structural assemblies to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers that will develop their full strength and at spacing required to support ceilings.
- B. Furnish concrete inserts and other devices indicated to other trades for installation well in advance of time needed for coordination with other construction.
- C. Before sprayed-on fireproofing is applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed-on fireproofing. Where offset anchor plates are required, provide continuous units fastened to building structure not more than 24 inches (600 mm) o.c.
- D. After sprayed-on fireproofing has been applied, remove only as much fireproofing as needed to complete installation of gypsum board assemblies without reducing thickness of fireproofing below that is required to obtain fire-resistance rating indicated. Protect remaining fireproofing from damage.

3.3 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than **1/16 inch** (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than **8 sq. ft.** (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow **1/4- to 3/8-inch-** (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide **1/4- to 1/2-inch-** (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
- J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for

locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

- K. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases that are braced internally.
1. Except where concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 2. Fit gypsum panels accurately around ducts, pipes, and conduits.
 3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- L. Floating Construction: Where feasible, including where recommended by manufacturer, install gypsum panels over wood framing, with floating internal corner construction.
- M. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's recommendations, applicable code requirements.
1. Space screws a maximum of 12 inches (304.8 mm) o.c. for vertical applications.
- N. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) o.c.
- O. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.
- P. Spot grout hollow metal door frames for solid-core wood doors, hollow metal doors, and doors over 32 inches (813 mm) wide. Apply spot grout at each jamb anchor clip and immediately insert gypsum panels into frames.

3.4 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
1. Wallboard Type: **[As indicated on Drawings] [Vertical surfaces unless otherwise indicated].**
 2. Type X: **[As indicated on Drawings] [Where required for fire-resistance-rated assembly] [Vertical surfaces unless otherwise indicated] <Insert requirements>.**
 3. Flexible Type: **[As indicated on Drawings] [Apply in double layer at curved assemblies].**
 4. Ceiling Type: **[As indicated on Drawings] [Ceiling surfaces].**
 5. Foil-Backed Type: **[As indicated on Drawings] <Insert requirements>.**
 6. Abuse-Resistant Type: **[As indicated on Drawings] <Insert requirements>.**

7. Moisture- and Mold-Resistant Type: **[As indicated on Drawings] <Insert requirements>**.
 8. Type C: **[As indicated on Drawings] [Where required for specific fire-resistance-rated assembly indicated]**.
 9. Glass-Mat Interior Type: **[As indicated on Drawings] <Insert requirements>**.
 10. Acoustically Enhanced Type: **[As indicated on Drawings] <Insert requirements>**.
 11. Skim-Coated Type: **[As indicated on Drawings] <Insert requirements>**.
- B. Single-Layer Application:
1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 2. On partitions/walls, apply gypsum panels **[horizontally (perpendicular to framing)]** unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, **16 inches** (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 4. Fastening Methods: **[Fasten base layers and face layers separately to supports with screws] [Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners]**.
- D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily

brace or fasten gypsum panels until fastening adhesive has set.

E. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus **12-inch-** (300-mm-) long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws **16 inches** (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced **12 inches** (300 mm) o.c.
3. Wet gypsum panels on surfaces that will become compressed when panels are installed over a curve and where curve radius prevents using dry panels. Comply with gypsum board manufacturer's recommendations relative to curve radii, wetting methods, stacking panels after wetting, and other preparations that precede installing wetted gypsum panels.
4. Apply gypsum panels horizontally with wrapped edges perpendicular to studs. On convex sides of partitions, begin installation at one end of curved surface and fasten gypsum panels to studs as they are wrapped around the curve. On concave side, start fastening panels to stud at center of curve and work outward to panel ends. Fasten panels to framing with screws spaced 12 inches (300 mm) o.c.
5. Allow wetted gypsum panels to dry completely before applying joint treatment

3.5 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

A. Apply panels perpendicular to supports, with end joints staggered and located over supports.

1. Install with **1/4-inch** (6.4-mm) open space where panels abut other construction or structural penetrations.
2. Fasten with corrosion-resistant screws.

3.6 APPLYING TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at [**showers, tubs, and where indicated**] [**locations indicated to receive tile**]. Install with **1/4-inch** (6.4-mm) gap where panels abut other construction or penetrations.
- B. Cementitious Backer Units: ANSI A108.11, at [**showers, tubs, and where indicated**] [**locations indicated to receive tile**].
- C. Water-Resistant Backing Board: Install where indicated with **1/4-inch** (6.4-mm) gap where panels abut other construction or penetrations.
- D. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.7 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control and Expansion Joints: Install control and expansion joints at locations indicated on Drawings, and in full accordance with ASTM C 840, and in specific locations approved by DEN Project Manager for visual effect.
1. Submit drawing showing locations and details of all control joints and expansion joints.
 2. If control joints are not fully indicated on Drawings, provide control joints and expansion joints in compliance with ASTM C 840, and indicate on shop drawing.
- C. Interior Trim: Install in the following locations:
1. Cornerbead: Use at outside corners[**unless otherwise indicated**].
 2. Bullnose Bead: Use [**at outside corners**] [**where indicated**] <Insert requirements>.
 3. LC-Bead: Use [**at exposed panel edges**] <Insert requirements>.
 4. L-Bead: Use [**where indicated**] <Insert requirements>.
 5. U-Bead: Use [**at exposed panel edges**] [**where indicated**] <Insert requirements>.
 6. Curved-Edge Cornerbead: Use at curved openings.
- D. Exterior Trim: Install in the following locations:
1. Cornerbead: Use at outside corners.
 2. LC-Bead: Use [**at exposed panel edges**] <Insert requirements>.
- E. Aluminum Trim: Install in locations [**indicated on Drawings**] <Insert requirements>.

3.8 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints[, **rounded or beveled edges**,] and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.

2. Level 2: **[Panels that are substrate for tile] [Panels that are substrate for acoustical tile] [Where indicated on Drawings] <Insert locations>**.
 3. Level 3: **[Where indicated on Drawings] <Insert locations>**.
 4. Level 4: **[At panel surfaces that will be exposed to view unless otherwise indicated] <Insert locations>**.
 - a. Primer and its application to surfaces are specified in other Section 099123 "Interior Painting." Level 5 is suitable for surfaces receiving gloss and semigloss enamels and other surfaces subject to severe lighting. It is considered a high-quality gypsum board finish.
 5. Level 5: **[Where indicated on Drawings] <Insert locations>**.
 - a. Primer and its application to surfaces are specified in other Section 099123 "Interior Painting."
- E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
- F. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.
- G. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.9 APPLYING TEXTURE FINISHES

- A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.
- B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture **[matching approved mockup and]** free of starved spots or other evidence of thin application or of application patterns.
- C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written recommendations.

3.10 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: DEN Project Manager will conduct an above-ceiling observation prior to installation of gypsum board ceilings and report any deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
 1. Notify DEN Project Manager minimum **[seven (7)] <Insert number>** days in advance of the date and the time when the Project, or part of the Project, will be ready for an above-ceiling observation.

2. Prior to notifying DEN Project Engineer, complete the following in areas to receive gypsum board ceilings:
 - a. Installation of [80%] <Insert number> of lighting fixtures, powered for operation.
 - b. Installation, insulation, and leak and pressure testing of water piping systems.
 - c. Installation of air duct systems.
 - d. Installation of air devices.
 - e. Installation of mechanical system control air tubing.
 - f. Installation of ceiling support framing.
 - g. <Insert requirements.>

3.11 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this section. The cost of the work described in this section shall be included in the applicable unit price item, work order or lump sum bid item.

END OF SECTION 092900

SECTION 093000 - TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Ceramic tile.
2. Stone thresholds.
3. Waterproof membrane.
4. Crack isolation membrane.
5. Tile backing panels.
6. Metal edge strips.

- B. Related Sections:

1. **[Section 071326 "Self-Adhering Sheet Waterproofing"] [Section 071353 "Elastomeric Sheet Waterproofing"] [Section 071354 "Thermoplastic Sheet Waterproofing"] [Section 071413 "Hot Fluid-Applied Rubberized Asphalt Waterproofing"] [Section 071416 "Cold Fluid-Applied Waterproofing"]** for waterproofing under thickset mortar beds.
2. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
3. Section 092400 "Portland Cement Plastering" for Portland cement scratch coat over metal lath on wall surfaces.
4. Section 092613 "Gypsum Veneer Plastering" for cementitious backer units.
5. Section 092900 "Gypsum Board" for **[cementitious backer units] [glass-mat, water-resistant backer board]**.
6. Section 093033 "Stone Tiling."
7. Section 096340 "Stone Flooring" for stone thresholds.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PERFORMANCE REQUIREMENTS

- A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
 - 1. Level Surfaces: Minimum **<Insert required static coefficient of friction>**.
 - 2. Step Treads: Minimum **<Insert required static coefficient of friction>**.
 - 3. Ramp Surfaces: Minimum **<Insert required static coefficient of friction>**.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For **[adhesives] [and] [sealants]**, documentation including printed statement of VOC content.
 - 2. Product Data for Credit IEQ 4.3: For **[adhesives] [and] [grouts]**, documentation including printed statement of VOC content.
 - 3. Product Data for Credit IEQ 4.3: For tile floors, documentation from an independent testing agency indicating compliance with the FloorScore Standard.
 - 4. Laboratory Test Reports for Credit IEQ 4: For **[adhesives] [sealants] [and] [tile flooring systems]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- D. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.
- E. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.[**For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.**]
2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least [12 inches (300 mm) **square**] <Insert size>, but not fewer than 4 tiles. Use grout of type and in color or colors approved for completed Work.
3. Full-size units of each type of trim and accessory[**for each color and finish required**].
4. Stone thresholds in 6-inch (150-mm) lengths.
5. Metal edge strips in 6-inch (150-mm) lengths.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- C. Product Certificates: For each type of product, signed by product manufacturer.
- D. Material Test Reports: For each tile-setting and -grouting product[**and special purpose tile**].

1.7 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Tile and Trim Units:[**Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.**]
 - a. <Insert, in separate subparagraphs, tile-type designation or description and quantity required for each category of tile for which extra material is required>.
 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.9 QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain **[tile of each type and color or finish] [tile of each type] [tile of each color or finish] [tile]** from one source or producer.
1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
 2. A firm that has specialized in installation of types of products required for Project for not less than five (5) years and which is acceptable to manufacturer(s) of primary materials.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
1. Stone thresholds.
 2. Waterproof membrane.
 3. Crack isolation membrane.
 4. Joint sealants.
 5. Cementitious backer units.
 6. Metal edge strips.
- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockup of **[each type of]** floor tile installation.
 2. Build mockup of **[each type of]** wall tile installation.
 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.
1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.
- E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.
- C. FloorScore Compliance: Tile for floors shall comply with requirements of FloorScore Standard.
- D. Low-Emitting Materials: Tile flooring systems shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

- F. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
1. Where tile is indicated for installation [**in swimming pools**] [**on exteriors**] [**or**] [**in wet areas**], do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.
- G. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.2 TILE PRODUCTS

- A. Tile Type [**CT-#**]: Factory-mounted [**unglazed**] [**glazed**] ceramic mosaic tile.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Olean; Division of Dal-Tile International Inc.
 - b. Crossville, Inc.
 - c. Daltile; Division of Dal-Tile International Inc.
 - d. Deutsche Steinzeug America, Inc.
 - e. Interceramic.
 - f. Lone Star Ceramics Company.
 - g. Grupo Porcelanite.
 - h. Portobello America, Inc.
 - i. Seneca Tiles, Inc.
 - j. <Insert manufacturer's name>.
 - k. or approved equal.
 2. Composition: [**Porcelain**] [**Impervious natural clay or porcelain**] [**Vitreous or impervious natural clay or porcelain**].
 3. Module Size: [**1 by 1 inch** (25.4 by 25.4 mm)] [**1 by 2 inches** (25.4 by 50.8 mm)] [**2 by 2 inches** (50.8 by 50.8 mm)] <Insert size>.
 4. Thickness: **1/4 inch** (6.35 mm).
 5. Face: [**Plain**] [**Pattern of design indicated**,] with cushion edges.
 6. Surface: [**Smooth, without**] [**Slip-resistant, with**] abrasive admixture.
 7. Finish: [**Bright, opaque**] [**Bright, clear**] [**Mat, opaque**] [**Mat, clear**] [**Semimat, opaque**] [**Semimat, clear**] [**Vellum, opaque**] [**Vellum, clear**] [**Crystalline**] <Insert description> glaze.
 8. Tile Color and Pattern: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and pattern>.
 9. Grout Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.

10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable[**and matching characteristics of adjoining flat tile**]. Provide shapes as follows, selected from manufacturer's standard shapes:
- a. Base Cove: Cove, module size [1 by 1 inch (25.4 by 25.4 mm)] [2 by 1 inch (50.8 by 25.4 mm)] **<Insert size>**.
 - b. Base Cap for Portland Cement Mortar Installations: Bead (bullnose), module size [1 by 1 inch (25.4 by 25.4 mm)] [2 by 1 inch (50.8 by 25.4 mm)] **<Insert size>**.
 - c. Base Cap for Thin-Set Mortar Installations: Surface bullnose, module size [1 by 1 inch (25.4 by 25.4 mm)] [2 by 1 inch (50.8 by 25.4 mm)] [2 by 2 inches (50.8 by 50.8 mm)] **<Insert size>**.
 - d. Wainscot Cap for Portland Cement Mortar Installations: Bead (bullnose), module size [1 by 1 inch (25.4 by 25.4 mm)] [2 by 1 inch (50.8 by 25.4 mm)] **<Insert size>**.
 - e. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose, module size [1 by 1 inch (25.4 by 25.4 mm)] [2 by 1 inch (50.8 by 25.4 mm)] [2 by 2 inches (50.8 by 50.8 mm)] **<Insert size>**.
 - f. Wainscot Cap for Flush Conditions: Regular flat tile for conditions where tile wainscot is shown flush with wall surface above it, same size as adjoining flat tile.
 - g. External Corners for Portland Cement Mortar Installations: Bead (bullnose), module size [1 by 1 inch (25.4 by 25.4 mm)] [2 by 1 inch (50.8 by 25.4 mm)] **<Insert size>**.
 - h. External Corners for Thin-Set Mortar Installations: Surface bullnose, module size [1 by 1 inch (25.4 by 25.4 mm)] [2 by 1 inch (50.8 by 25.4 mm)] [2 by 2 inches (50.8 by 50.8 mm)] **<Insert size>**.
 - i. Internal Corners: Cove, module size [1 by 1 inch (25.4 by 25.4 mm)] [2 by 1 inch (50.8 by 25.4 mm)] **<Insert size>**.
 - j. Internal Corners: Field-buttet square corners. For coved base and cap, use angle pieces designed to fit with stretcher shapes.
 - k. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch (12.7 to 6.35 mm) across nominal 4-inch (100-mm) dimension.

B. Tile Type [CT-<#>]: [Unglazed] [Glazed] square-edged quarry tile.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. American Olean; Division of Dal-Tile International Inc.
 - b. Atlas Minerals & Chemicals, Inc.
 - c. Daltile; Division of Dal-Tile International Inc.
 - d. Deutsche Steinzeug America, Inc.
 - e. Endicott Tile Ltd.; Endicott Clay Products Co.
 - f. Florida Brick & Clay Company Inc.
 - g. Florida Tile Industries, Inc.
 - h. Interceramic.
 - i. Metropolitan Ceramics.

- j. Portobello America, Inc.
 - k. Quarry Tile Co.
 - l. Seneca Tiles, Inc.
 - m. Summitville Tiles, Inc.
 - n. United States Ceramic Tile Company.
 - o. **<Insert manufacturer's name>**.
 - p. or approved equal.
2. Face Size: [3 by 3 inches (76 by 76 mm)] [4 by 4 inches (102 by 102 mm)] [6 by 3 inches (152 by 76 mm)] [6 by 6 inches (152 by 152 mm)] [8 by 3-7/8 inches (203 by 98 mm)] [8 by 8 inches (203 by 203 mm)] **<Insert size>**.
 3. Thickness: [3/8 inch (9.5 mm)] [1/2 inch (12.7 mm)] [3/4 inch (19 mm)].
 4. Wearing Surface: [Nonabrasive, smooth] [Abrasive aggregate embedded in surface] **<Insert description>**.
 5. Finish: [Bright, opaque] [Bright, clear] [Mat, opaque] [Mat, clear] [Semimat, opaque] [Semimat, clear] [Vellum, opaque] [Vellum, clear] [Crystalline] **<Insert description>** glaze.
 6. Tile Color and Pattern: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] **<Insert color and pattern>**.
 7. Grout Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] **<Insert color>**.
 8. For furan-grouted quarry tile, precoat with temporary protective coating.
 9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable[**and matching characteristics of adjoining flat tile**]. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base: Coved[**with surface bullnose top edge**], face size [6 by 6 inches (152 by 152 mm)] [8 by 3-7/8 inches (203 by 98 mm)] **<Insert size>**.
 - b. Wainscot Cap: Surface bullnose, face size [6 by 6 inches (152 by 152 mm)] [8 by 3-7/8 inches (203 by 98 mm)] **<Insert size>**.
 - c. Wainscot Cap for Flush Conditions: Regular flat tile for conditions where tile wainscot is shown flush with wall surface above it, same size as adjoining flat tile.
- C. Tile Type [CT-<#>]: [Unglazed] [Glazed] paver tile.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Marazzi Tile, Inc.
 - b. American Olean; Division of Dal-Tile International Inc.
 - c. Crossville, Inc.
 - d. Daltile; Division of Dal-Tile International Inc.
 - e. Deutsche Steinzeug America, Inc.
 - f. Florida Tile Industries, Inc.
 - g. Florim USA.
 - h. GranitiFiandre; c/o Trans Ceramica, Ltd.
 - i. Interceramic.

- j. Laufen.
 - k. Lone Star Ceramics Company.
 - l. Grupo Porcelanite.
 - m. Portobello America, Inc.
 - n. Seneca Tiles, Inc.
 - o. United States Ceramic Tile Company.
 - p. <Insert manufacturer's name>.
 - q. or approved equal.
2. Composition: [**Porcelain**] [**Impervious natural clay or porcelain**] [**Vitreous or impervious natural clay or porcelain**] [**Natural clay or porcelain**].
 3. Face Size: [**3 by 3 inches** (76 by 76 mm)] [**4 by 4 inches** (102 by 102 mm)] [**6 by 6 inches** (152 by 152 mm)] [**7-3/4 by 3-7/8 inches** (197 by 98 mm)] [**7-7/8 by 7-7/8 inches** (200 by 200 mm)] [**11-13/16 by 11-13/16 inches** (300 by 300 mm)] [**165 by 333 mm**] [**200 by 250 mm**] [**250 by 250 mm**] [**165 by 333 mm**] [**333 by 333 mm**] [**400 by 400 mm**] <Insert size>.
 4. Thickness: [**1/4 inch** (6.35 mm)] [**3/8 inch** (9.5 mm)] [**1/2 inch** (12.7 mm)].
 5. Face: [**Plain with square or cushion edges**] [**Plain with square edges**] [**Plain with cushion edges**] [**Pattern of design indicated, with square or cushion edges**] [**As indicated**].
 6. Finish: [**Bright, opaque**] [**Bright, clear**] [**Mat, opaque**] [**Mat, clear**] [**Semimat, opaque**] [**Semimat, clear**] [**Vellum, opaque**] [**Vellum, clear**] [**Crystalline**] <Insert description> glaze.
 7. Tile Color and Pattern: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and pattern>.
 8. Grout Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable[**and matching characteristics of adjoining flat tile**]. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base Cove: Cove, module size [**same as adjoining flat tile**] <Insert size>.
 - b. Base Cap for Portland Cement Mortar Installations: Bead (bullnose), module size [**same as adjoining flat tile**] <Insert size>.
 - c. Base Cap for Thin-Set Mortar Installations: Surface bullnose, module size [**same as adjoining flat tile**] <Insert size>.
 - d. Wainscot Cap for Portland Cement Mortar Installations: Bead (bullnose), module size [**same as adjoining flat tile**] <Insert size>.
 - e. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose, module size [**same as adjoining flat tile**] <Insert size>.
 - f. Wainscot Cap for Flush Conditions: Regular flat tile for conditions where tile wainscot is shown flush with wall surface above it, same size as adjoining flat tile.
 - g. External Corners for Portland Cement Mortar Installations: Bead (bullnose), module size [**same as adjoining flat tile**] <Insert size>.
 - h. External Corners for Thin-Set Mortar Installations: Surface bullnose, module size [**same as adjoining flat tile**] <Insert size>.

- i. Internal Corners: Cove, module size [**same as adjoining flat tile**] <Insert **size**>.
- j. Internal Corners: Field-buttet square corners. For coved base and cap, use angle pieces designed to fit with stretcher shapes.
- k. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from **1/2 to 1/4 inch** (12.7 to 6.35 mm) across nominal **4-inch** (100-mm) dimension.

D. Tile Type [**CT-<#>**]: [**Glazed wall tile**] [**Decorative thin wall tile**].

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Marazzi Tile, Inc.
 - b. American Olean; Division of Dal-Tile International Inc.
 - c. Daltile; Division of Dal-Tile International Inc.
 - d. Deutsche Steinzeug America, Inc.
 - e. Florida Tile Industries, Inc.
 - f. Florim USA.
 - g. Laufen.
 - h. Grupo Porcelanite.
 - i. Portobello America, Inc.
 - j. Seneca Tiles, Inc.
 - k. United States Ceramic Tile Company.
 - l. <Insert **manufacturer's name**>.
 - m. or approved equal.
2. Module Size: [**4-1/4 by 4-1/4 inches** (108 by 108 mm)] [**6 by 4-1/4 inches** (152 by 108 mm)] [**6 by 6 inches** (152 by 152 mm)] [**200 by 200 mm**] [**250 by 250 mm**] [**200 by 300 mm**] <Insert **size**>.
3. Thickness: **5/16 inch** (8 mm).
4. Face: [**Plain with modified square edges or cushion edges**] [**Plain with modified square edges**] [**Plain with cushion edges**] [**Pattern of design indicated, with manufacturer's standard edges**].
5. Finish: [**Bright, opaque**] [**Bright, clear**] [**Mat, opaque**] [**Mat, clear**] [**Semimat, opaque**] [**Semimat, clear**] [**Vellum, opaque**] [**Vellum, clear**] [**Crystalline**] <Insert **description**> glaze.
6. Tile Color and Pattern: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert **color and pattern**>.
7. Grout Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert **color**>.
8. Mounting: Factory, back mounted.
9. Mounting: Pregouted sheets of tiles factory assembled and grouted with manufacturer's standard white silicone rubber.
10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable[**and matching characteristics of adjoining flat tile**]. Provide shapes as follows, selected from manufacturer's standard shapes:

- a. Base for Portland Cement Mortar Installations: Coved, module size [4-1/4 by 4-1/4 inches (108 by 108 mm)] [6 by 6 inches (152 by 152 mm)] [6 by 3-3/4 inches (152 by 95 mm)] <Insert size>.
 - b. Base for Thin-Set Mortar Installations: Straight, module size [4-1/4 by 4-1/4 inches (108 by 108 mm)] [6 by 6 inches (152 by 152 mm)] [6 by 2 inches (152 by 51 mm)] <Insert size>.
 - c. Wainscot Cap for Portland Cement Mortar Installations: Bullnose cap, module size [4-1/4 by 4-1/4 inches (108 by 108 mm)] [6 by 6 inches (152 by 152 mm)] [6 by 2 inches (152 by 51 mm)] <Insert size>.
 - d. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose, module size [4-1/4 by 4-1/4 inches (108 by 108 mm)] [6 by 6 inches (152 by 152 mm)] [6 by 2 inches (152 by 51 mm)] <Insert size>.
 - e. Wainscot Cap for Flush Conditions: Regular flat tile for conditions where tile wainscot is shown flush with wall surface above it, same size as adjoining flat tile.
 - f. External Corners for Portland Cement Mortar Installations: Bullnose shape with radius of at least 3/4 inch (19 mm) unless otherwise indicated.
 - g. External Corners for Thin-Set Mortar Installations: Surface bullnose, same size as adjoining flat tile.
 - h. Internal Corners: Field-buttet square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.
- E. Accessories: Provide vitreous china accessories of type and size indicated, suitable for installing by same method as adjoining wall tile.
1. One soap holder[**with grab handle**] for each shower and tub indicated.
 2. One paper holder at each water closet.
 3. Color and Finish: [**Match adjoining glazed wall tile**] [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] [**White, bright glaze**] <Insert color and finish>.

2.3 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch (1.5 mm) above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch (12.7 mm) or less above adjacent floor surface.
- B. Granite Thresholds: ASTM C 615, with [**polished**] [**honed**] <Insert finish> finish.
1. Description: Uniform, [**fine**] [**medium**]-grained, [**white**] [**gray**] [**black**] <Insert color> stone without veining.
 2. Description: Match DEN Project Manager's sample.
 3. Description: Provide[**one of**] the following:

- a. **<Insert, in separate subparagraphs, name of variety and producer, distributor, or importer>.**
- C. Marble Thresholds: ASTM C 503, with a minimum abrasion resistance of [10] [12] per ASTM C 1353 or ASTM C 241 and with honed finish.
1. Description: Uniform, fine- to medium-grained white stone with gray veining.
 2. Description: Match DEN Project Manager's sample.
 3. Description: Provide[**one of**] the following:
 - a. **<Insert, in separate subparagraphs, name of variety and producer, distributor, or importer>.**
- D. Slate Thresholds: ASTM C 629, Classification [I Exterior] [II Interior], with fine, even grain and honed finish.
1. Description: Uniform, [black] [blue-black] [gray] [blue-gray] [green] **<Insert color>** stone[**and unfading**].
 2. Description: Match DEN Project Manager's sample.
 3. Description: Provide[**one of**] the following:
 - a. **<Insert, in separate subparagraphs, name of variety and producer, distributor, or importer>.**

2.4 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, in maximum lengths available to minimize end-to-end butt joints.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. C-Cure; C-Cure Board 990.
 - b. Custom Building Products; Wonderboard.
 - c. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
 - d. USG Corporation; DUROCK Cement Board.
 - e. **<Insert manufacturer's name; product name or designation>.**
 - f. or approved equal.
 2. Thickness: [1/4 inch (6.4 mm)] [1/2 inch (12.7 mm)] [5/8 inch (15.9 mm)] [**As indicated**].
- B. Fiber-Cement Underlayment: ASTM C 1288, in maximum lengths available to minimize end-to-end butt joints.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; FiberCement [**Underlayment**] [**BackerBoard**].
 - b. James Hardie; [**Hardiebacker**] [**Hardiebacker 500**].
 - c. **<Insert manufacturer's name; product name or designation>.**
 - d. or approved equal.

2. Thickness: [1/4 inch (6.4 mm)] [1/2 inch (12.7 mm)] [**As indicated**].

2.5 WATERPROOF MEMBRANE

- A. General: Manufacturer's standard product[, **selected from the following**,] that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch (0.76-mm) nominal thickness.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Noble Company (The); Nobleseal TS.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
- C. PVC Sheet: Two layers of PVC sheet heat-fused together and to facings of nonwoven polyester; 0.040-inch (1.01-mm) nominal thickness.
 1. Compotite Corporation; Composeal Gold.
 2. **<Insert manufacturer's name; product name or designation>**.
 3. or approved equal.
- D. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch (0.203-mm) nominal thickness.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Schluter Systems L.P.; KERDI.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
- E. Fabric-Reinforced, Modified-Bituminous Sheet: Self-adhering, SBS-modified-bituminous sheet with woven reinforcement facing; 0.040-inch (1.01-mm) nominal thickness.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. National Applied Construction Products, Inc.; Strataflex.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
- F. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Boiardi Products; a QEP company; Elastiment 344 Reinforced

- b. Waterproofing and Anti-Fracture/Crack Suppression Membrane.
 - b. Bonsal American; an Oldcastle company; B 6000 Waterproof Membrane with Glass Fabric.
 - c. Bostik, Inc.; Hydroment Blacktop 90210.
 - d. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
 - e. Laticrete International, Inc.; Laticrete 9235 Waterproof Membrane.
 - f. MAPEI Corporation; [**Mapelastic L (PRP M19)**] [**Mapelastic HPG with MAPEI Fiberglass Mesh**].
 - g. Mer-Kote Products, Inc.; Hydro-Guard 2000.
 - h. Summitville Tiles, Inc.; S-9000.
 - i. **<Insert manufacturer's name; product name or designation>**.
 - j. or approved equal.

- G. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Boiardi Products; a QEP company; Elastiment 644 Membrane Waterproofing System.
 - b. Bonsal American; an Oldcastle company; B 6000 Waterproof Membrane.
 - c. Bostik, Inc.; [**Durabond D-222 Duraguard Membrane**] [**Hydroment Gold**].
 - d. C-Cure; Pro-Red Waterproofing Membrane 63.
 - e. Custom Building Products; Redgard Waterproofing and Crack Prevention Membrane.
 - f. Jamo Inc.; Waterproof.
 - g. Laticrete International, Inc.; [**Latapoxy 24hr HydroProofing**] [**Laticrete Watertight Floor N' Wall Waterproofing**].
 - h. MAPEI Corporation; Mapelastic HPG.
 - i. Southern Grouts & Mortars, Inc.; Southcrete 1100 Crack Suppression and Waterproofing.
 - j. TEC; a subsidiary of H. B. Fuller Company; HydraFlex - Waterproofing Crack Isolation Membrane.
 - k. **<Insert manufacturer's name; product name or designation>**.
 - l. or approved equal.

- H. Latex-Portland Cement: Flexible mortar consisting of cement-based mix and latex additive.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Boiardi Products; a QEP company; Elastiment 323 Cement Based Waterproofing, Anti-Fracture/Crack Suppression Membrane.
 - b. C-Cure; UltraCure 971.
 - c. MAPEI Corporation; Mapelastic (PRP 315).
 - d. Southern Grouts & Mortars, Inc.; Southcrete 1100.
 - e. TEC; a subsidiary of H. B. Fuller Company; Triple Flex Waterproofing, Crack Isolation Membrane & Mortar.
 - f. **<Insert manufacturer's name; product name or designation>**.
 - g. or approved equal.

- I. Urethane Waterproofing and Tile-Setting Adhesive: One-part, liquid-applied urethane[, **with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24),**], [that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers,"] in a consistency suitable for trowel application and intended for use as both waterproofing and tile-setting adhesive in a two-step process.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Bostik, Inc.; [Durabond D-200] [Hydroment Ultra-Set] [Hydroment Ultra-Set Advanced].
 - b. <Insert manufacturer's name; product name or designation>.
 - c. or approved equal.

2.6 CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product[, **selected from the following,**] that complies with ANSI A118.12 for [standard] [high] performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch (0.76-mm) nominal thickness.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Noble Company (The); Nobleseal CIS.
 - b. <Insert manufacturer's name; product name or designation>.
 - c. or approved equal.
- C. PVC Sheet: Two layers of PVC sheet heat-fused together and to facings of nonwoven polyester; 0.040-inch (1.01-mm) nominal thickness.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Composit Corporation; Composeal Gold.
 - b. <Insert manufacturer's name; product name or designation>.
 - c. or approved equal.
- D. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch (0.203-mm) nominal thickness.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Schluter Systems L.P.; KERDI.
 - b. <Insert manufacturer's name; product name or designation>.
 - c. or approved equal.

- E. Corrugated Polyethylene: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on the underside; **3/16-inch** (4-mm) nominal thickness.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Schluter Systems L.P.; DITRA.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
- F. Fabric-Reinforced, Modified-Bituminous Sheet: Self-adhering, modified-bituminous sheet with fabric reinforcement facing; **0.040-inch** (1.01-mm) nominal thickness.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. MAPEI Corporation; Mapelastic SM.
 - b. National Applied Construction Products, Inc.; Strataflex.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
- G. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Boiardi Products; a QEP company; Elastiment 344 Reinforced Waterproofing and Anti-Fracture/Crack Suppression Membrane.
 - b. Bonsal American; an Oldcastle company; B 6000 Waterproof Membrane with Glass Fabric.
 - c. Bostik, Inc.; Hydroment Blacktop 90210.
 - d. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
 - e. Laticrete International, Inc.; Laticrete [**Blue 92 Anti-Fracture Membrane**] [**9235 Waterproof Membrane**].
 - f. MAPEI Corporation; [**Mapelastic L (PRP M19)**] [**Mapelastic HPG with MAPEI Fiberglass Mesh**].
 - g. Mer-Kote Products, Inc.; Hydro-Guard 2000.
 - h. Summitville Tiles, Inc.; S-9000.
 - i. **<Insert manufacturer's name; product name or designation>**.
 - j. or approved equal.
- H. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Bostik, Inc.; [**Durabond D-222 Duraguard Membrane**] [**Hydroment Gold**].
 - b. C-Cure; [**CureLastic 949**] [**Pro-Red Waterproofing Membrane 963**].
 - c. Custom Building Products; [**Redgard Waterproofing and Crack Prevention Membrane**] [**FractureFree Crack Prevention Membrane**] [**Semco Crack Prevention Membrane**].
 - d. Jamo Inc.; Waterproof.

- e. Mer-Kote Products, Inc.; Fracture-Guard 5000.
 - f. Southern Grouts & Mortars, Inc.; Southcrete 1100 Crack Suppression and Waterproofing.
 - g. TEC; a subsidiary of H. B. Fuller Company; HydraFlex - Waterproofing Crack Isolation Membrane.
 - h. <Insert manufacturer's name; product name or designation>.
 - i. or approved equal.
- I. Latex-Portland Cement: Flexible mortar consisting of cement-based mix and latex additive.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. C-Cure; UltraCure 971.
 - b. MAPEI Corporation; Mapelastic (PRP 315).
 - c. TEC; a subsidiary of H. B. Fuller Company; Triple Flex Waterproofing, Crack Isolation Membrane & Mortar.
 - d. <Insert manufacturer's name; product name or designation>.
 - e. or approved equal.
- J. Urethane Crack Isolation Membrane and Tile-Setting Adhesive: One-part, liquid-applied urethane[, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24),][, that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers,"] in a consistency suitable for trowel application and intended for use as both waterproofing and tile-setting adhesive in a two-step process.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Bostik, Inc.; [Durabond D-200] [Hydroment Ultra-Set] [Hydroment Ultra-Set Advanced].
 - b. <Insert manufacturer's name; product name or designation>.
 - c. or approved equal.

2.7 SETTING MATERIALS

- A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
1. Cleavage Membrane: Asphalt felt, ASTM D 226, Type I (No. 15); or polyethylene sheeting, ASTM D 4397, 4.0 mils (0.1 mm) thick.
 2. Reinforcing Wire Fabric: Galvanized, welded wire fabric, 2 by 2 inches (50.8 by 50.8 mm) by 0.062-inch (1.57-mm) diameter; comply with ASTM A 185 and ASTM A 82 except for minimum wire size.
 3. Expanded Metal Lath: Diamond-mesh lath complying with ASTM C 847.
 - a. Base Metal and Finish for Interior Applications: Uncoated or zinc-coated (galvanized) steel sheet, with uncoated steel sheet painted after fabrication

- into lath.
 - b. Base Metal and Finish for Exterior Applications: Zinc-coated (galvanized) steel sheet.
 - c. Configuration over Studs and Furring: Flat.
 - d. Configuration over Solid Surfaces: Self furring.
 - e. Weight: [2.5 lb/sq. yd. (1.4 kg/sq. m)] [3.4 lb/sq. yd. (1.8 kg/sq. m)].
4. Latex Additive: **[Manufacturer's standard] [acrylic resin] [or] [styrene-butadiene-rubber]** water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed Portland cement and aggregate mortar bed.
- B. Dry-Set Portland Cement Mortar (Thin Set): ANSI A118.1.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Boiardi Products; a QEP company.
 - b. Bonsal American; an Oldcastle company.
 - c. Bostik, Inc.
 - d. C-Cure.
 - e. Custom Building Products.
 - f. Jamo Inc.
 - g. Laticrete International, Inc.
 - h. MAPEI Corporation.
 - i. Southern Grouts & Mortars, Inc.
 - j. Summitville Tiles, Inc.
 - k. TEC; a subsidiary of H. B. Fuller Company.
 - l. **<Insert manufacturer's name>**.
 - m. or approved equal.
 - 2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.1.
- C. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Boiardi Products; a QEP company.
 - b. Bonsal American; an Oldcastle company.
 - c. Bostik, Inc.
 - d. C-Cure.
 - e. Custom Building Products.
 - f. Jamo Inc.
 - g. Laticrete International, Inc.
 - h. MAPEI Corporation.
 - i. Mer-Kote Products, Inc.
 - j. Southern Grouts & Mortars, Inc.

- k. Summitville Tiles, Inc.
 - l. TEC; a subsidiary of H. B. Fuller Company.
 - m. **<Insert manufacturer's name>**.
 - n. or approved equal.
 2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
 3. Provide prepackaged, dry-mortar mix combined with **[acrylic resin] [or] [styrene-butadiene-rubber]** liquid-latex additive at Project site.
 4. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.
- D. Medium-Bed, Latex-Portland Cement Mortar: Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for application thickness of **[5/8 inch (16 mm)] <Insert thickness>**.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bonsal American; an Oldcastle company.
 - b. Bostik, Inc.
 - c. C-Cure.
 - d. Custom Building Products.
 - e. Jamo Inc.
 - f. Laticrete International, Inc.
 - g. MAPEI Corporation.
 - h. Mer-Kote Products, Inc.
 - i. Southern Grouts & Mortars, Inc.
 - j. Summitville Tiles, Inc.
 - k. TEC; a subsidiary of H. B. Fuller Company.
 - l. **<Insert manufacturer's name>**.
 - m. or approved equal.
 2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
 3. Provide prepackaged, dry-mortar mix combined with **[acrylic resin] [or] [styrene-butadiene-rubber]** liquid-latex additive at Project site.
- E. EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar (Thin Set): ANSI A118.11.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bonsal American; an Oldcastle company.
 - b. Bostik, Inc.
 - c. C-Cure.
 - d. Custom Building Products.
 - e. Jamo Inc.
 - f. Laticrete International, Inc.

- g. MAPEI Corporation.
 - h. Southern Grouts & Mortars, Inc.
 - i. Summitville Tiles, Inc.
 - j. TEC; a subsidiary of H. B. Fuller Company.
 - k. <Insert manufacturer's name>.
 - l. or approved equal.
 2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
 3. Provide prepackaged, dry-mortar mix combined with [acrylic resin] [or] [styrene-butadiene-rubber] liquid-latex additive at Project site.
- F. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3[.], **with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).**[, that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Atlas Minerals & Chemicals, Inc.
 - b. Bonsal American; an Oldcastle company.
 - c. Bostik, Inc.
 - d. C-Cure.
 - e. Custom Building Products.
 - f. Jamo Inc.
 - g. Laticrete International, Inc.
 - h. MAPEI Corporation.
 - i. Mer-Kote Products, Inc.
 - j. Southern Grouts & Mortars, Inc.
 - k. Summitville Tiles, Inc.
 - l. TEC; a subsidiary of H. B. Fuller Company.
 - m. <Insert manufacturer's name>.
 - n. or approved equal.
 2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 deg F (60 deg C) and 212 deg F (100 deg C), respectively, and certified by manufacturer for intended use.
- G. Chemical-Resistant Furan Mortar: ANSI A118.5, with [carbon] <Insert material> filler.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Atlas Minerals & Chemicals, Inc.
 - b. <Insert manufacturer's name>.
 - c. or approved equal.

- H. Organic Adhesive: ANSI A136.1, Type I.[.], **with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).**[.], **that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."**]
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bonsal American; an Oldcastle company.
 - b. Bostik, Inc.
 - c. C-Cure.
 - d. Custom Building Products.
 - e. DAP Inc.
 - f. Jamo Inc.
 - g. Laticrete International, Inc.
 - h. MAPEI Corporation.
 - i. Southern Grouts & Mortars, Inc.
 - j. Summitville Tiles, Inc.
 - k. TEC; a subsidiary of H. B. Fuller Company.
 - l. **<Insert manufacturer's name>**.
 - m. or approved equal.

2.8 GROUT MATERIALS

- A. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.
- B. Standard Cement Grout: ANSI A118.6.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Boiardi Products; a QEP company.
 - b. Bonsal American; an Oldcastle company.
 - c. Bostik, Inc.
 - d. C-Cure.
 - e. Custom Building Products.
 - f. Jamo Inc.
 - g. Laticrete International, Inc.
 - h. MAPEI Corporation.
 - i. Southern Grouts & Mortars, Inc.
 - j. Summitville Tiles, Inc.
 - k. TEC; a subsidiary of H. B. Fuller Company.
 - l. **<Insert manufacturer's name>**.
 - m. or approved equal.
- C. Polymer-Modified Tile Grout: ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Boiardi Products; a QEP company.
 - b. Bonsal American; an Oldcastle company.
 - c. Bostik, Inc.
 - d. C-Cure.
 - e. Custom Building Products.
 - f. Jamo Inc.
 - g. Laticrete International, Inc.
 - h. MAPEI Corporation.
 - i. Southern Grouts & Mortars, Inc.
 - j. Summitville Tiles, Inc.
 - k. TEC; a subsidiary of H. B. Fuller Company.
 - l. **<Insert manufacturer's name>**.
 - m. or approved equal.
 2. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.
 3. Polymer Type: [**Acrylic resin**] [**or**] [**styrene-butadiene rubber**] in liquid-latex form for addition to prepackaged dry-grout mix.
- D. Water-Cleanable Epoxy Grout: ANSI A118.3[, **with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D**].
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Atlas Minerals & Chemicals, Inc.
 - b. Boiardi Products; a QEP company.
 - c. Bonsal American; an Oldcastle company.
 - d. Bostik, Inc.
 - e. C-Cure.
 - f. Custom Building Products.
 - g. Jamo Inc.
 - h. Laticrete International, Inc.
 - i. MAPEI Corporation.
 - j. Mer-Kote Products, Inc.
 - k. Southern Grouts & Mortars, Inc.
 - l. Summitville Tiles, Inc.
 - m. TEC; a subsidiary of H. B. Fuller Company.
 - n. **<Insert manufacturer's name>**.
 - o. or approved equal.
 2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to **140 deg F** (60 deg C) and **212 deg F** (100 deg C), respectively, and certified by manufacturer for intended use.
- E. Chemical-Resistant Furan Grout: ANSI A118.5, with carbon filler[, **with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D**].

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Atlas Minerals & Chemicals, Inc.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.

F. Grout for PregROUTed Tile Sheets: Same product used in factory to pregROUT tile sheets.

2.9 ELASTOMERIC SEALANTS

A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Section 079200 "Joint Sealants."

B. Retain first subparagraph below if required for LEED-NC, or LEED-CI, or LEED-CS Credit IEQ 4.1.

1. Sealants shall have a VOC content of **[250] <Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
3. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.

C. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.

D. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. DAP Inc.; **[Titanium Enriched Kitchen and Bath Sealant] [100 percent Silicone Kitchen and Bath Sealant]**.
 - b. Dow Corning Corporation; Dow Corning 786.
 - c. GE Silicones; a division of GE Specialty Materials; Sanitary 1700.
 - d. Laticrete International, Inc.; Latasil Tile & Stone Sealant.
 - e. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
 - f. Tremco Incorporated; Tremsil 600 White.
 - g. **<Insert manufacturer's name; product name or designation>**.
 - h. or approved equal.

E. Multipart, Pourable Urethane Sealant for Use T: ASTM C 920; Type M; Grade P; Class

25; Uses T, M, A, and, as applicable to joint substrates indicated, O.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Bostik, Inc.; Chem-Calk 550.
 - b. Degussa Building Systems; Sonneborn Sonolastic SL 2.
 - c. Pecora Corporation; [**Dynatrol II-SG**] [**NR-200 Urexpan**].
 - d. Sika Corporation; Sikaflex-2c SL.
 - e. Tremco Incorporated.; [**THC-900**] [**THC-901**] [**Vulkem 245**].
 - f. **<Insert manufacturer's name; product name or designation>**.
 - g. or approved equal.

F. Chemical-Resistant Sealants: For chemical-resistant floors, provide chemical-resistant elastomeric sealant of type recommended and produced by chemical-resistant mortar and grout manufacturer for type of application indicated, with proven service record and compatibility with tile and other setting materials, and with chemical resistance equivalent to mortar/grout.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Atlas Minerals & Chemicals, Inc.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.

2.10 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, Portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; [**half-hard brass**] [**white zinc alloy**] [**nickel silver**] [**stainless-steel, ASTM A 666, 300 Series**] exposed-edge material.
- C. Temporary Protective Coating: [**Either product**] [**Product**] indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
 1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of **120 to 140 deg F** (49 to 60 deg C) per ASTM D 87.
 2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.
- D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated

by tile and grout manufacturers.

- E. Grout Sealer: Manufacturer's standard[**silicone**] product for sealing grout joints and that does not change color or appearance of grout.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Bonsal American; an Oldcastle company; Grout Sealer.
 - b. Bostik, Inc.; CeramaSeal [**Grout & Tile Sealer**] [**Magic Seal**] [**Silox 8**] [**Siloxane 220**].
 - c. C-Cure; Penetrating Sealer 978.
 - d. Custom Building Products; [**Surfaceguard**] [**Grout and Tile**] [**Grout**] Sealer.
 - e. Jamo Inc.; [**Matte Finish**] [**Penetrating**] Sealer.
 - f. MAPEI Corporation; KER [**003, Silicone Spray Sealer for Cementitious Tile Grout**] [**004, Keraseal Penetrating Sealer for Unglazed Grout and Tile**].
 - g. Southern Grouts & Mortars, Inc.; Silicone Grout Sealer.
 - h. Summitville Tiles, Inc.; SL-15, Invisible Seal Penetrating Grout and Tile Sealer.
 - i. TEC; a subsidiary of H. B. Fuller Company; [**TA-256 Penetrating Silicone**] [**TA-257 Silicone**] Grout Sealer.
 - j. or approved equal.

2.11 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

2. Verify that concrete substrates for tile floors installed with **[adhesives] [bonded mortar bed] [or] [thin-set mortar]** comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with DEN Project Manager.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with **[adhesives] [or] [thin-set mortar]** with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped **1/4 inch per foot (1:50)** toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- D. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 TILE INSTALLATION

- A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:

- a. Exterior tile floors.
 - b. Tile floors in wet areas.
 - c. Tile swimming pool decks.
 - d. Tile floors in laundries.
 - e. Tile floors composed of tiles **8 by 8 inches** (200 by 200 mm) or larger.
 - f. Tile floors composed of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
1. Ceramic Mosaic Tile: **1/16 inch** (1.6 mm).
 2. Quarry Tile: [**1/4 inch** (6.35 mm)] [**3/8 inch** (9.5 mm)].
 3. Paver Tile: [**1/4 inch** (6.35 mm)] [**3/8 inch** (9.5 mm)].
 4. Glazed Wall Tile: **1/16 inch** (1.6 mm).
 5. Decorative Thin Wall Tile: **1/16 inch** (1.6 mm).
- G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

- I. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
 - 1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-Portland cement mortar (thin set).
 - 2. Do not extend **[cleavage membrane] [waterproofing] [or] [crack isolation membrane]** under thresholds set in **[dry-set Portland cement] [or] [latex-Portland cement]** mortar. Fill joints between such thresholds and adjoining tile set on **[cleavage membrane] [waterproofing] [or] [crack isolation membrane]** with elastomeric sealant.
- J. Metal Edge Strips: Install **[at locations indicated] [where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile] [where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated]**.
- K. Grout Sealer: Apply grout sealer to **[cementitious]** grout joints **[in tile floors]** according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 TILE BACKING PANEL INSTALLATION

- A. Install **[cementitious backer units] [and] [fiber-cement underlayment]** and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. **[Use latex-Portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.]**

3.5 WATERPROOFING INSTALLATION

- A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.
- B. Do not install tile or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

3.6 CRACK ISOLATION MEMBRANE INSTALLATION

- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.
- B. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

3.7 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
1. Remove [**epoxy**] [**and**] [**latex-Portland cement**] grout residue from tile as soon as possible.
 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
 3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.
- B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.8 EXTERIOR TILE INSTALLATION SCHEDULE

- A. Exterior Floor Installations:
1. Tile Installation F101: Cement mortar bed (thickset) [**bonded to concrete**] [**over waterproof membrane on concrete**] [**over waterproof membrane on concrete where indicated and bonded to concrete where membrane is not indicated**]; TCA F101 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
 - a. Tile Type: <Insert tile-type designation>.
 - b. Thin-Set Mortar for Cured-Bed Method: [**Dry-set**] [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.
 - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
 2. Tile Installation F102: Thin-set mortar [**on concrete**] [**over waterproof membrane on concrete**] [**over waterproof membrane on concrete where indicated and on concrete where membrane is not indicated**]; TCA F102.
 - a. Tile Type: <Insert tile-type designation>.

- b. Thin-Set Mortar: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
- c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.

B. Exterior Wall Installations, Masonry or Concrete:

- 1. Tile Installation W201: Cement mortar bed (thickset) on metal lath over waterproof membrane; TCA W201 and **[ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C]**.
 - a. Tile Type: **<Insert tile-type designation>**.
 - b. Bond Coat Mortar for Wet-Set Method: **[Dry-set] [Latex-]** Portland cement mortar.
 - c. Thin-Set Mortar for Cured-Bed Method: **[Dry-set] [Latex-]** Portland cement mortar.
 - d. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
- 2. Tile Installation W202: Thin-set mortar; TCA W202.
 - a. Tile Type: **<Insert tile-type designation>**.
 - b. Thin-Set Mortar: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.

3.9 INTERIOR TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

- 1. Tile Installation F111: Cement mortar bed (thickset) with cleavage membrane; TCA F111 and **[ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C]**.
 - a. Tile Type: **<Insert tile-type designation>**.
 - b. Thin-Set Mortar for Cured-Bed Method: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
- 2. Tile Installation F112: Cement mortar bed (thickset) bonded to concrete; TCA F112 and **[ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C]**.
 - a. Tile Type: **<Insert tile-type designation>**.

- b. Thin-Set Mortar for Cured-Bed Method: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
 3. Tile Installation F113: Thin-set mortar; TCA F113.
 - a. Tile Type: **<Insert tile-type designation>**.
 - b. Thin-Set Mortar: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
 4. Tile Installation F114: Cement mortar bed (thickset) with cleavage membrane; **[epoxy] [furan]** grout; TCA F114 and ANSI A108.1B.
 - a. Tile Type: **<Insert tile-type designation>**.
 - b. Thin-Set Mortar for Cured-Bed Method: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
 - c. Grout: **[Water-cleanable epoxy] [Chemical-resistant furan]** grout.
 5. Tile Installation F115: Thin-set mortar; **[epoxy] [furan]** grout; TCA F115.
 - a. Tile Type: **<Insert tile-type designation>**.
 - b. Thin-Set Mortar: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
 - c. Grout: **[Water-cleanable epoxy] [Chemical-resistant furan]** grout.
 6. Tile Installation F116: **[Organic adhesive] [Water-cleanable, tile-setting epoxy]**; TCA F116.
 - a. Tile Type: **<Insert tile-type designation>**.
 - b. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
 7. Tile Installation F121: Cement mortar bed (thickset) on waterproof membrane; TCA F121 and **[ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C]**.
 - a. Tile Type: **<Insert tile-type designation>**.
 - b. Thin-Set Mortar for Cured-Bed Method: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
 8. Tile Installation F122: Thin-set mortar on waterproof membrane; TCA F122.

- a. Tile Type: <Insert tile-type designation>.
 - b. Thin-Set Mortar: [Latex-] [Medium-bed, latex-] Portland cement mortar.
 - c. Grout: Polymer-modified [sanded] [unsanded] grout.
9. Tile Installation F125A: Thin-set mortar on crack isolation membrane; TCA F125A.
- a. Tile Type: <Insert tile-type designation>.
 - b. Thin-Set Mortar: [Latex-] [Medium-bed, latex-] Portland cement mortar.
 - c. Grout: [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy] grout.
10. Tile Installation F131: Water-cleanable, tile-setting epoxy; epoxy grout; TCA F131.
- a. Tile Type: <Insert tile-type designation>.
 - b. Grout: Water-cleanable epoxy grout.
11. Tile Installation F132: Water-cleanable, tile-setting epoxy on cured cement mortar bed [bonded to concrete subfloor] [installed over cleavage membrane]; epoxy grout; TCA F132.
- a. Tile Type: <Insert tile-type designation>.
 - b. Grout: Water-cleanable epoxy grout.
12. Tile Installation F133: [Chemical-resistant furan mortar] [Water-cleanable, tile-setting epoxy]; furan grout. TCA F133[except use water-cleanable, tile-setting epoxy instead of chemical-resistant furan mortar for setting tile].
- a. Tile Type: <Insert tile-type designation>.
 - b. Grout: Chemical-resistant furan grout.
- B. Interior Floor Installations, Wood Subfloor:
1. Tile Installation F121: Cement mortar bed (thickset) on waterproof membrane; TCA F121 and [ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C].
 - a. Tile Type: <Insert tile-type designation>.
 - b. Thin-Set Mortar for Cured-Bed Method: [Dry-set] [Latex-] [Medium-bed, latex-] Portland cement mortar.
 - c. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy] grout.
 2. Tile Installation F141: Cement mortar bed (thickset) with cleavage membrane; TCA F141 and [ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C].
 - a. Tile Type: <Insert tile-type designation>.
 - b. Thin-Set Mortar for Cured-Bed Method: [Dry-set] [Latex-] [Medium-bed, latex-] Portland cement mortar.

- c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
 3. Tile Installation F142: Organic adhesive; TCA F142.
 - a. Tile Type: <**Insert tile-type designation**>.
 - b. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
 4. Tile Installation F143: Water-cleanable, tile-setting epoxy; epoxy grout; TCA F143.
 - a. Tile Type: <**Insert tile-type designation**>.
 - b. Grout: Water-cleanable epoxy grout.
 5. Tile Installation F144: Thin-set mortar on cementitious backer units or fiber cement underlayment; TCA F144.
 - a. Tile Type: <**Insert tile-type designation**>.
 - b. Thin-Set Mortar: [**Dry-set**] [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.
 - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
 6. Tile Installation F150/160: Thin-set mortar on exterior-glue plywood; TCA F150 or TCA F160.
 - a. Tile Type: <**Insert tile-type designation**>.
 - b. Thin-Set Mortar: EGP latex-Portland cement mortar.
 - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
- C. Interior Radiant Heat Floor Installations, Concrete Subfloor:
 1. Tile Installation RH110: Thin-set mortar on crack isolation membrane; hydronic piping installed in concrete; TCA RH110.
 - a. Tile Type: <**Insert tile-type designation**>.
 - b. Thin-Set Mortar: [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.
 - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
 2. Tile Installation RH115: Thin-set mortar; electric radiant system encapsulated in thin-set mortar; TCA RH115.
 - a. Tile Type: <**Insert tile-type designation**>.

- b. Thin-Set Mortar: [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.
 - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
 3. Tile Installation RH116: Thin-set mortar on crack isolation membrane; electric radiant system encapsulated in cementitious self-leveling underlayment; TCA RH116.
 - a. Tile Type: <**Insert tile-type designation**>.
 - b. Cementitious Self-Leveling Underlayment: Specified in Section 035416 "Hydraulic Cement Underlayment."
 - c. Thin-Set Mortar: [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.
 - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
- D. Interior Radiant Heat Floor Installations, Wood Subfloor:
 1. Tile Installation RH130: Thin-set mortar on exterior-glue plywood; electric radiant system encapsulated in thin-set mortar; TCA RH130.
 - a. Tile Type: <**Insert tile-type designation**>.
 - b. Thin-Set Mortar: EGP latex-Portland cement mortar.
 - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
 2. Tile Installation RH135: Thin-set mortar on cementitious backer units or fiber cement underlayment; electric radiant system encapsulated in thin-set mortar; TCA RH135.
 - a. Tile Type: <**Insert tile-type designation**>.
 - b. Thin-Set Mortar: [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.
 - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
 3. Tile Installation RH140: Thin-set mortar on crack isolation membrane; electric radiant system encapsulated in cementitious self-leveling underlayment; TCA RH140.
 - a. Tile Type: <**Insert tile-type designation**>.
 - b. Cementitious Self-Leveling Underlayment: Specified in Section 035416 "Hydraulic Cement Underlayment."
 - c. Thin-Set Mortar: [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.
 - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.

- E. Interior Wall Installations, Masonry or Concrete:
1. Tile Installation W202: Thin-set mortar; TCA W202.
 - a. Tile Type: <Insert tile-type designation>.
 - b. Thin-Set Mortar: [Dry-set] [Latex-] [Medium-bed, latex-] Portland cement mortar.
 - c. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy] grout.
 2. Tile Installation W211: Cement mortar bed (thickset) bonded to substrate; TCA W211 and [ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C].
 - a. Tile Type: <Insert tile-type designation>.
 - b. Bond Coat Mortar for Wet-Set Method: [Dry-set] [Latex-] Portland cement mortar.
 - c. Thin-Set Mortar for Cured-Bed Method: [Dry-set] [Latex-] Portland cement mortar.
 - d. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy] grout.
 3. Tile Installation W221: Cement mortar bed (thickset) on metal lath[**over waterproof membrane**]; TCA W221 and [ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C].
 - a. Tile Type: <Insert tile-type designation>.
 - b. Bond Coat Mortar for Wet-Set Method: [Dry-set] [Latex-] Portland cement mortar.
 - c. Thin-Set Mortar for Cured-Bed Method: [Dry-set] [Latex-] Portland cement mortar.
 - d. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy] grout.
 4. Tile Installation W222: One-coat cement mortar bed (thickset) on metal lath[**over waterproof membrane**]; TCA W222 and [ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C].
 - a. Tile Type: <Insert tile-type designation>.
 - b. Bond Coat Mortar for Wet-Set Method: [Dry-set] [Latex-] Portland cement mortar.
 - c. Thin-Set Mortar for Cured-Bed Method: [Dry-set] [Latex-] Portland cement mortar.
 - d. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] grout.
 5. Tile Installation W223: Organic adhesive; TCA W223.

- a. Tile Type: <Insert tile-type designation>.
- b. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] grout.

F. Interior Wall Installations, Wood Studs or Furring:

1. Tile Installation W221: Cement mortar bed (thickset)[**over waterproof membrane**] on solid backing; TCA W221 and [ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C].
 - a. Tile Type: <Insert tile-type designation>.
 - b. Bond Coat Mortar for Wet-Set Method: [Dry-set] [Latex-] Portland cement mortar.
 - c. Thin-Set Mortar for Cured-Bed Method: [Dry-set] [Latex-] Portland cement mortar.
 - d. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy] grout.
2. Tile Installation W222: One-coat cement mortar bed (thickset)[**over waterproof membrane**] on solid backing; TCA W222 and [ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C].
 - a. Tile Type: <Insert tile-type designation>.
 - b. Bond Coat Mortar for Wet-Set Method: [Dry-set] [Latex-] Portland cement mortar.
 - c. Thin-Set Mortar for Cured-Bed Method: [Dry-set] [Latex-] Portland cement mortar.
 - d. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy] grout.
3. Tile Installation W223: Organic adhesive on solid backing; TCA W223.
 - a. Tile Type: <Insert tile-type designation>.
 - b. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] grout.
4. Tile Installation W231: Cement mortar bed (thickset); TCA W231 and [ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C].
 - a. Tile Type: <Insert tile-type designation>.
 - b. Bond Coat Mortar for Wet-Set Method: [Dry-set] [Latex-] Portland cement mortar.
 - c. Thin-Set Mortar for Cured-Bed Method: [Dry-set] [Latex-] Portland cement mortar.

- d. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
 5. Tile Installation W243: Thin-set mortar on gypsum board; TCA W243.
 - a. Tile Type: **<Insert tile-type designation>**.
 - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
 6. Tile Installation W244: Thin-set mortar on cementitious backer units or fiber cement underlayment **[over cleavage membrane]**; TCA W244.
 - a. Tile Type: **<Insert tile-type designation>**.
 - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
 7. Tile Installation W245: **[Thin-set mortar] [Organic adhesive]** on coated glass-mat, water-resistant gypsum backer board; TCA W245.
 - a. Tile Type: **<Insert tile-type designation>**.
 - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
- G. Interior Wall Installations, Metal Studs or Furring:
1. Tile Installation W221: Cement mortar bed (thickset) **[over waterproof membrane]** on solid backing; TCA W221 and **[ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C]**.
 - a. Tile Type: **<Insert tile-type designation>**.
 - b. Bond Coat Mortar for Wet-Set Method: **[Dry-set] [Latex-]** Portland cement mortar.
 - c. Thin-Set Mortar for Cured-Bed Method: **[Dry-set] [Latex-]** Portland cement mortar.
 - d. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
 2. Tile Installation W222: One-coat cement mortar bed (thickset) **[over waterproof membrane]** on solid backing; TCA W222 and **[ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C]**.
 - a. Tile Type: **<Insert tile-type designation>**.

- b. Bond Coat Mortar for Wet-Set Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
 - c. Thin-Set Mortar for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
 - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
3. Tile Installation W223: Organic adhesive on solid backing; TCA W223.
 - a. Tile Type: <**Insert tile-type designation**>.
 - b. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
4. Tile Installation W241: Cement mortar bed (thickset); TCA W241 and ANSI A108.1B.
 - a. Tile Type: <**Insert tile-type designation**>.
 - b. Thin-Set Mortar for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
 - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
5. Tile Installation W242: Organic adhesive on gypsum board; TCA W242.
 - a. Tile Type: <**Insert tile-type designation**>.
 - b. Grout: [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
6. Tile Installation W243: Thin-set mortar on gypsum board; TCA W243.
 - a. Tile Type: <**Insert tile-type designation**>.
 - b. Thin-Set Mortar: [**Dry-set**] [**Latex-**] Portland cement mortar.
 - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
7. Tile Installation W244: Thin-set mortar on cementitious backer units or fiber cement underlayment[**over cleavage membrane**]; TCA W244.
 - a. Tile Type: <**Insert tile-type designation**>.
 - b. Thin-Set Mortar: [**Dry-set**] [**Latex-**] Portland cement mortar.
 - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
8. Tile Installation W245: [**Thin-set mortar**] [**Organic adhesive**] on coated glass-mat, water-resistant gypsum backer board; TCA W245.

- a. Tile Type: <Insert tile-type designation>.
 - b. Thin-Set Mortar: [Dry-set] [Latex-] Portland cement mortar.
 - c. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy] grout.
- H. Bathtub Wall Installations, [Wood] [Metal] Studs or Furring:
1. Tile Installation B413: [Thin-set mortar] [Organic adhesive] on water-resistant gypsum board; TCA B413.
 - a. Tile Type: <Insert tile-type designation>.
 - b. Thin-Set Mortar: [Dry-set] [Latex-] Portland cement mortar.
 - c. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] grout.
- I. Bathtub/Shower Wall Installations, [Wood] [Metal] Studs or Furring:
1. Tile Installation B411: Cement mortar bed (thickset); TCA B411 and ANSI A108.1A.
 - a. Tile Type: <Insert tile-type designation>.
 - b. Bond Coat Mortar for Wet-Set Method: [Dry-set] [Latex-] Portland cement mortar.
 - c. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] grout.
 2. Tile Installation B412: Thin-set mortar on cementitious backer units or fiber cement underlayment; TCA B412.
 - a. Tile Type: <Insert tile-type designation>.
 - b. Thin-Set Mortar: [Dry-set] [Latex-] Portland cement mortar.
 - c. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy] grout.
 3. Tile Installation B419: [Thin-set mortar] [Organic adhesive] on coated glass-mat, water-resistant backer board; TCA B419.
 - a. Tile Type: <Insert tile-type designation>.
 - b. Thin-Set Mortar: [Dry-set] [Latex-] Portland cement mortar.
 - c. Grout: [Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy] grout.
- J. Shower Receptor and Wall Installations, Concrete or Masonry:
1. Tile Installation B414: Cement mortar bed (thickset); TCA B414 and [ANSI

A108.1A] [ANSI A108.1B] [ANSI A108.1C].

- a. Tile Type: <Insert tile-type designation>.
 - b. Bond Coat Mortar for Wet-Set Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
 - c. Thin-Set Mortar for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
 - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
2. Tile Installation B421: Thin-set mortar on waterproof membrane; TCA B421.
- a. Tile Type: <Insert tile-type designation>.
 - b. Thin-Set Mortar: Latex-Portland cement mortar.
 - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
3. Tile Installation B422: Thin-set mortar on waterproof membrane with integrated bonding flange for bonded membranes; TCA B422.
- a. Tile Type: <Insert tile-type designation>.
 - b. Thin-Set Mortar: [**Dry-set**] [**Latex-**] Portland cement mortar.
 - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
- K. Shower Receptor and Wall Installations, [**Wood**] [**Metal**] Studs or Furring:
1. Tile Installation B414: Cement mortar bed (thickset); TCA B414 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
 - a. Tile Type: <Insert tile-type designation>.
 - b. Bond Coat Mortar for Wet-Set Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
 - c. Thin-Set Mortar for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
 - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
 2. Tile Installation B415: Thin-set mortar on cementitious backer units or fiber cement underlayment; TCA B415.
 - a. Tile Type: <Insert tile-type designation>.
 - b. Thin-Set Mortar: [**Dry-set**] [**Latex-**] Portland cement mortar.
 - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.

3. Tile Installation B420: Thin-set mortar on coated glass-mat, water-resistant backer board; TCA B420.
 - a. Tile Type: **<Insert tile-type designation>**.
 - b. Thin-Set Mortar: **[Dry-set]** **[Latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement]** **[Standard sanded cement]** **[Standard unsanded cement]** **[Polymer-modified sanded]** **[Polymer-modified unsanded]** grout.

4. Tile Installation B421: Thin-set mortar on waterproof membrane over cementitious backer units or fiber cement underlayment; TCA B421.
 - a. Tile Type: **<Insert tile-type designation>**.
 - b. Thin-Set Mortar: Latex-Portland cement mortar.
 - c. Grout: **[Sand-Portland cement]** **[Standard sanded cement]** **[Standard unsanded cement]** **[Polymer-modified sanded]** **[Polymer-modified unsanded]** grout.

5. Tile Installation B422: Thin-set mortar on waterproof membrane over cementitious backer units or fiber cement underlayment with integrated bonding flange for bonded membranes; TCA B422.
 - a. Tile Type: **<Insert tile-type designation>**.
 - b. Thin-Set Mortar: Latex-Portland cement mortar.
 - c. Grout: **[Sand-Portland cement]** **[Standard sanded cement]** **[Standard unsanded cement]** **[Polymer-modified sanded]** **[Polymer-modified unsanded]** grout.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 093000

SECTION 093033 - STONE TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Dimension stone tile and related setting materials applied to **[floors] [and] [walls]**.
2. Stone thresholds.
3. Waterproof membrane.
4. Crack isolation membrane.
5. Tile backing panels.
6. Metal edge strips.

B. Related Sections:

1. Section 033000 "Cast-in-Place Concrete" for monolithic slab finishes specified for tile substrates.
2. **[Section 071326 "Self-Adhering Sheet Waterproofing"] [Section 071353 "Elastomeric Sheet Waterproofing"] [Section 071354 "Thermoplastic Sheet Waterproofing"] [Section 071413 "Hot Fluid-Applied Rubberized Asphalt Waterproofing"] [Section 071416 "Cold Fluid-Applied Waterproofing"]** for waterproofing under thickset mortar beds.
3. Section 092400 "Portland Cement Plastering" for Portland cement scratch coat over metal lath on wall surfaces.
4. Section 092613 "Gypsum Veneer Plastering" for cementitious backer units.
5. Section 092900 "Gypsum Board" for **[cementitious backer units] [glass-mat, water-resistant backer board]**.
6. Section 096340 "Stone Flooring" for stone paving and flooring other than dimension stone tile.
7. Section 097516 "Stone Base" for stone base in the form of running trim rather than tile.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. Dimension Stone Tile: Modular stone units less than **3/4 inch (19 mm)** thick.
- B. Module Size: Actual tile size plus joint width.
- C. Polished Finish: Smooth surface that produces sharp, mirrorlike reflections. Reflected images of overhead fluorescent tubes have straight lines without visible distortion when viewed at arm's length.
- D. Honed Finish: Smooth, nonreflective surface similar to that produced by grinding with a 400- to 1200-grit abrasive; with a gap not exceeding **0.005 inch (0.13 mm)** when faces are tested for flatness with a **24-inch (600-mm)** straightedge.
- E. Sand-Rubbed Finish: Uniform, fine-textured surface similar to that produced by grinding with a 40-grit abrasive; with a gap not exceeding **1/32 inch (0.8 mm)** when faces are tested for flatness with a **24-inch (600-mm)** straightedge.
- F. Thermal Finish: Uniform, coarse-textured surface produced by thermal shock; with a gap not exceeding [**3/16 inch (5 mm)**] **<Insert gap>** when faces are tested for flatness with a **24-inch (600-mm)** straightedge.
- G. Natural-Cleft Finish: Uneven surface produced by splitting stone along a natural cleavage plane; without visible tool marks and with a gap not exceeding [**3/16 inch (5 mm)**] **<Insert gap>** when faces are tested for flatness with a **24-inch (600-mm)** straightedge.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
 - 2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured[**and regionally extracted and manufactured**] materials. Include statement indicating cost for each regionally manufactured material.
 - a. Include statement indicating location and distance from manufacturer to Project for each regionally manufactured material.
 - b. Include statement indicating location of and distance from Project to point of extraction, harvest, or recovery for each raw material used in regionally

extracted and manufactured materials and fraction by weight of each regionally manufactured material that is regionally extracted.

3. Product Data for Credit IEQ 4.1: For **[adhesives] [and] [sealants]**, documentation including printed statement of VOC content.
 4. Product Data for Credit IEQ 4.3: For **[adhesives] [and] [grouts]**, documentation including printed statement of VOC content.
 5. Product Data for Credit IEQ 4.3: For stone tile floors, documentation from an independent testing agency indicating compliance with the FloorScore Standard.
 6. Laboratory Test Reports for Credit IEQ 4: For **[adhesives] [sealants] [and] [stone tile flooring systems]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Show locations of each type of stone tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in substrates and finished stone tile surfaces. **[Show stone thresholds.]**
- D. Samples for Initial Selection: For each type of grout indicated and accessories involving color selection.
- E. Samples for Verification:
1. Full-size units of each type of stone tile **[in each finish required]**.
 2. Assembled Samples with grouted joints for each type of stone tile **[and for each finish required]**, at least **[36 inches (900 mm) square]** **<Insert size>** and mounted on a rigid panel. Use grout of type and in color(s) approved for completed Work.
 3. Range Samples consisting of at least **[two] [three] [four] [five]** **<Insert number>** full-size units of each type of stone tile, exhibiting extremes of the full range of color and other visual characteristics expected. Range Samples establish the standard by which individual stone tiles **[and thresholds]** will be judged.
 4. Stone thresholds in **6-inch (150-mm)** lengths.
 5. Metal edge strips in **6-inch (150-mm)** lengths.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For Installer.
- 1.6 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For dimension stone tile to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Dimension Stone Tile: **[Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.]**
 - a. **<Insert, in separate subparagraphs, stone tile-type designation or description and quantity required for each category of stone tile for which extra material is required>.**
 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.8 QUALITY ASSURANCE

- A. Supplier Qualifications: A firm experienced in supplying products similar to those indicated for the Project and with a record of successful in-service performance.
- B. Source Limitations for Stone Tile[**and Thresholds**]: Obtain each stone product type through single source from single producer.
1. For each stone product type, provide one stone variety.
 2. Where two or more stone product types are identical except for size or finish, provide same variety for each type.
 3. Where threshold types are identical to stone tile types except for size or finish, provide same variety.
 4. Obtain each variety of stone from same location in a single quarry with resources to provide materials of consistent quality in appearance and physical properties.
- C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
- D. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
1. Waterproof membrane.
 2. Crack isolation membrane.
 3. Joint sealants.
 4. Cementitious backer units.
 5. Metal edge strips.
- E. Installer Qualifications: A firm that has specialized in installation of types of products required for Project for not less than five (5) years and which is acceptable to manufacturer(s) of primary materials.

- F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup of[**each type of**] stone floor tile installation.
 - 2. Build mockup of[**each type of**] stone wall tile installation.
 - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

- G. Dry-Laid Mockups: Lay out tiles in dry-laid mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Lay out mockup of[**each type of**] stone floor tile installation.
 - 2. Lay out mockup of[**each type of**] stone wall tile installation.
 - 3. Maintain dry-laid mockups in an undisturbed condition until equivalent areas of the completed Work are approved to serve as mockups.

- H. Preinstallation Conference: Conduct conference at [**Project site**] [**location and time as determined by DEN Project Manager**] <Insert location>.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use.

- B. Store stone tile and cementitious materials on elevated platforms, under cover, and in a dry location.

- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

- D. Store liquid materials in unopened containers and protected from freezing.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install stone tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.11 SEQUENCING AND SCHEDULING

- A. Sequence stone tile installation with other work to minimize possibility of damage and soiling during remainder of construction period.

- B. Install stone tile and accessories only after other finishing operations, including painting, have been completed.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 STONE PRODUCTS

- A. Varieties and Sources: Subject to compliance with requirements, **[provide those indicated] [provide one of those indicated] [stone products that may be incorporated into the Work include, but are not limited to, those indicated]**.
- B. Regional Materials: Provide stone tiles **[and thresholds]** that have been manufactured within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.
- C. Regionally Manufactured Materials: Provide stone tiles **[and thresholds]** that have been manufactured within **500 miles (800 km)** of Project site.
- D. Regionally Extracted and Manufactured Materials: Provide stone tiles **[and thresholds]** that have been manufactured within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.
- E. FloorScore Compliance: Stone tile for floors shall comply with requirements of FloorScore Standard.
- F. Low-Emitting Materials: Stone tile flooring systems shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- G. Abrasion Resistance of Stone Tile for Floors: Provide stone with a value of not less than **[8] [10] [12] [25] <Insert value>**, as determined per ASTM C 1353 or ASTM C 241.
- H. Static Coefficient of Friction of Stone Tile for Floors: Provide products with the following values as determined by testing identical products per ASTM C 1028:
 - 1. Level Surfaces: Minimum **<Insert required static coefficient of friction>**.
 - 2. Step Treads: Minimum **<Insert required static coefficient of friction>**.
 - 3. Ramp Surfaces: Minimum **<Insert required static coefficient of friction>**.
- I. Provide stone products that are free of defects impairing their function for use indicated, including cracks, seams, and starts.

- J. Pattern Orientation: For stone varieties with a directional pattern, provide tile with pattern **[oriented parallel to one side of tile] [randomly oriented at various angles to sides of tiles]**.
1. For stone varieties that exhibit a directional pattern, provide thresholds with pattern **[oriented parallel to] [oriented at an angle of 45 degrees or less to] [randomly oriented at various angles to]** long edges of thresholds.
- K. Stone Tile Type[**ST-<#>**]:
1. Stone Type: Granite, complying with ASTM C 615.
 2. Stone Type: Limestone, complying with ASTM C 568, Classification **[II (Medium Density)] [III (High Density)]**.
 3. Stone Type: Marble, complying with ASTM C 503, Classification **[I, Calcite] [II, Dolomite]**.
 4. Stone Type: Quartz-based stone, complying with ASTM C 616, Classification **[II, Quartzitic Sandstone] [III, Quartzite]**.
 5. Stone Type: Serpentine, complying with ASTM C 1526, Classification **[I, Exterior] [II, Interior]**.
 6. Stone Type: Slate, complying with ASTM C 629, Classification **[I, Exterior] [II, Interior]**.
 7. Stone Type: Travertine, complying with ASTM C 1527, Classification **[I, Exterior] [II, Interior]**.
 8. Varieties and Sources:
 - a. **<Insert name of variety and producer, distributor, or importer>**.
 9. Cut: **[Vein] [Fleuri]**.
 10. Finish: **[Polished] [Honed] [Sand rubbed] [Thermal] [Natural cleft] [As indicated] [Match DEN Project Manager's sample]**.
 11. Edges: **[Square] [Beveled] [Eased]**.
 12. Module Size: **[6 by 6 inches (152 by 152 mm)] [6 by 12 inches (152 by 305)] [12 by 12 inches (305 by 305 mm)] [300 by 300 mm] [18 by 18 inches (457 by 457 mm)] [500 by 500 mm] [As indicated]**.
 13. Nominal Tile Thickness: **[1/4 inch (6 mm)] [3/8 inch (10 mm)] [1/2 inch (13 mm)] [5/8 inch (16 mm)]**.
 14. Joint Width: **[Hand tight] [1/16 inch (1.5 mm)] [1/8 inch (3 mm)] [1/4 inch (6 mm)] [3/8 inch (10 mm)] [1/2 inch (13 mm)]**.
- L. Stone Threshold Type[**TH-<#>**]:
1. Stone Type: Granite, complying with ASTM C 615.
 2. Stone Type: Limestone, complying with ASTM C 568, Classification **[II (Medium Density)] [III (High Density)]**.
 3. Stone Type: Marble, complying with ASTM C 503, Classification **[I, Calcite] [II, Dolomite]**.
 4. Stone Type: Quartz-based stone, complying with ASTM C 616, Classification **[II, Quartzitic Sandstone] [III, Quartzite]**.
 5. Stone Type: Serpentine, complying with ASTM C 1526, Classification **[I, Exterior] [II, Interior]**.

6. Stone Type: Slate, complying with ASTM C 629, Classification [**I, Exterior**] [**II, Interior**].
7. Stone Type: Travertine, complying with ASTM C 1527, Classification [**I, Exterior**] [**II, Interior**].
8. Varieties and Sources:
 - a. <Insert name of variety and producer, distributor, or importer>.
9. Cut: [**Vein**] [**Fleuri**].
10. Finish: [**Polished**] [**Honed**] [**Sand rubbed**] [**Thermal**] [**Natural cleft**] [**As indicated**] [**Match DEN Project Manager's sample**].
11. Edges: [**Square**] [**Beveled**] [**Eased**] [**As indicated**].
12. Nominal Threshold Thickness: [**1/4 inch (6 mm)**] [**3/8 inch (10 mm)**] [**1/2 inch (13 mm)**] [**5/8 inch (16 mm)**] [**3/4 inch (19 mm)**].

2.2 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, in maximum lengths available to minimize end-to-end butt joints.
 1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. C-Cure; C-Cure Board 990.
 - b. Custom Building Products; Wonderboard.
 - c. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
 - d. USG Corporation; DUROCK Cement Board.
 - e. <Insert manufacturer's name; product name or designation>.
 - f. or approved equal.
 2. Thickness: [**1/4 inch (6.4 mm)**] [**1/2 inch (12.7 mm)**] [**5/8 inch (15.9 mm)**] [**As indicated**].
- B. Fiber-Cement Underlayment: ASTM C 1288, in maximum lengths available to minimize end-to-end butt joints.
 1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; FiberCement [Underlayment] [BackerBoard].
 - b. James Hardie; [Hardiebacker] [Hardiebacker 500].
 - c. <Insert manufacturer's name; product name or designation>.
 - d. or approved equal.
 2. Thickness: [**1/4 inch (6.4 mm)**] [**1/2 inch (12.7 mm)**] [**As indicated**].

2.3 WATERPROOF MEMBRANES

- A. General: Manufacturer's standard product[, **selected from the following,**] that complies with ANSI A118.10 and is recommended by the manufacturer for the

application indicated. Include reinforcement and accessories recommended by manufacturer.

- B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; **0.030-inch** (0.76-mm) nominal thickness.
- Products:** Subject to compliance with requirements, provide one of the following:
 - Noble Company (The);** Nobleseal TS.
 - <Insert manufacturer's name; product name or designation>.**
 - or approved equal.
- C. PVC Sheet: Two layers of PVC sheet heat-fused together and to facings of nonwoven polyester; **0.040-inch** (1.01-mm) nominal thickness.
- Products:** Subject to compliance with requirements, provide one of the following:
 - Compotite Corporation;** Composeal Gold.
 - <Insert manufacturer's name; product name or designation>.**
 - or approved equal.
- D. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; **0.008-inch** (0.203-mm) nominal thickness.
- Products:** Subject to compliance with requirements, provide one of the following:
 - Schluter Systems L.P.;** KERDI.
 - <Insert manufacturer's name; product name or designation>.**
 - or approved equal.
- E. Fabric-Reinforced, Modified-Bituminous Sheet: Self-adhering, SBS-modified-bituminous sheet with woven reinforcement facing; **0.040-inch** (1.01-mm) nominal thickness.
- Products:** Subject to compliance with requirements, provide one of the following:
 - National Applied Construction Products, Inc.;** Strataflex.
 - <Insert manufacturer's name; product name or designation>.**
 - or approved equal.
- F. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.
- Products:** Subject to compliance with requirements, provide one of the following:
 - Boiardi Products, a QEP company; Elastiment 344 Reinforced Waterproofing and Anti-Fracture/Crack Suppression Membrane.**
 - Bonsal American, an Oldcastle company; B 6000 Waterproof Membrane with Glass Fabric.**
 - Bostik, Inc.; Hydroment Blacktop 90210.**

- d. [Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.](#)
 - e. [Laticrete International, Inc.; Laticrete 9235 Waterproof Membrane.](#)
 - f. [MAPEI Corporation; \[Mapelastic L \(PRP M19\)\] \[Mapelastic HPG with MAPEI Fiberglass Mesh\].](#)
 - g. [Mer-Kote Products, Inc.; Hydro-Guard 2000.](#)
 - h. [Summitville Tiles, Inc.; S-9000.](#)
 - i. **<Insert manufacturer's name; product name or designation>.**
 - j. or approved equal.
- G. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. [Boiardi Products, a QEP company; Elastiment 644 Membrane Waterproofing System.](#)
 - b. [Bonsal American, an Oldcastle company; B 6000 Waterproof Membrane.](#)
 - c. [Bostik, Inc.; \[Durabond D-222 Duraguard Membrane\] \[Hydroment Gold\].](#)
 - d. [C-Cure; Pro-Red Waterproofing Membrane 63.](#)
 - e. [Custom Building Products; Redgard Waterproofing and Crack Prevention Membrane.](#)
 - f. [Jamo Inc.; Waterproof.](#)
 - g. [Laticrete International, Inc.; \[Latapoxy 24hr HydroProofing\] \[Laticrete Watertight Floor N' Wall Waterproofing\].](#)
 - h. [MAPEI Corporation; Mapelastic HPG.](#)
 - i. [Southern Grouts & Mortars, Inc.; Southcrete 1100 Crack Suppression and Waterproofing.](#)
 - j. [TEC, a subsidiary of H. B. Fuller Company; HydraFlex - Waterproofing Crack Isolation Membrane.](#)
 - k. **<Insert manufacturer's name; product name or designation>.**
 - l. or approved equal.
- H. Latex-Portland Cement: Flexible mortar consisting of cement-based mix and latex additive.
1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. [Boiardi Products, a QEP company; Elastiment 323 Cement Based Waterproofing, Anti-Fracture/Crack Suppression Membrane.](#)
 - b. [C-Cure; UltraCure 971.](#)
 - c. [MAPEI Corporation; Mapelastic \(PRP 315\).](#)
 - d. [Southern Grouts & Mortars, Inc.; Southcrete 1100.](#)
 - e. [TEC, a subsidiary of H. B. Fuller Company; Triple Flex Waterproofing, Crack Isolation Membrane & Mortar.](#)
 - f. **<Insert manufacturer's name; product name or designation>.**
 - g. or approved equal.
- I. Urethane Waterproofing and Tile-Setting Adhesive: One-part, liquid-applied urethane[, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)],[, that complies with the testing and product

requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers,") in a consistency suitable for trowel application and intended for use as both waterproofing and tile-setting adhesive in a two-step process.

1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. **Bostik, Inc.;** [Durabond D-200] [Hydroment Ultra-Set] [Hydroment Ultra-Set Advanced].
 - b. <Insert manufacturer's name; product name or designation>.
 - c. or approved equal.

2.4 CRACK ISOLATION MEMBRANES

A. General: Manufacturer's standard product[, **selected from the following,**] that complies with ANSI A118.12 for [**standard**] [**high**] performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; **0.030-inch** (0.76-mm) nominal thickness.

1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. **Noble Company (The);** Nobleseal CIS.
 - b. <Insert manufacturer's name; product name or designation>.
 - c. or approved equal.

C. PVC Sheet: Two layers of PVC sheet heat-fused together and to facings of nonwoven polyester; **0.040-inch** (1.01-mm) nominal thickness.

1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. **Compotite Corporation;** Composeal Gold.
 - b. <Insert manufacturer's name; product name or designation>.
 - c. or approved equal.

D. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; **0.008-inch** (0.203-mm) nominal thickness.

1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. **Schluter Systems L.P.;** KERDI.
 - b. <Insert manufacturer's name; product name or designation>.
 - c. or approved equal.

E. Corrugated Polyethylene: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on the underside; **1/8-inch** (3-mm) nominal thickness.

1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. Schluter Systems L.P.; DITRA.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.

- F. Fabric-Reinforced, Modified-Bituminous Sheet: Self-adhering, modified-bituminous sheet with fabric reinforcement facing; 0.040-inch (1.01-mm) nominal thickness.
 1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. MAPEI Corporation: Mapelastic SM.
 - b. National Applied Construction Products, Inc.: Strataflex.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.

- G. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.
 1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. Boiardi Products, a QEP company; Elastiment 344 Reinforced Waterproofing and Anti-Fracture/Crack Suppression Membrane.
 - b. Bonsal American, an Oldcastle company; B 6000 Waterproof Membrane with Glass Fabric.
 - c. Bostik, Inc.; Hydroment Blacktop 90210.
 - d. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
 - e. Laticrete International, Inc.; Laticrete [**Blue 92 Anti-Fracture Membrane**] [**9235 Waterproof Membrane**].
 - f. MAPEI Corporation; [**Mapelastic L (PRP M19)**] [**Mapelastic HPG with MAPEI Fiberglass Mesh**].
 - g. Mer-Kote Products, Inc.; Hydro-Guard 2000.
 - h. Summitville Tiles, Inc.; S-9000.
 - i. **<Insert manufacturer's name; product name or designation>**.
 - j. or approved equal.

- H. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
 1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. Bostik, Inc.; [**Durabond D-222 Duraguard Membrane**] [**Hydroment Gold**].
 - b. C-Cure; [**CureLastic 949**] [**Pro-Red Waterproofing Membrane 963**].
 - c. Custom Building Products; [**Redgard Waterproofing and Crack Prevention Membrane**] [**FractureFree Crack Prevention Membrane**] [**Semco Crack Prevention Membrane**].
 - d. Jamo Inc.; Waterproof.
 - e. Mer-Kote Products, Inc.; Fracture-Guard 5000.
 - f. Southern Grouts & Mortars, Inc.; Southcrete 1100 Crack Suppression and Waterproofing.

- c. Configuration over Studs and Furring: Flat.
 - d. Configuration over Solid Surfaces: Self furring.
 - e. Weight: [2.5 lb/sq. yd. (1.4 kg/sq. m)] [3.4 lb/sq. yd. (1.8 kg/sq. m)].
 4. Latex Additive: **[Manufacturer's standard] [acrylic resin] [or] [styrene-butadiene-rubber]** water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed Portland cement and aggregate mortar bed.
- B. Dry-Set Portland Cement Mortar (Thin Set): ANSI A118.1.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Boiardi Products; a QEP company.](#)
 - b. [Bonsal American; an Oldcastle company.](#)
 - c. [Bostik, Inc.](#)
 - d. [C-Cure.](#)
 - e. [Custom Building Products.](#)
 - f. [Jamo Inc.](#)
 - g. [Laticrete International, Inc.](#)
 - h. [MAPEI Corporation.](#)
 - i. [Southern Grouts & Mortars, Inc.](#)
 - j. [Summitville Tiles, Inc.](#)
 - k. [TEC; a subsidiary of H. B. Fuller Company.](#)
 - l. **<Insert manufacturer's name>.**
 - m. or approved equal.
 2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.1.
- C. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Boiardi Products; a QEP company.](#)
 - b. [Bonsal American; an Oldcastle company.](#)
 - c. [Bostik, Inc.](#)
 - d. [C-Cure.](#)
 - e. [Custom Building Products.](#)
 - f. [Jamo Inc.](#)
 - g. [Laticrete International, Inc.](#)
 - h. [MAPEI Corporation.](#)
 - i. [Mer-Kote Products, Inc.](#)
 - j. [Southern Grouts & Mortars, Inc.](#)
 - k. [Summitville Tiles, Inc.](#)
 - l. [TEC; a subsidiary of H. B. Fuller Company.](#)
 - m. **<Insert manufacturer's name>.**

- n. or approved equal.
 2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
 3. Provide prepackaged, dry-mortar mix combined with [**acrylic resin**] [**or**] [**styrene-butadiene-rubber**] liquid-latex additive at Project site.
 4. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.
- D. Medium-Bed, Latex-Portland Cement Mortar: Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for application thickness of [**5/8 inch** (16 mm)] **<Insert thickness>**.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Bonsal American; an Oldcastle company.](#)
 - b. [Bostik, Inc.](#)
 - c. [C-Cure.](#)
 - d. [Custom Building Products.](#)
 - e. [Jamo Inc.](#)
 - f. [Laticrete International, Inc.](#)
 - g. [MAPEI Corporation.](#)
 - h. [Mer-Kote Products, Inc.](#)
 - i. [Southern Grouts & Mortars, Inc.](#)
 - j. [Summitville Tiles, Inc.](#)
 - k. [TEC; a subsidiary of H. B. Fuller Company.](#)
 - l. **<Insert manufacturer's name>**.
 - m. or approved equal.
 2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
 3. Provide prepackaged, dry-mortar mix combined with [**acrylic resin**] [**or**] [**styrene-butadiene-rubber**] liquid-latex additive at Project site.
- E. EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar (Thin Set): ANSI A118.11.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Bonsal American; an Oldcastle company.](#)
 - b. [Bostik, Inc.](#)
 - c. [C-Cure.](#)
 - d. [Custom Building Products.](#)
 - e. [Jamo Inc.](#)
 - f. [Laticrete International, Inc.](#)
 - g. [MAPEI Corporation.](#)
 - h. [Southern Grouts & Mortars, Inc.](#)
 - i. [Summitville Tiles, Inc.](#)

- j. [TEC; a subsidiary of H. B. Fuller Company.](#)
 - k. <Insert manufacturer's name>.
 - l. or approved equal.
 2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
 3. Provide prepackaged, dry-mortar mix combined with [acrylic resin] [or] [styrene-butadiene-rubber] liquid-latex additive at Project site.
- F. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3[.], with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D.], that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Atlas Minerals & Chemicals, Inc.](#)
 - b. [Bonsal American; an Oldcastle company.](#)
 - c. [Bostik, Inc.](#)
 - d. [C-Cure.](#)
 - e. [Custom Building Products.](#)
 - f. [Jamo Inc.](#)
 - g. [Laticrete International, Inc.](#)
 - h. [MAPEI Corporation.](#)
 - i. [Mer-Kote Products, Inc.](#)
 - j. [Southern Grouts & Mortars, Inc.](#)
 - k. [Summitville Tiles, Inc.](#)
 - l. [TEC; a subsidiary of H. B. Fuller Company.](#)
 - m. <Insert manufacturer's name>.
 - n. or approved equal.
- G. Organic Adhesive: ANSI A136.1, Type I[.], with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D.], that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Bonsal American; an Oldcastle company.](#)
 - b. [Bostik, Inc.](#)
 - c. [C-Cure.](#)
 - d. [Custom Building Products.](#)
 - e. [DAP Inc.](#)
 - f. [Jamo Inc.](#)
 - g. [Laticrete International, Inc.](#)
 - h. [MAPEI Corporation.](#)

- i. [Southern Grouts & Mortars, Inc.](#)
- j. [Summitville Tiles, Inc.](#)
- k. [TEC; a subsidiary of H. B. Fuller Company.](#)
- l. **<Insert manufacturer's name>.**
- m. or approved equal

2.6 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.

B. Standard Cement Grout: ANSI A118.6.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. [Boiardi Products; a QEP company.](#)
- b. [Bonsal American; an Oldcastle company.](#)
- c. [Bostik, Inc.](#)
- d. [C-Cure.](#)
- e. [Custom Building Products.](#)
- f. [Jamo Inc.](#)
- g. [Laticrete International, Inc.](#)
- h. [MAPEI Corporation.](#)
- i. [Southern Grouts & Mortars, Inc.](#)
- j. [Summitville Tiles, Inc.](#)
- k. [TEC; a subsidiary of H. B. Fuller Company.](#)
- l. **<Insert manufacturer's name>.**
- m. or approved equal.

C. Polymer-Modified Tile Grout: ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. [Boiardi Products; a QEP company.](#)
- b. [Bonsal American; an Oldcastle company.](#)
- c. [Bostik, Inc.](#)
- d. [C-Cure.](#)
- e. [Custom Building Products.](#)
- f. [Jamo Inc.](#)
- g. [Laticrete International, Inc.](#)
- h. [MAPEI Corporation.](#)
- i. [Southern Grouts & Mortars, Inc.](#)
- j. [Summitville Tiles, Inc.](#)
- k. [TEC; a subsidiary of H. B. Fuller Company.](#)
- l. **<Insert manufacturer's name>.**
- m. or approved equal.

2. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.
 3. Polymer Type: [**Acrylic resin**] [or] [**styrene-butadiene rubber**] in liquid-latex form for addition to prepackaged dry-grout mix.
- D. Water-Cleanable Epoxy Grout: ANSI A118.3[, **with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D**].
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Atlas Minerals & Chemicals, Inc.](#)
 - b. [Boiardi Products; a QEP company.](#)
 - c. [Bonsal American; an Oldcastle company.](#)
 - d. [Bostik, Inc.](#)
 - e. [C-Cure.](#)
 - f. [Custom Building Products.](#)
 - g. [Jamo Inc.](#)
 - h. [Laticrete International, Inc.](#)
 - i. [MAPEI Corporation.](#)
 - j. [Mer-Kote Products, Inc.](#)
 - k. [Southern Grouts & Mortars, Inc.](#)
 - l. [Summitville Tiles, Inc.](#)
 - m. [TEC; a subsidiary of H. B. Fuller Company.](#)
 - n. **<Insert manufacturer's name>**.
 - o. or approved equal.

2.7 ELASTOMERIC SEALANTS

- A. Sealants shall have a VOC content of [**250**] **<Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D.
- B. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.
- D. Colors: Provide colors of exposed sealants to match colors of grout in stone tile adjoining sealed joints unless otherwise indicated.
- E. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior stone tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.
 1. [Products](#): Subject to compliance with requirements, provide one of the following:

- a. [DAP Inc.](#); **[Titanium Enriched Kitchen and Bath Sealant] [100 percent Silicone Kitchen and Bath Sealant]**.
 - b. [Dow Corning Corporation; Dow Corning 786.](#)
 - c. [GE Silicones, a division of GE Specialty Materials; Sanitary 1700.](#)
 - d. [Laticrete International, Inc.; Latacil Tile & Stone Sealant.](#)
 - e. [Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.](#)
 - f. [Tremco Incorporated; Tremsil 600 White.](#)
 - g. **<Insert manufacturer's name; product name or designation>**.
 - h. or approved equal.
- F. Multipart, Pourable Urethane Sealant for Use T: ASTM C 920; Type M; Grade P; Class 25; Uses T, M, A, and, as applicable to joint substrates indicated, O.
1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. [Bostik, Inc.; Chem-Calk 550.](#)
 - b. [Degussa Building Systems; Sonneborn Sonolastic SL 2.](#)
 - c. [Pecora Corporation; \[Dynatrol II-SG\] \[NR-200 Urexpan\].](#)
 - d. [Sika Corporation; Sikaflex-2c SL.](#)
 - e. [Tremco Incorporated.; \[THC-900\] \[THC-901\] \[Vulkem 245\].](#)
 - f. **<Insert manufacturer's name; product name or designation>**.
 - g. or approved equal.

2.8 MISCELLANEOUS MATERIALS

- A. Trowelable Patching Compounds: Latex-modified, Portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Angle or L-shaped, height to match stone tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; **[half-hard brass] [white zinc alloy] [nickel silver] [stainless-steel, ASTM A 666, 300 Series]** exposed-edge material.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Blanke Corporation.](#)
 - b. [Ceramic Tool Company, Inc.](#)
 - c. [Schluter Systems L.P.](#)
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
- C. Protective Coating: Liquid grout-release coating that is formulated to protect exposed surfaces of stone tile against adherence of mortar and grout; compatible with stone, mortar, and grout products; easily removable after grouting is completed without damaging grout or stone tile; and recommended for use as temporary protective coating for stone tile.

1. Floor sealer complying with "Floor Sealer" Paragraph below may be used provided it is recommended by manufacturer for use as a grout release.
- D. Cleaner: A neutral cleaner capable of removing soil and residue without harming stone tile and grout surfaces, specifically approved for materials and installations indicated by stone tile producers and grout manufacturers.
- E. Floor Sealer: Colorless, stain- and slip-resistant sealer, not affecting color or physical properties of stone surfaces as recommended by stone tile producers for application indicated.
 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Bostik, Inc.](#)
 - b. [Custom Building Products.](#)
 - c. [Hillyard, Inc.](#)
 - d. [HMK Stone Care System.](#)
 - e. [Summitville Tiles, Inc.](#)
 - f. <Insert manufacturer's name>.
 - g. or approved equal.

2.9 FABRICATION

- A. Facial Dimensions of Stone Tiles with [**Polished**] [**or**] [**Honed**] Faces: Do not vary facial dimensions from specified dimensions by more than plus or minus **1/64 inch** (0.4 mm).
- B. Facial Dimensions of Stone Tiles with [**Sand-Rubbed**] [**Natural-Cleft**] [**or**] [**Thermal-Finished**] Faces: Do not vary facial dimensions from specified dimensions by more than plus or minus **1/32 inch** (0.8 mm).
- C. Thickness of Stone Tiles with [**Polished**] [**Honed**] [**or**] [**Sand-Rubbed**] Finish: Do not vary from specified thickness by more than plus or minus **1/32 inch** (0.8 mm).
- D. Thickness of Stone Tiles with [**Natural-Cleft**] [**or**] [**Thermal**] Finish: Do not vary average thickness of each stone tile from specified thickness by more than plus or minus [**1/32 inch** (0.8 mm)] [**1/16 inch** (1.6 mm)].
- E. Joint Surfaces: Except for specified beveled or eased edges if any, dress joint surfaces square for full depth of stone tile.
- F. Backs of Pieces: Gage units by dressing backs of pieces smooth and flat. When tested with a **24-inch** (600-mm) straightedge, gap shall not exceed **1/32 inch** (0.8 mm).
 1. Natural-cleft stone need not be gaged if gap does not exceed **1/16 inch** (1.6 mm) when tested with a **24-inch** (600-mm) straightedge on backs of units.
- G. Thresholds: Fabricate to size and profile as indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges of thresholds at 1:2 slope, aligning lower edge of bevel with adjacent floor finish. Limit height of bevel to **1/2 inch (13 mm)** or less, and finish bevel to match face of threshold.

2.10 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and with mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where stone tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed stone tile.
 1. Verify that substrates for setting stone tile are firm, dry, clean, and free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone, and that they comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 2. Verify that concrete substrates for stone tile floors installed with **[adhesives]** **[bonded mortar bed]** **[or]** **[thin-set mortar]** comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind stone tile has been completed.
 4. Verify that joints and cracks in stone tile substrates are coordinated with stone tile joint locations; if not coordinated, adjust joint locations in consultation with DEN Project Manager.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for stone tile floors installed with **[adhesives]** **[or]** **[thin-set mortar]** with trowelable patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped **1/4 inch per foot (1:50)** toward drains.
- C. Lay out stone tile patterns by marking joint lines on substrates to verify joint placement at edges, corners, doors, and other critical elements.
 - 1. Notify DEN Project Manager seven days in advance of dates and times when layout will be done.
 - 2. Obtain DEN Project Manager's approval of layout before starting stone tile installation.
- D. Lay out stone tiles on substrates or on an adjacent surface to establish placement of individual stone tiles for balance of color and pattern variations.
 - 1. Notify DEN Project Manager seven days in advance of dates and times when layout will be done.
 - 2. DEN Project Manager may relocate specific stone tiles with other stone tiles of same type and will determine final location of each stone tile within indicated patterns.
 - 3. Identify each stone tile with a temporary number marked on face of stone tile that corresponds with an identical number marked on a layout drawing, and obtain DEN Project Manager's approval before starting stone tile installation.
- E. Field-Applied Temporary Protective Coating: If indicated under stone tile type or needed to prevent grout from staining or adhering to exposed stone tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed stone tile surfaces.

3.3 STONE TILE INSTALLATION

- A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in stone tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods specified in stone tile installation schedules, and apply to types of setting and grouting materials used.
 - 1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
 - a. Exterior stone tile floors.
 - b. Stone tile floors in wet areas.

- c. Stone tile floors composed of stone tiles **8 by 8 inches** (200 by 200 mm) or larger.
- B. Wipe backs of stone tiles with a damp cloth to remove dirt and dust before units are installed.
- C. Extend stone tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- D. Accurately form intersections and returns. Perform cutting and drilling of stone tile without marring visible surfaces. Carefully grind cut edges of stone tile abutting trim, finish, or built-in items for straight aligned joints. Fit stone tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap stone tile.
- E. Finish cut stone tile edges that will not be concealed by other construction by grinding and honing cut surfaces [**and beveling edges**] [**and easing edges**] to match factory-fabricated edges[**unless otherwise indicated**].
- F. Jointing Pattern: Lay stone tile in grid pattern unless otherwise indicated. Lay out stone tile work and center stone tile fields in both directions in each space or on each wall area. Lay out stone tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. Where adjoining stone tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
- G. Lay out stone tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- H. Match stone tiles within each space by selecting tiles to achieve uniformity of color and pattern. Reject or relocate stone tiles that do not match color and pattern of adjacent tiles.
- I. Mix stone tiles to achieve a uniformly random distribution of color shadings and patterns.
- J. Pattern Orientation: For stone varieties with directional pattern, orient pattern as [**indicated**] [**directed by DEN Project Manager**].
- K. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and stone tile. Do not saw-cut joints after installing stone tiles.
 - 1. Where joints occur in concrete substrates, locate joints in stone tile surfaces directly above them.

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- L. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-Portland cement mortar (thin set).
 2. Do not extend **[cleavage membrane] [waterproofing] [or] [crack isolation membrane]** under thresholds set in **[dry-set Portland cement] [or] [latex-Portland cement]** mortar. Fill joints between such thresholds and adjoining stone tile set on **[cleavage membrane] [waterproofing] [or] [crack isolation membrane]** with elastomeric sealant.
- M. Metal Edge Strips: Install **[at locations indicated] [where exposed edge of stone tile flooring meets carpet, wood, or other flooring that finishes flush with top of stone tile] [where exposed edge of stone tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of stone tile and no threshold is indicated].**

3.4 TILE BACKING PANEL INSTALLATION

- A. Install **[cementitious backer units] [or] [fiber-cement underlayment]** at **[showers] [tubs]** and where indicated.
- B. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. **[Use latex-Portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.]**

3.5 WATERPROOFING INSTALLATION

- A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.
- B. Do not install tile or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

3.6 CRACK ISOLATION MEMBRANE INSTALLATION

- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.
- B. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

3.7 INSTALLATION TOLERANCES

- A. Variation from Plumb: For vertical joints, external corners, and other conspicuous lines, do not exceed **1/8 inch in 8 feet** (3 mm in 2.4 m).
- B. Variation in Level: For horizontal joints and other conspicuous lines, do not exceed **1/8 inch in 10 feet** (3 mm in 3 m), or **1/2 inch** (12 mm) maximum.
- C. Variation in Surface Plane of Flooring: Do not exceed **1/8 inch in 10 feet** (3 mm in 3 m) from level or slope indicated when tested with a **10-foot** (3-m) straightedge.
- D. Variation in Plane between Adjacent Units (Lipping): Do not exceed the following differences between faces of adjacent units as measured from a straightedge parallel to stone tiled surface:
 - 1. Units with Polished Faces: **1/64 inch** (0.4 mm).
 - 2. Units with Honed Faces: [**1/64 inch** (0.4 mm)] [**1/32 inch** (0.8 mm)].
 - 3. Units with Sand-Rubbed Faces: **1/32 inch** (0.8 mm).
 - 4. Units with Thermal-Finished Faces: Depth of thermal finish or **3/16 inch** (5 mm), whichever is less.
 - 5. Units with Natural-Cleft Faces: Depth of natural-cleft finish or **3/16 inch** (5 mm), whichever is less.
- E. Variation in Joint Width: Do not vary joint thickness more than **1/16 inch** (1.6 mm) or one-fourth of nominal joint width, whichever is less.
- F. Hand-Tight Joints: Do not exceed [**1/64 inch** (0.4 mm)] [**1/32 inch** (0.8 mm)].

3.8 ADJUSTING AND CLEANING

- A. Remove and replace material that is stained or otherwise damaged or that does not match adjoining stone tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean stone tile surfaces so they are free of foreign matter.
 - 1. Remove [**epoxy**] [**and**] [**latex-Portland cement**] grout residue from stone tile as soon as possible.
 - 2. Clean grout smears and haze from stone tile according to stone tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by stone tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of stone tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
 - 3. Remove temporary protective coating by method recommended by coating manufacturer and acceptable to stone tile and grout manufacturer. Trap and

remove coating to prevent drain clogging.[**Do not remove floor sealer if used as protective coating.**]

- C. Apply sealer to cleaned stone tile flooring according to sealer manufacturer's written instructions.

3.9 PROTECTION

- A. Protect installed stone tile floors with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by stone tile manufacturer, apply coat of neutral protective cleaner to completed stone tile walls and floors.
- B. Prohibit foot and wheel traffic from stone tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from stone tile surfaces.

3.10 EXTERIOR STONE TILE INSTALLATION SCHEDULE

- A. Exterior Floor Installations:

- 1. Stone Tile Installation F101: Cement mortar bed (thickset) [**bonded to concrete**] [**over waterproof membrane on concrete**] [**over waterproof membrane on concrete where indicated and bonded to concrete where membrane is not indicated**]; TCA F101 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
 - a. Stone Tile Type: <**Insert stone tile-type designation**>.
 - b. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: [**Dry-set**] [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.
 - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
- 2. Stone Tile Installation F102: Thin-set mortar [**on concrete**] [**over waterproof membrane on concrete**] [**over waterproof membrane on concrete where indicated and on concrete where membrane is not indicated**]; TCA F102.
 - a. Stone Tile Type: <**Insert stone tile-type designation**>.
 - b. Thin-Set Mortar: [**Dry-set**] [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.
 - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.

- B. Exterior Wall Installations, Masonry or Concrete:

1. Stone Tile Installation W201: Cement mortar bed (thickset) on metal lath over waterproof membrane; TCA W201 and **[ANSI A108.1A]** **[ANSI A108.1B]** **[ANSI A108.1C]**.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Bond Coat for Wet-Set Method: **[Dry-set]** **[Latex-]** Portland cement mortar.
 - c. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: **[Dry-set]** **[Latex-]** Portland cement mortar.
 - d. Grout: **[Sand-Portland cement]** **[Standard sanded cement]** **[Standard unsanded cement]** **[Polymer-modified sanded]** **[Polymer-modified unsanded]** grout.

2. Stone Tile Installation W202: Thin-set mortar; TCA W202.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: **[Dry-set]** **[Latex-]** **[Medium-bed, latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement]** **[Standard sanded cement]** **[Standard unsanded cement]** **[Polymer-modified sanded]** **[Polymer-modified unsanded]** grout.

3.11 INTERIOR STONE TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. Stone Tile Installation F111: Cement mortar bed (thickset) with cleavage membrane; TCA F111 and **[ANSI A108.1A]** **[ANSI A108.1B]** **[ANSI A108.1C]**.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: **[Dry-set]** **[Latex-]** **[Medium-bed, latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement]** **[Standard sanded cement]** **[Standard unsanded cement]** **[Polymer-modified sanded]** **[Polymer-modified unsanded]** grout.

2. Stone Tile Installation F112: Cement mortar bed (thickset) bonded to concrete; TCA F112 and **[ANSI A108.1A]** **[ANSI A108.1B]** **[ANSI A108.1C]**.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: **[Dry-set]** **[Latex-]** **[Medium-bed, latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement]** **[Standard sanded cement]** **[Standard unsanded cement]** **[Polymer-modified sanded]** **[Polymer-modified unsanded]** grout.

3. Stone Tile Installation F113: Thin-set mortar; TCA F113.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.

- b. Thin-Set Mortar: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
4. Stone Tile Installation F114: Cement mortar bed (thickset) with cleavage membrane; epoxy grout; TCA F114 and ANSI A108.1B.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
 - c. Grout: Water-cleanable epoxy grout.
5. Stone Tile Installation F116: **[Organic adhesive] [Water-cleanable, tile-setting epoxy]**; TCA F116.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
6. Stone Tile Installation F121: Cement mortar bed (thickset) on waterproof membrane; TCA F121 and **[ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C]**.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
7. Stone Tile Installation F122: Thin-set mortar on waterproof membrane; TCA F122.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: **[Latex-] [Medium-bed, latex-]** Portland cement mortar.
 - c. Grout: Polymer-modified **[sanded] [unsanded]** grout.
8. Stone Tile Installation F125A: Thin-set mortar on crack isolation membrane; TCA F125A.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: **[Latex-] [Medium-bed, latex-]** Portland cement mortar.
 - c. Grout: **[Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
9. Stone Tile Installation F131: Water-cleanable, tile-setting epoxy; epoxy grout; TCA F131.

- a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Grout: Water-cleanable epoxy grout.
10. Stone Tile Installation F132: Water-cleanable, tile-setting epoxy on cured cement mortar bed [**bonded to concrete subfloor**] [**installed over cleavage membrane**]; epoxy grout; TCA F132.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Grout: Water-cleanable epoxy grout.
- B. Interior Floor Installations, Wood Subfloor:
 1. Stone Tile Installation F121: Cement mortar bed (thickset) on waterproof membrane; TCA F121 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: [**Dry-set**] [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.
 - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
 2. Stone Tile Installation F141: Cement mortar bed (thickset) with cleavage membrane; TCA F141 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: [**Dry-set**] [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.
 - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
 3. Stone Tile Installation F142: Organic adhesive; TCA F142.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
 4. Stone Tile Installation F143: Water-cleanable, tile-setting epoxy; epoxy grout; TCA F143.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Grout: Water-cleanable epoxy grout.
 5. Stone Tile Installation F144: Thin-set mortar on cementitious backer units or fiber-cement underlayment; TCA F144.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: [**Dry-set**] [**Latex-**] [**Medium-bed, latex-**] Portland cement mortar.

- c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
 6. Stone Tile Installation F150/160: Thin-set mortar on exterior-glue plywood; TCA F150 or TCA F160.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: EGP latex-Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
- C. Interior Radiant-Heat Floor Installations, Concrete Subfloor:
1. Stone Tile Installation RH110: Thin-set mortar on crack isolation membrane; hydronic piping installed in concrete; TCA RH110.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: **[Latex-] [Medium-bed, latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
 2. Stone Tile Installation RH115: Thin-set mortar; electric radiant-heat system encapsulated in thin-set mortar; TCA RH115.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: **[Latex-] [Medium-bed, latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
 3. Stone Tile Installation RH116: Thin-set mortar on crack isolation membrane; electric radiant-heat system encapsulated in cementitious self-leveling underlayment; TCA RH116.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Cementitious Self-Leveling Underlayment: Specified in Section 035416 "Hydraulic Cement Underlayment."
 - c. Thin-Set Mortar: **[Latex-] [Medium-bed, latex-]** Portland cement mortar.
 - d. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
- D. Interior Radiant-Heat Floor Installations, Wood Subfloor:
1. Stone Tile Installation RH130: Thin-set mortar on exterior-glue plywood; electric radiant-heat system encapsulated in thin-set mortar; TCA RH130.

- a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: EGP latex-Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
2. Stone Tile Installation RH135: Thin-set mortar on cementitious backer units or fiber-cement underlayment; electric radiant-heat system encapsulated in thin-set mortar; TCA RH135.
- a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: **[Latex-] [Medium-bed, latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
3. Stone Tile Installation RH140: Thin-set mortar on crack isolation membrane; electric radiant-heat system encapsulated in cementitious self-leveling underlayment; TCA RH140.
- a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Cementitious Self-Leveling Underlayment: Specified in Section 035416 "Hydraulic Cement Underlayment."
 - c. Thin-Set Mortar: **[Latex-] [Medium-bed, latex-]** Portland cement mortar.
 - d. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
- E. Interior Wall Installations, Masonry or Concrete:
1. Stone Tile Installation W202: Thin-set mortar; TCA W202.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: **[Dry-set] [Latex-] [Medium-bed, latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
 2. Stone Tile Installation W211: Cement mortar bed (thickset) bonded to substrate; TCA W211 and **[ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C]**.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Bond Coat for Wet-Set Method: **[Dry-set] [Latex-]** Portland cement mortar.
 - c. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: **[Dry-set] [Latex-]** Portland cement mortar.
 - d. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.

3. Stone Tile Installation W221: Cement mortar bed (thickset) on metal lath[**over waterproof membrane**]; TCA W221 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
 - a. Stone Tile Type: <**Insert stone tile-type designation**>.
 - b. Bond Coat for Wet-Set Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
 - c. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
 - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
 4. Stone Tile Installation W222: One-coat cement mortar bed (thickset) on metal lath[**over waterproof membrane**]; TCA W222 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
 - a. Stone Tile Type: <**Insert stone tile-type designation**>.
 - b. Bond Coat for Wet-Set Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
 - c. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
 - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
 5. Stone Tile Installation W223: Organic adhesive; TCA W223.
 - a. Stone Tile Type: <**Insert stone tile-type designation**>.
 - b. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
- F. Interior Wall Installations, Wood Studs or Furring:
1. Stone Tile Installation W221: Cement mortar bed (thickset)[**over waterproof membrane**] on solid backing; TCA W221 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
 - a. Stone Tile Type: <**Insert stone tile-type designation**>.
 - b. Bond Coat for Wet-Set Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
 - c. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
 - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
 2. Stone Tile Installation W222: One-coat cement mortar bed (thickset)[**over waterproof membrane**] on solid backing; TCA W222 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
 - a. Stone Tile Type: <**Insert stone tile-type designation**>.

- b. Bond Coat for Wet-Set Method: **[Dry-set] [Latex-]** Portland cement mortar.
 - c. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: **[Dry-set] [Latex-]** Portland cement mortar.
 - d. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
3. Stone Tile Installation W223: Organic adhesive on solid backing; TCA W223.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
4. Stone Tile Installation W231: Cement mortar bed (thickset); TCA W231 and **[ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C]**.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Bond Coat for Wet-Set Method: **[Dry-set] [Latex-]** Portland cement mortar.
 - c. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: **[Dry-set] [Latex-]** Portland cement mortar.
 - d. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
5. Stone Tile Installation W243: Thin-set mortar on gypsum board; TCA W243.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
6. Stone Tile Installation W244: Thin-set mortar on cementitious backer units or fiber-cement underlayment **[over cleavage membrane]**; TCA W244.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
7. Stone Tile Installation W245: **[Thin-set mortar] [Organic adhesive]** on coated glass-mat, water-resistant gypsum backer board; TCA W245.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.

G. Interior Wall Installations, Metal Studs or Furring:

1. Stone Tile Installation W221: Cement mortar bed (thickset) [**over waterproof membrane**] on solid backing; TCA W221 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
 - a. Stone Tile Type: <**Insert stone tile-type designation**>.
 - b. Bond Coat for Wet-Set Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
 - c. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
 - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
2. Stone Tile Installation W222: One-coat cement mortar bed (thickset) [**over waterproof membrane**] on solid backing; TCA W222 and [**ANSI A108.1A**] [**ANSI A108.1B**] [**ANSI A108.1C**].
 - a. Stone Tile Type: <**Insert stone tile-type designation**>.
 - b. Bond Coat for Wet-Set Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
 - c. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
 - d. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] [**Water-cleanable epoxy**] grout.
3. Stone Tile Installation W223: Organic adhesive on solid backing; TCA W223.
 - a. Stone Tile Type: <**Insert stone tile-type designation**>.
 - b. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
4. Stone Tile Installation W241: Cement mortar bed (thickset); TCA W241 and ANSI A108.1B.
 - a. Stone Tile Type: <**Insert stone tile-type designation**>.
 - b. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: [**Dry-set**] [**Latex-**] Portland cement mortar.
 - c. Grout: [**Sand-Portland cement**] [**Standard sanded cement**] [**Standard unsanded cement**] [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
5. Stone Tile Installation W242: Organic adhesive on gypsum board; TCA W242.
 - a. Stone Tile Type: <**Insert stone tile-type designation**>.
 - b. Grout: [**Polymer-modified sanded**] [**Polymer-modified unsanded**] grout.
6. Stone Tile Installation W243: Thin-set mortar on gypsum board; TCA W243.

- a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
7. Stone Tile Installation W244: Thin-set mortar on cementitious backer units or fiber-cement underlayment[**over cleavage membrane**]; TCA W244.
- a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
8. Stone Tile Installation W245: **[Thin-set mortar] [Organic adhesive]** on coated glass-mat, water-resistant gypsum backer board; TCA W245.
- a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
- H. Bathtub Wall Installations, **[Wood] [Metal]** Studs or Furring:
1. Stone Tile Installation B413: **[Thin-set mortar] [Organic adhesive]** on water-resistant gypsum board; TCA B413.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
- I. Bathtub/Shower Wall Installations, **[Wood] [Metal]** Studs or Furring:
1. Stone Tile Installation B411: Cement mortar bed (thickset); TCA B411 and ANSI A108.1A.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Bond Coat for Wet-Set Method: **[Dry-set] [Latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
 2. Stone Tile Installation B412: Thin-set mortar on cementitious backer units or fiber-cement underlayment; TCA B412.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.

- b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
 3. Stone Tile Installation B419: **[Thin-set mortar] [Organic adhesive]** on coated glass-mat, water-resistant backer board; TCA B419.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded] [Water-cleanable epoxy]** grout.
- J. Shower Receptor and Wall Installations, Concrete or Masonry:
 1. Stone Tile Installation B414: Cement mortar bed (thickset); TCA B414 and **[ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C]**.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Bond Coat for Wet-Set Method: **[Dry-set] [Latex-]** Portland cement mortar.
 - c. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: **[Dry-set] [Latex-]** Portland cement mortar.
 - d. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
 2. Stone Tile Installation B421: Thin-set mortar on waterproof membrane; TCA B421.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: Latex-Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
 3. Stone Tile Installation B422: Thin-set mortar on waterproof membrane with integrated bonding flange for bonded membranes; TCA B422.
 - a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
- K. Shower Receptor and Wall Installations, **[Wood] [Metal]** Studs or Furring:
 1. Stone Tile Installation B414: Cement mortar bed (thickset); TCA B414 and **[ANSI A108.1A] [ANSI A108.1B] [ANSI A108.1C]**.

- a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Bond Coat for Wet-Set Method: **[Dry-set] [Latex-]** Portland cement mortar.
 - c. Bond Coat (Thin-Set Mortar) for Cured-Bed Method: **[Dry-set] [Latex-]** Portland cement mortar.
 - d. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
2. Stone Tile Installation B415: Thin-set mortar on cementitious backer units or fiber-cement underlayment; TCA B415.
- a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
3. Stone Tile Installation B420: Thin-set mortar on coated glass-mat, water-resistant backer board; TCA B420.
- a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: **[Dry-set] [Latex-]** Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
4. Stone Tile Installation B421: Thin-set mortar on waterproof membrane over cementitious backer units or fiber-cement underlayment; TCA B421.
- a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: Latex-Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.
5. Stone Tile Installation B422: Thin-set mortar on waterproof membrane over cementitious backer units or fiber-cement underlayment with integrated bonding flange for bonded membranes; TCA B422.
- a. Stone Tile Type: **<Insert stone tile-type designation>**.
 - b. Thin-Set Mortar: Latex-Portland cement mortar.
 - c. Grout: **[Sand-Portland cement] [Standard sanded cement] [Standard unsanded cement] [Polymer-modified sanded] [Polymer-modified unsanded]** grout.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 093033

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for ceilings.
- B. Related Requirements:
 - 1. Section 095123 "Acoustical Tile Ceilings" for ceilings consisting of mineral-base acoustical tiles used with concealed suspension systems, stapling, or adhesive bonding.
 - 2. Section 095133 "Acoustical Metal Pan Ceilings."
- C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.
- D. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[location and time as determined by DEN Project Manager] [Project site] <Insert location>**.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.

2. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
 3. Laboratory Test Reports for Credit EQ 4: For **[ceiling systems] [and] [sealants]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Samples: For each exposed product and for each color and texture specified, **6 inches** (150 mm) in size.
- D. Samples for Initial Selection: For components with factory-applied color finishes.
- E. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
1. Acoustical Panel: Set of **[full-size] [6-inch- (150-mm-) square]** Samples of each type, color, pattern, and texture.
 2. Exposed Suspension-System Members, Moldings, and Trim: Set of **6-inch- (150-mm-) long** Samples of each type, finish, and color.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Suspended ceiling components.
 2. Structural members to which suspension systems will be attached.
 3. Size and location of initial access modules for acoustical panels.
 4. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Fire alarm system devices.
 - g. Security devices.
 - h. **<Insert item>**.
 5. Perimeter moldings.
- B. Qualification Data: For testing agency.
- C. Product Test Reports: For each acoustical panel ceiling, for tests performed by **[manufacturer and witnessed by a qualified testing agency] [a qualified testing agency]**.

- D. Evaluation Reports: For each acoustical panel ceiling suspension system[**and anchor and fastener type**], from ICC-ES.
- E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Panels: Full-size panels equal to [2] <Insert number> percent of quantity installed.
 - 2. Suspension-System Components: Quantity of each exposed component equal to [2] <Insert number> percent of quantity installed.
 - 3. Hold-Down Clips: Equal to [2] <Insert number> percent of quantity installed.
 - 4. Impact Clips: Equal to [2] <Insert number> percent of quantity installed.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.
- B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup of typical ceiling area as shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

- B. CONSTRUCTION WASTE MANAGEMENT

- C. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7] <Insert requirement>.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for [Class A] materials.
 - 2. Smoke-Developed Index: [50] <Insert value> or less.
- C. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 ACOUSTICAL PANELS, GENERAL

- A. Low-Emitting Materials: Acoustical panel ceilings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Source Limitations:

1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
 2. Suspension System: Obtain each type from single source from single manufacturer.
- C. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.
- D. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
- E. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.
- F. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is **15-3/4 inches** (400 mm) away from test surface according to ASTM E 795.
- G. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by DEN Project Manager from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
- H. Antimicrobial Fungicide Treatment: Provide acoustical panels with face and back surfaces coated with antimicrobial treatment consisting of manufacturer's standard formulation with fungicide added to inhibit growth of mold and mildew and showing no mold or mildew growth when tested according to ASTM D3273 and evaluated according to ASTM D3274 or ASTM G21.
- 2.3 ACOUSTICAL PANELS **<Insert drawing designation>**
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armstrong World Industries, Inc.
 2. CertainTeed Corp.
 3. Chicago Metallic Corporation.
 4. USG Interiors, Inc.; Subsidiary of USG Corporation.
 5. **<Insert manufacturer's name>**
 6. or approved equal.
- B. Classification: Provide[**fire-resistance-rated**] panels complying with ASTM E 1264 for

type, form, and pattern as follows:

1. Type and Form: Type III, mineral base with painted finish; [**Form 1, nodular**] [**Form 2, water felted**] [**Form 4, cast or molded**].
 2. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 1, nodular; with [**glass-fiber cloth**] [**washable vinyl-film**] overlay.
 3. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 2, water felted; with [**vinyl overlay on face**] [**vinyl overlay on face and back**] [**vinyl overlay on face, back, and sealed edges**] [**fiberglass-fabric overlay on face**].
 4. Type and Form: Type XII, glass-fiber base with membrane-faced overlay; [**Form 1, plastic**] [**Form 2, cloth**] [**Form 3, other**].
 5. Type and Form: Type XX, other types; described as high-density, ceramic- and mineral-base panels with scrubbable finish, resistant to heat, moisture, and corrosive fumes.
 6. Type and Form: <Insert type and form>.
 7. Pattern: [**C (perforated, small holes)**] [**CD (perforated, small holes and fissured)**] [**CE (perforated, small holes and lightly textured)**] [**D (fissured)**] [**E (lightly textured)**] [**F (heavily textured)**] [**G (smooth)**] [**GH (smooth and printed)**] [**I (embossed)**] [**J (embossed-in-register)**] [**K (surface scored)**] [**Z (other patterns as described)**] [**As indicated by manufacturer's designation**] <Insert pattern>.
- C. Color: [**White**] [**As selected from manufacturer's full range**] [**Match DEN Project Manager's sample**] [**As indicated by manufacturer's designation**] [**As indicated on Drawings**] [**As indicated in a schedule**] <Insert color>.
- D. LR: Not less than [**0.65**] [**0.70**] [**0.75**] [**0.80**] [**0.85**] [**0.90**] <Insert LR>.
- E. NRC: Not less than [**0.10**] [**0.35**] [**0.40**] [**0.50**] [**0.55**] [**0.60**] [**0.65**] [**0.70**] [**0.75**] [**0.80**] [**0.85**] [**0.90**] [**0.95**] [**1.00**] <Insert NRC>.
- F. CAC: Not less than [**20**] [**25**] [**30**] [**35**] [**40**] <Insert CAC>.
- G. AC: Not less than [**170**] [**180**] [**190**] [**200**] [**210**] <Insert AC>.
- H. Edge/Joint Detail: [**Square**] [**Reveal sized to fit flange of exposed suspension-system members**] [**Flush reveal sized to fit flange of exposed suspension-system members**] [**Beveled, kerfed and rabbeted long edges and square, butt-on short edges**] <Insert manufacturer's special proprietary edge detail>.
- I. Thickness: [**5/8 inch (15 mm)**] [**3/4 inch (19 mm)**] [**7/8 inch (22 mm)**] [**As indicated on Drawings**] [**As indicated in a schedule**] <Insert thickness>.
- J. Thickness: [**1/8 inch (3 mm)**] [**7/16 inch (12 mm)**] [**9/16 inch (15 mm)**] [**5/8 inch (15 mm)**] [**3/4 inch (19 mm)**] [**7/8 inch (22 mm)**] [**1 inch (25 mm)**] [**1-1/2 inches (38 mm)**] [**2 inches (51 mm)**] [**3 inches (76 mm)**] [**As indicated on Drawings**] [**As indicated in a schedule**] <Insert dimension>.

- K. Modular Size: [24 by 24 inches (610 by 610 mm)] [24 by 48 inches (610 by 1220 mm)] [600 by 600 mm] [600 by 1200 mm] [As indicated on Drawings] [As indicated in a schedule] <Insert size>.
- L. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 METAL SUSPENSION SYSTEMS, GENERAL

- A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25] <Insert number> percent.
- B. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
 - 1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
 - 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to [five] <Insert safety factor> times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Type: [Cast-in-place] [Postinstalled expansion] [Postinstalled bonded] anchors.
 - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
 - c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
 - d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
 - 2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to [10] <Insert safety factor> times that imposed by ceiling construction, as determined by testing according to

ASTM E 1190, conducted by a qualified testing and inspecting agency.

- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
 3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
 4. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than [0.106-inch- (2.69-mm-)] [0.135-inch- (3.5-mm-)] **<Insert dimension>** diameter wire.
- E. **[Hanger Rods] [Flat Hangers]**: Mild steel, zinc coated or protected with rust-inhibitive paint.
- F. Angle Hangers: Angles with legs not less than **7/8 inch** (22 mm) wide; formed with **0.04-inch-** (1-mm-) thick, galvanized-steel sheet complying with ASTM A 653/A 653M, **G90** (Z275) coating designation; with bolted connections and **5/16-inch-** (8-mm-) diameter bolts.
- G. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- H. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- I. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in place.
- J. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced **24 inches** (610 mm) o.c. on all cross tees.
- K. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.
- L. Clean-Room Gasket System: Where indicated, provide manufacturer's standard system, including **[manufacturer's standard] [closed-cell PVC] [neoprene] [antimicrobial]** gasket and related adhesives, tapes, seals, and retention clips, designed to seal out foreign material from and maintain positive pressure in clean room.

2.5 METAL SUSPENSION SYSTEM **<Insert drawing designation>**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armstrong World Industries, Inc.
 2. CertainTeed Corp.

3. Chicago Metallic Corporation.
 4. USG Interiors, Inc.; Subsidiary of USG Corporation.
 5. **<Insert manufacturer's name>**
 6. or approved equal.
- B. Wide-Face, Capped, Double-Web,[**Fire-Rated**,] Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than **G30 (Z90)** coating designation; with prefinished **15/16-inch-** (24-mm-) wide metal caps on flanges.
1. Structural Classification: [**Intermediate**] [**Heavy**]-duty system.
 2. End Condition of Cross Runners: [**Override (stepped)**] [**or**] [**butt-edge**] type.
 3. Face Design: Flat, flush.
 4. Cap Material: [**Steel**] [**or**] [**aluminum**] cold-rolled sheet.
 5. Cap Finish: [**Painted white**] [**Painted in color as selected from manufacturer's full range**] [**Painted to match color indicated by manufacturer's designation**] [**Painted to match color of acoustical unit**] [**Plated with metallic finish as selected from manufacturer's full range**] [**Plated with metallic finish indicated by manufacturer's designation**] [**Natural finish for aluminum**].
- C. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than **G30 (Z90)** coating designation; with prefinished **9/16-inch-** (15-mm-) wide metal caps on flanges.
1. Structural Classification: [**Intermediate**] [**Heavy**]-duty system.
 2. End Condition of Cross Runners: [**Override (stepped)**] [**or**] [**butt-edge**] type.
 3. Face Design: [**Flat, flush**] [**Flanges formed with an integral center reveal**].
 4. Cap Material: [**Steel**] [**or**] [**aluminum**] cold-rolled sheet.
 5. Cap Finish: [**Painted white**] [**Painted in color as selected from manufacturer's full range**] [**Painted to match color indicated by manufacturer's designation**] [**Painted to match color of acoustical unit**] [**Plated with metallic finish as selected from manufacturer's full range**] [**Plated with metallic finish indicated by manufacturer's designation**] [**Natural finish for aluminum**].
- D. Narrow-Face, Steel-Capped, Double-Web, Fire-Rated Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than **G30 (Z90)** coating designation; with prefinished, cold-rolled, **9/16-inch-** (15-mm-) wide metal caps on flanges.
1. Structural Classification: Intermediate-duty system.
 2. Face Design: Flat, flush.
 3. Cap Finish: [**Painted white**] [**Painted in color as selected from manufacturer's full range**] [**Painted to match color indicated by manufacturer's designation**] [**Painted to match color of acoustical unit**] [**Plated with metallic finish as selected from manufacturer's full range**]

**[Plated with metallic finish indicated by manufacturer's designation]
[Natural finish for aluminum].**

- E. Narrow-Face, Uncapped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized; to produce structural members with **9/16-inch-** (15-mm-) wide faces.
1. Structural Classification: **[Intermediate] [Heavy]**-duty system.
 2. Face Design: **[With 1/8-inch-** (3.2-mm-) **wide, slotted, box-shaped flange] [With 1/4-inch-** (6.35-mm-) **wide, slotted, box-shaped flange] [Flanges formed in stepped design with a center protrusion projecting 19/64 inch** (7.54 mm) **below flange surfaces supporting panel faces and forming 3/16-inch-** (4.76-mm-) **wide reveals between edges of protrusion and those of panels].**
 3. Face Finish: Painted **[white] [in color as selected from manufacturer's full range] [to match color indicated by manufacturer's designation] [to match color of acoustical unit].**
 4. Reveal Finish: Painted **[to match flange color] [white] [black] [in color other than flange color as selected from manufacturer's full range of contrasting reveal colors].**
- F. Wide-Face, Capped, Double-Web, **[Fire-Rated,]** Hot-Dip Galvanized, **G60** (Z180), Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; hot-dip galvanized according to ASTM A 653/A 653M, **G60** (Z180) coating designation; with prefinished, cold-rolled, **15/16-inch-** (24-mm-) wide aluminum caps on flanges.
1. Structural Classification: **[Intermediate] [Heavy]**-duty system.
 2. Face Design: Flat, flush.
 3. Face Finish: **[Painted white] [Painted to match color indicated by manufacturer's designation] [Painted to match color of acoustical unit] [Natural finish].**
- G. Wide-Face, Single-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet electrolytically zinc coated, with prefinished flanges of width indicated.
1. Structural Classification: Heavy-duty system.
 2. Face Finish: Painted **[white] [black].**
- H. Wide-Face, Capped, Double-Web, Stainless-Steel Suspension System: Main and cross runners roll formed from Type 304 or 316, stainless-steel sheet, with prefinished **15/16-inch-** (24-mm-) wide stainless-steel caps on flanges.
1. Structural Classification: Intermediate-duty system.
 2. Face Design: Flat, flush.
- I. Narrow-Face, Single-Web, Extruded-Aluminum Suspension System: Main and cross runners formed from extruded aluminum to produce structural members with **9/16-inch-** (15-mm-) wide faces.

1. Structural Classification: **[Intermediate] [Heavy]**-duty system.
 2. Face Design: Screw-slot profile.
 3. Face Finish: **[Painted white] [Satin anodized according to AAMA 611, AA-M12C22A31]**.
 4. Reveal Finish: **[Match face finish] [Painted white] [Painted black]**.
- J. Extra-Wide-Face, **[Double] [Single]**-Web, Metal Suspension System: Main and cross runners formed from **[extruded aluminum] [aluminum-capped steel] [steel-capped steel]** <Insert description> to produce structural members with **[1-1/2-inch- (38-mm-)] [2-inch- (50-mm-)]** wide flanges.
1. Structural Classification: **[Intermediate] [Heavy]**-duty system.
 2. Face Design: Flat, flush.
 3. Face Finish: **[Painted white] [Satin anodized according to AAMA 611, AA-M12C22A31]**.
 4. Gasket System: Clean-room type.

2.6 METAL EDGE MOLDINGS AND TRIM <Insert drawing designation>

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armstrong World Industries, Inc.
 2. CertainTeed Corp.
 3. Chicago Metallic Corporation.
 4. Fry Reglet Corporation.
 5. Gordon, Inc.
 6. USG Interiors, Inc.; Subsidiary of USG Corporation.
 7. **<Insert manufacturer's name>**
 8. or approved equal.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
 2. For lay-in panels with reveal edge details, provide **[stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member] <Insert description>**.
 3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
- C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:

1. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of aluminum extrusions complying with [ASTM B 221](#) (ASTM B 221M) for Alloy and Temper 6063-T5.
2. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
3. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of **1.5 mils** (0.04 mm). Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.7 ACOUSTICAL SEALANT

A. Products: Subject to compliance with requirements, provide one of the following:

1. Acoustical Sealant for Exposed and Concealed Joints:
 - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
 - b. USG Corporation; SHEETROCK Acoustical Sealant.
 - c. **<Insert manufacturer's name>**
 - d. or approved equal.
2. Acoustical Sealant for Concealed Joints:
 - a. Henkel Corporation; OSI Pro-Series SC-175 Acoustical Sound Sealant.
 - b. Pecora Corporation; AIS-919.
 - c. Tremco, Inc.; Tremco Acoustical Sealant.
 - d. **<Insert manufacturer's name>**
 - e. or approved equal.

B. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.
2. Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant.
3. Acoustical sealant shall **[have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).] [comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]**

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which

acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
 - 1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required[**and, if permitted with fire-resistance-rated ceilings,**] to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.

6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 8. Do not attach hangers to steel deck tabs.
 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 10. Space hangers not more than **48 inches** (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than **8 inches** (200 mm) from ends of each member.
 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than **16 inches** (400 mm) o.c. and not more than **3 inches** (75 mm) from ends, leveling with ceiling suspension system to a tolerance of **1/8 inch in 12 feet** (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 - b. Install panels with pattern running in one direction parallel to **[long]** **[short]** axis of space.
 - c. Install panels in a basket-weave pattern.
 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.

4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
6. Install [**hold-down**] [**impact**] clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions unless otherwise indicated.
7. Install clean-room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer's written instructions.
8. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: [**Owner will engage**] [**Engage**] a qualified special inspector to perform the following special inspections:
 1. Compliance of seismic design.
- B. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections and prepare test reports.
- C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.
 1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
 - a. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.
 - b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- D. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 095113

SECTION 095133 - ACOUSTICAL METAL PAN CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes acoustical metal pans and associated suspension system for interior ceilings.
- B. Related Requirements:
 - 1. Section 095113 "Acoustical Panel Ceilings" for ceilings consisting of mineral-base and glass-fiber-base acoustical panels and exposed suspension systems.
 - 2. Section 095123 "Acoustical Tile Ceilings" for ceilings consisting of mineral-base acoustical tiles used with concealed suspension systems, stapling, or adhesive bonding.
 - 3. Section 095423 "Linear Metal Ceilings."
 - 4. Section 095436 "Suspended Decorative Grids."
- C. Products furnished, but not installed, under this Section include anchors, clips, and other ceiling attachment devices to be cast in concrete.
- D. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>**.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 2. Product Data for Credit IEQ 4.1: For sealants[**and adhesives**], documentation including printed statement of VOC content.
 3. Laboratory Test Reports for Credit IEQ 4.1: For [**ceiling systems**] [**and sealants**], documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Samples: For each exposed product and for each color and texture specified, **6 inches (150 mm)** in size.
- D. Samples for Initial Selection: For units with factory-applied finishes.
- E. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below:
1. Metal Pans: Set of [**full-size**] [**6-inch- (150-mm-) square**] Samples of each type, finish, color, pattern, and texture. Show pan edge profile.
 2. Exposed Suspension-System Members, Moldings, and Trim: Set of **6-inch- (150-mm-)** long Samples of each type, finish, and color.
 3. Sound Absorber: Sample of each type matching size of Sample metal pan.
- F. Delegated-Design Submittal: For design of [**seismic restraints and**] attachment devices.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Suspended ceiling components.
 2. Structural members to which suspension systems will be attached.
 3. Size and location of access modules for acoustical panels.
 4. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. **<Insert item>**.
 5. Perimeter moldings.

- B. Qualification Data: For testing agency.
- C. Product Test Reports: For each acoustical metal pan ceiling, for tests performed by **[manufacturer and witnessed by a qualified testing agency] [a qualified testing agency]**.
- D. Evaluation Reports: For each acoustical metal pan ceiling suspension system[**and anchor and fastener type**].
- E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Metal Pans: Full-size units equal to **[2] <Insert number>** percent of quantity installed.
 - 2. Suspension-System Components: Quantity of each grid, exposed molding, and trim equal to **[2] <Insert number>** percent of quantity installed.
 - 3. Hold-Down Clips: **[Equal to 2 percent of quantity installed] <Insert number>**.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup of typical ceiling area as shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical metal pans, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they are protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

- B. Handle acoustical metal pans, suspension-system components, and accessories carefully to avoid damaging units and finishes in any way.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design **[seismic restraints and]**attachment devices.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for **[Class A] [Class B] [Class C]** materials.
 - 2. Smoke-Developed Index: **[50] [450] <Insert value>** or less.

2.2 ACOUSTICAL METAL PANS, GENERAL

- A. Source Limitations: Obtain each type of acoustical metal ceiling pan and supporting suspension system from single source from single manufacturer.
- B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25] <Insert number>** percent for metal pans and not less than **<Insert number>** percent for sound-absorbent insulation.
- C. Glass-Fiber Insulation: Made with binder containing no urea formaldehyde.
- D. Acoustical Panel Standard: Provide manufacturer's standard pans of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is **15-3/4 inches (400 mm)** away from test surface according to ASTM E 795.
- E. Sheet Metal Characteristics: For metal components exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, roughness, stains, or discolorations.

1. Aluminum Sheet: Rolled aluminum sheet, complying with **ASTM B 209** (ASTM B 209M); alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
 2. Steel Sheet: Commercial-quality, cold-rolled, carbon-steel sheet; stretcher leveled; with protective coating complying with ASTM C 635/C 635M.
 - a. Painted Finishes: Electrolytic zinc-coated steel complying with ASTM A 879/A 879M, **13Z** (40G) coating, surface treatment as recommended by finish manufacturer for type of use and finish indicated.
 - b. Chemical/Mechanical Finishes: Uncoated steel sheet complying with ASTM A 1008/A 1008M with luster or bright finish as required by finisher for applying electroplating or other metallic-finishing processes.
 3. Stainless-Steel Sheet: Complying with ASTM A 240/A 240M, [**Type 304**] [**Type 430**] <Insert type>.
- F. Sound-Absorbent Fabric Layer: Provide fabric layer, sized to fit concealed surface of pan, and consisting of black, nonwoven, nonflammable, sound-absorbent material with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing according to ASTM E 84.
1. Bond fabric layer to panels in the factory with manufacturer's standard nonflammable adhesive.
- G. Sound-Absorbent Pads: Provide width and length to completely fill concealed surface of pan, with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing according to ASTM E 84, and to comply with the following requirements:
1. Plastic Sheet-Wrapped, Mineral-Fiber Insulation: Pads consisting of nonrigid, PVC plastic sheet encapsulating unfaced mineral-fiber insulation complying with ASTM C 553, Type I, Type II, or Type III, and as follows:
 - a. Mineral-Fiber Type and Thickness: Glass fiber; [**1 inch** (25 mm)] [**1-1/2 inches** (38 mm)] [**3 inches** (76 mm)] <Insert dimension>.
 - b. Mineral-Fiber Density: [**3/4 lb/cu. ft.** (12 kg/cu. m)] [**1 lb/cu. ft.** (16 kg/cu. m)] [**1-1/2 lb/cu. ft.** (24 kg/cu. m)] <Insert value>.
 - c. Plastic Sheet Thickness and Color: Not less than **0.003 inch** (0.076 mm); [**clear**] [**flat black**] [**white**].
 2. Unwrapped, Glass-Fiber Insulation: Black coated, unfaced, complying with ASTM C 553, Type I, Type II, or Type III; not less than **1-lb/cu. ft.** (16-kg/cu. m) density; treated to be nondusting; [**1 inch** (25 mm)] [**1-1/2 inches** (38 mm)] <Insert dimension> thick.
 3. Spacer Grids: Provide manufacturer's standard [**aluminum**] [**galvanized-steel**] grid units that provide an air cushion between metal pans and insulation pads and that act to improve sound absorption.

- H. Sound Attenuation Panels: Provide manufacturer's standard **[aluminum]** **[galvanized-steel]** unperforated metal backing unit that acts as a sound attenuation pan to reduce the travel of sound through ceiling plenum into adjoining rooms.
1. Sound-Absorbent Pads: Provide secondary sound-absorbent pads, **[same as specified for primary sound-absorbent pads]** **<Insert requirements>**, for placement over sound attenuation pan to reduce plenum sound.
- I. Adhesive: Manufacturer's standard nonflammable adhesive for sound-absorbent **[fabric]** **[and]** **[pads]**.
1. Adhesive shall have a VOC content of **[50]** **<Insert number>** g/L or less.
 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- 2.3 ALUMINUM PANS FOR ACOUSTICAL METAL PAN CEILING **<Insert drawing designation>**
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [American Decorative Ceilings](#); **<Insert product name or designation>**.
 2. [Armstrong World Industries, Inc.](#); **<Insert product name or designation>**.
 3. [Ceilings Plus](#); **<Insert product name or designation>**.
 4. [Chicago Metallic Corporation](#); **<Insert product name or designation>**.
 5. [Gage Corporation International \(The\)](#); **<Insert product name or designation>**.
 6. [Hunter Douglas Architectural Products, Inc.](#); **<Insert product name or designation>**.
 7. [Simplex Ceilings, a division of Intalite Inc.](#); **<Insert product name or designation>**.
 8. [Steel Ceilings Inc.](#); **<Insert product name or designation>**.
 9. [USG Interiors, Inc.](#); **<Insert product name or designation>**.
 10. **<Insert manufacturer>**
 11. or approved equal.
- B. Classification: Units complying with ASTM E 1264 for **[Type VII, perforated aluminum facing (pan) with mineral- or glass-fiber-base backing]** **[Type XX, other types described as perforated aluminum facing (pan) units with sound-absorbent fabric backing]** **[Type XX, other types described as unperforated aluminum facing (pan) units]** **<Insert Type XX description>**.
1. Pattern: Pattern A (perforated, regularly spaced large holes), arranged in **[diagonal]** **[parallel]** alignment to pan edge with uniform perforations of dimension, holes per square foot or inch, and percent open area as **[indicated by product designation]** **[selected from manufacturer's full range]**.
 2. Pattern: Pattern C (perforated, small holes) regularly spaced, with uniform perforations of dimension, holes per square foot or inch, and percent open area

- as [specified by product designation] [selected from manufacturer's full range].
3. Pattern: <Insert pattern designation for perforated pans and any requirements for perforation alignment, hole shape and size, holes per square foot or inch, percent open area, and border requirements>.
- C. Pan Fabrication: Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated and finished to comply with requirements indicated.
1. Lay-in Pans: Formed to set in exposed suspension grid.
 2. Clip-in Pans: Designed to clip in and be securely retained in exposed suspension grid by formed edges or accessory clips provided by manufacturer.
 3. Snap-in Pans: Designed with dimples or continuous beads on flanges for snap-in, secure engagement with concealed suspension system.
 4. Torsion-Spring-Hinged Pans: Designed to be securely retained in preslotted, exposed suspension grid by torsion springs provided by manufacturer.
 5. <Insert type and description>.
- D. Pan Thickness: Not less than [0.019 inch (0.5 mm)] [0.025 inch (0.6 mm)] [0.032 inch (0.8 mm)] [0.040 inch (1.0 mm)] <Insert dimension>.
- E. Pan Edge Detail: [Square] [Beveled] [Reveal] [Manufacturer's standard edge detail].
- F. Pan Joint Detail: [Butt] [Wide reveal, not less than 15/16 inch (24 mm) wide] [Narrow reveal, not greater than 9/16 inch (15 mm) wide] [Flush narrow reveal, not greater than 9/16 inch (15 mm) wide] <Insert description>.
- G. Pan Size: [12 by 12 inches (305 by 305 mm)] [12 by 24 inches (305 by 610 mm)] [12 by 36 inches (305 by 915 mm)] [24 by 24 inches (610 by 610 mm)] [24 by 48 inches (610 by 1220 mm)] [24 by 60 inches (610 by 1525 mm)] [30 by 30 inches (760 by 760 mm)] [30 by 60 inches (760 by 1525 mm)] [As indicated on Drawings] <Insert dimensions>.
- H. Scoring: Score pans at intervals to appear as [12-by-12-inch (305-by-305-mm)] <Insert dimensions> ceiling units.
- I. Pan Face Finish: [Mill] [Lacquered mill] [Clear anodized] [Clear mirror anodized] [Painted white] [Painted to match color indicated by product designation] [Painted to match DEN Project Manager's sample] [Painted in color selected from manufacturer's full range] [Bright-reflective metallic finish selected from manufacturer's full range] <Insert finish>.
- J. LR: Not less than [0.70] [0.75] <Insert number>.
- K. NRC: Not less than [0.60] [0.65] [0.70] [0.75] [0.80] [0.85] [0.90] [0.95] <Insert number>.
- L. CAC: Not less than [35] [40] [45] <Insert number>.

- 2.4 STEEL PANS FOR ACOUSTICAL METAL PAN CEILING <Insert drawing designation>
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [American Decorative Ceilings](#); <Insert product name or designation>.
 2. [Armstrong World Industries, Inc.](#); <Insert product name or designation>.
 3. [CertainTeed Corp.](#)
 4. [Ceilings Plus](#); <Insert product name or designation>.
 5. [Chicago Metallic Corporation](#); <Insert product name or designation>.
 6. [Hunter Douglas Architectural Products, Inc.](#); <Insert product name or designation>.
 7. [Simplex Ceilings, a division of Intalite Inc.](#); <Insert product name or designation>.
 8. [Steel Ceilings Inc.](#); <Insert product name or designation>.
 9. [USG Interiors, Inc.](#); <Insert product name or designation>.
 10. <Insert manufacturer's name>.
 11. or approved equal.
- B. Classification: Units complying with ASTM E 1264 for [Type V, perforated steel facing (pan) with mineral- or glass-fiber-base backing] [Type XX, other types described as perforated steel facing (pan) units with sound-absorbent fabric backing] [Type XX, other types described as unperforated steel facing (pan) units] <Insert Type XX description>.
1. Pattern: Pattern A (perforated, regularly spaced large holes), arranged in [diagonal] [parallel] alignment to pan edge with uniform perforations of dimension, holes per square foot or inch, and percent open area as [indicated by product designation] [selected from manufacturer's full range].
 2. Pattern: Pattern C (perforated, small holes) regularly spaced, with uniform perforations of dimension, holes per square foot or inch, and percent open area as [specified by product designation] [selected from manufacturer's full range].
 3. Pattern: <Insert pattern designation for perforated pans and any requirements for perforation alignment, hole shape and size, holes per square foot or inch, and percent open area>.
- C. Pan Fabrication: Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated and finished to comply with requirements indicated.
1. Lay-in Pans: Formed to set in exposed suspension grid.
 2. Clip-in Pans: Designed to clip in and be securely retained in exposed suspension grid by formed edges or accessory clips provided by manufacturer.
 3. Snap-in Pans: Designed with dimples or continuous beads on flanges for snap-in, secure engagement with concealed suspension system.
 4. Torsion-Spring-Hinged Pans: Designed to be securely retained in preslotted, exposed suspension grid by torsion springs provided by manufacturer.
 5. <Insert type and description>.

- D. Pan Thickness: Not less than [0.010 inch (0.25 mm)] [0.019 inch (0.5 mm)] [0.025 inch (0.6 mm)] [0.030 inch (0.75 mm)] [0.036 inch (0.9 mm)] <Insert dimension>.
- E. Pan Edge Detail: [Square] [Beveled] [Reveal] [Manufacturer's standard edge detail].
- F. Pan Joint Detail: [Butt] [Wide reveal, not less than 15/16 inch (24 mm) wide] [Narrow reveal, not greater than 9/16 inch (15 mm) wide] [Flush narrow reveal, not greater than 9/16 inch (15 mm) wide] <Insert description>.
- G. Pan Size: [12 by 12 inches (305 by 305 mm)] [12 by 24 inches (305 by 610 mm)] [12 by 36 inches (305 by 915 mm)] [24 by 24 inches (610 by 610 mm)] [24 by 48 inches (610 by 1220 mm)] [24 by 60 inches (610 by 1525 mm)] [30 by 30 inches (760 by 760 mm)] [30 by 60 inches (760 by 1525 mm)] [As indicated on Drawings] <Insert dimensions>.
- H. Scoring: Score pans at intervals to appear as [12-by-12-inch (305-by-305-mm)] <Insert dimensions> ceiling units.
- I. Pan Face Finish: [Painted white] [Painted to match color indicated by product designation] [Painted to match DEN Project Manager's sample] [Painted in color selected from manufacturer's full range] [Plated with metallic finish, as selected from manufacturer's full range] [Bright-reflective metallic finish selected from manufacturer's full range] <Insert finish>.
- J. LR: Not less than [0.70] [0.75] <Insert number>.
- K. NRC: Not less than [0.60] [0.65] [0.70] [0.75] [0.80] [0.85] [0.90] [0.95] <Insert number>.
- L. CAC: Not less than [35] [40] [45] <Insert number>.
- 2.5 STAINLESS-STEEL PANS FOR ACOUSTICAL METAL PAN CEILING <Insert drawing designation>
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [Ceilings Plus.](#)
 2. [Chicago Metallic Corporation.](#)
 3. [Hunter Douglas.](#)
 4. [Simplex Ceilings; a division of Intalite Inc.](#)
 5. [Steel Ceilings Inc.](#)
 6. <Insert manufacturer's name>.
 7. or approved equal.
- B. Classification: Units complying with ASTM E 1264 for [Type VI, perforated stainless-steel facing (pan) with mineral- or glass-fiber-base backing] [Type XX, other types described as perforated stainless-steel facing (pan) units with

sound-absorbent fabric backing] [Type XX, other types described as **unperforated stainless-steel facing (pan) units**] <Insert Type XX description>.

1. Pattern: Pattern A (perforated, regularly spaced large holes), arranged in parallel alignment to pan edge with uniform perforations of **0.109-inch (2.8-mm)** diameter, 1800 holes/sq. ft. or inch, and 11.8 percent open area.
 2. Pattern: <Insert pattern designation for perforated pans and any requirements for perforation alignment, hole shape and size, holes per square foot or inch, and percent open area>.
- C. Pan Fabrication: Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated and finished to comply with requirements indicated.
1. Lay-in Pans: Formed to set in exposed suspension grid.
 2. Clip-in Pans: Designed to clip in and be securely retained in exposed suspension grid by formed edges or accessory clips provided by manufacturer.
 3. Snap-in Pans: Designed with dimples or continuous beads on flanges for snap-in, secure engagement with concealed suspension system.
 4. Torsion-Spring-Hinged Pans: Designed to be securely retained in preslotted, exposed suspension grid by torsion springs provided by manufacturer.
 5. <Insert type and description>.
- D. Pan Thickness: Not less than [**0.019 inch (0.5 mm)**] [**0.025 inch (0.6 mm)**] [**0.030 inch (0.76 mm)**] <Insert dimension>.
- E. Pan Edge Detail: [**Square**] [**Beveled**] [**Reveal**] [**Manufacturer's standard edge detail**].
- F. Pan Joint Detail: [**Butt**] [**Wide reveal, not less than 15/16 inch (24 mm) wide**] [**Narrow reveal, not greater than 9/16 inch (15 mm) wide**] [**Flush narrow reveal, not greater than 9/16 inch (15 mm) wide**] <Insert description>.
- G. Pan Size: [**12 by 12 inches (305 by 305 mm)**] [**12 by 24 inches (305 by 610 mm)**] [**12 by 36 inches (305 by 915 mm)**] [**24 by 24 inches (610 by 610 mm)**] [**24 by 48 inches (610 by 1220 mm)**] [**30 by 30 inches (760 by 760 mm)**] [**As indicated on Drawings**] <Insert dimensions>.
- H. Scoring: Score pans at intervals to appear as [**12-by-12-inch (305-by-305-mm)**] <Insert dimensions> ceiling units.
- I. Pan Face Finish: [**Directional Satin Finish: No. 4**] [**Dull Satin Finish: No. 6**] [**Mirrorlike Reflective, Nondirectional Polish: No. 8**] <Insert finish>.
- J. NRC: Not less than [**0.60**] [**0.65**] [**0.70**] [**0.75**] [**0.80**] [**0.85**] [**0.90**] [**0.95**] <Insert number>.
- K. CAC: Not less than [**35**] [**40**] [**45**] <Insert number>.

2.6 METAL SUSPENSION SYSTEMS, GENERAL

- A. Recycled Content of Metal Suspension System: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
- B. Metal Suspension System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635/C 635M requirements.
- C. Suspension Systems: Provide systems complete with carriers, runners, splice sections, connector clips, alignment clips, leveling clips, hangers, molding, trim, retention clips, load-resisting struts, and other suspension components required to support ceiling units and other ceiling-supported construction.
- D. Attachment Devices: Size for 5 times the design load indicated in ASTM C 635/C 635M, Table 1, Direct Hung, unless otherwise indicated. Comply with seismic design requirements.
 - 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to **[5]** **<Insert number>** times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Type: **[Cast-in-place]** **[Postinstalled expansion]** **[Postinstalled bonded]** anchors.
 - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
 - c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
 - d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
 - 2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to **[10]** **<Insert number>** times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.
- E. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
 - 3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel copper alloy for UNS No. N04400 alloy.

4. Size: Select wire diameter so its stress at 3 times the hanger design load indicated in ASTM C 635/C 635M, Table 1, Direct Hung, is less than yield stress of wire, but provide not less than [0.106-inch- (2.69-mm-)] [0.135-inch- (3.5-mm-)] <Insert dimension> diameter wire.
- F. [**Hanger Rods**] [**Flat Hangers**]: Mild steel, zinc coated or protected with rust-inhibitive paint.
 - G. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1.0-mm-) thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.
 - H. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
 - I. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
 - J. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical metal pans in place.
 - K. Hold-Down Clips: Manufacturer's standard hold-down clips spaced to secure acoustical metal pans in place [**to molding and trim at perimeter**] [**at each pan**] <Insert requirements>.
 - L. Exposed Metal Edge Moldings and Trim: Provide exposed members as indicated or as required to comply with seismic requirements of authorities having jurisdiction, to conceal edges of and penetrations through ceiling, to conceal edges of pans and runners, for fixture trim and adapters, for fasciae at changes in ceiling height, and for other conditions; of metal and finish matching acoustical metal pan ceiling units unless otherwise indicated.
 1. For Circular Penetrations of Ceiling: Fabricate edge moldings to diameter required to fit penetration exactly.
- 2.7 DIRECT-HUNG, STANDARD-GRID, METAL SUSPENSION SYSTEM FOR ACOUSTICAL METAL PAN CEILING <Insert drawing designation>
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. [Armstrong World Industries, Inc.](#)
 2. [CertainTeed Corp.](#)
 3. [Chicago Metallic Corporation.](#)
 4. [USG Interiors, Inc.; Subsidiary of USG Corporation.](#)
 5. <Insert manufacturer's name>.
 6. or approved equal.

- B. Suspension System: For **[clip-in]** **[lay-in]** **[torsion-spring-hinged]** **<Insert type>** pans.
- C. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytic zinc-coated or hot-dip galvanized according to ASTM A 653/A 653M, **G30 (Z90)** coating designation, with prefinished, cold-rolled, **15/16-inch-** (24-mm-) wide sheet metal caps on flanges.
1. Structural Classification: **[Intermediate]** **[Heavy]**-duty system.
 2. End Condition of Cross Runners: **[Override (stepped)]** **[or]** **[butt-edge]** type.
 3. Face Design: Flat, flush.
 4. Cap Material: **[Steel]** **[or]** **[aluminum]** cold-rolled sheet.
 5. Cap Finish: **[Painted white]** **[Painted in color as selected from manufacturer's full range]** **[Painted to match color indicated by manufacturer's designation]** **[Painted to match color of metal pan]** **[Plated with metallic finish, as selected from manufacturer's full range]** **[Plated with metallic finish indicated by manufacturer's designation]** **[Natural finish for aluminum]**.
- D. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytic zinc-coated or hot-dip galvanized according to ASTM A 653/653M, **G30 (Z90)** coating designation, with prefinished, cold-rolled, **9/16-inch-** (15-mm-) wide sheet metal caps on flanges.
1. Structural Classification: **[Intermediate]** **[Heavy]**-duty system.
 2. End Condition of Cross Runners: **[Override (stepped)]** **[or]** **[butt-edge]** type.
 3. Face Design: **[Flat, flush]** **[Flanges formed with an integral center reveal]**.
 4. Cap Material: **[Steel]** **[or]** **[aluminum]** cold-rolled sheet.
 5. Cap Finish: **[Painted white]** **[Painted in color as selected from manufacturer's full range]** **[Painted to match color indicated by manufacturer's designation]** **[Painted to match color of metal pan]** **[Plated with metallic finish, as selected from manufacturer's full range]** **[Plated with metallic finish indicated by manufacturer's designation]** **[Natural finish for aluminum]**.
- E. Narrow-Face, Uncapped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytic zinc-coated or hot-dip galvanized, to produce structural members with **9/16-inch-** (15-mm-) wide faces.
1. Structural Classification: **[Intermediate]** **[Heavy]**-duty system.
 2. Face Design: With **[1/8-inch-** (3.2-mm-)] **[1/4-inch-** (6.35-mm-)] wide, slotted, box-shaped flange.
 3. Face Finish: Painted **[white]** **[in color as selected from manufacturer's full range]** **[to match color indicated by manufacturer's designation]** **[to match color of metal pan]**.
- F. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A 653/A 653M, **G60 (Z180)** coating designation, with prefinished, cold-rolled, **15/16-inch-** (24-mm-) wide aluminum caps on flanges.

1. Structural Classification: **[Intermediate] [Heavy]**-duty system.
 2. Face Design: Flat, flush.
 3. Face Finish: **[Painted white] [Painted to match color indicated by manufacturer's designation] [Painted to match color of acoustical unit] [Natural finish]**.
- G. Wide-Face, Capped, Double-Web, Stainless-Steel Suspension System: Main and cross runners roll formed from and capped with Type 304 or Type 316 stainless-steel sheet, with prefinished, cold-rolled, **15/16-inch-** (24-mm-) wide stainless-steel caps on flanges.
1. Structural Classification: Intermediate-duty system.
 2. Face Design: Flat, flush.
 3. Finish: **[Directional Satin Finish: No. 4] [Dull Satin Finish: No. 6] [Mirrorlike Reflective, Nondirectional Polish: No. 8] <Insert finish>**.
- H. Suspension System for Torsion-Spring-Hinged Metal Pans: Provide runners with factory-cut slots fabricated to accept torsion-spring-hinged attachment.
- 2.8 METAL SUSPENSION SYSTEM FOR ACOUSTICAL SNAP-IN METAL PAN CEILING
<Insert drawing designation>
- A. Manufacturers: Subject to compliance with requirements, provide products by snap-in metal pan ceiling manufacturer.
- B. Indirect-Hung, Snap-**[Tee] [Bar]** System: Designed to support metal pans that snap into main runners, consisting of main runners connected to carrying channels that are attached by hangers to building structure, and complying with the following requirements:
1. Main Runners: Formed from the following metal:
 - a. Aluminum Sheet: Alloy and temper recommended by aluminum producer and finisher for type of use indicated and manufacturer's standard finish, complying with **ASTM B 209** (ASTM B 209M).
 - b. Electrolytic Zinc-Coated Steel Sheet: ASTM A 879/A 879M, with not less than **[08Z (24G)] <Insert coating designation>** zinc coating.
 - c. Hot-Dip Galvanized Steel: ASTM A 653/A 653M, with not less than **[G60 (Z180)] <Insert coating designation>** zinc coating.
 - d. Stainless-Steel Sheet: ASTM A 666, Type 302 or Type 304, stretcher leveled, with cold-rolled mill finish.
 - e. Metal Sheet: Metal as standard with ceiling system manufacturer, with factory-applied protective finish complying with ASTM C 635/C 635M.
 2. Carrying Channels: Same member and metal as indicated for main runners.
 3. Carrying Channels: Cold-rolled steel, not less than **0.060-inch** (1.5-mm) nominal thickness of base (uncoated) metal and **7/16-inch-** (11-mm-) wide flanges, **[protected with rust-inhibitive paint] [hot-dip galvanized according to ASTM A 653/A 653M, G60 (Z180) coating designation]**, and as follows:

- a. Depth and Weight: [1-1/2 inches and 475 lb/1000 feet (38 mm and 215 kg/305 m)] [2 inches and 590 lb/1000 feet (51 mm and 268 kg/305 m)].
4. Exterior Bracing Channels and Angles: Cold-rolled steel, hot-dip galvanized to comply with ASTM A 653/A 653M, G60 (Z180) coating designation; size and profile as required to withstand wind load.
- C. Direct-Hung, Snap-[Tee] [Bar] System: Designed to support metal pans that snap into main runners, consisting of main runners supported by hangers attached directly to building structure, and complying with the following requirements:
 1. Hangers: Angles or channels, as standard with ceiling system manufacturer, formed from same metal as main runners.
 2. Main Runners: Rolled aluminum sheet; alloy and temper recommended by aluminum producer and finisher for type of use indicated and manufacturer's standard finish, complying with ASTM B 209 (ASTM B 209M).
- D. Access Panels: For access at locations indicated, provide acoustical snap-in metal pan ceiling units, accessible by [key or tool] [two access knobs; place one access knob at each end of panel near corners].
 1. Access Key or Tool: Provide manufacturer's standard key or tool for opening access panels; [one] [two] <Insert number>.

2.9 ACOUSTICAL SEALANT

- A. Products: Subject to compliance with requirements, provide one of the following:
 1. Acoustical Sealant for Exposed and Concealed Joints:
 - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
 - b. USG Corporation; SHEETROCK Acoustical Sealant.
 - c. <Insert manufacturer's name; product name or designation>.
 - d. or approved equal.
 2. Acoustical Sealant for Concealed Joints:
 - a. Henkel Corporation; OSI Pro-Series SC-175 Acoustical Sound Sealant.
 - b. Pecora Corporation; AIS-919.
 - c. Tremco, Inc.; Tremco Acoustical Sealant.
 - d. <Insert manufacturer's name; product name or designation>.
 - e. or approved equal.
- B. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.

2. Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant.
3. Acoustical sealant shall have a VOC content of [250] <Insert number> g/L or less.
4. Acoustical sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.10 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

2.11 ALUMINUM FINISHES

- A. Mill Finish: AA-M10C10 (Mechanical Finish: as fabricated, unspecified; Chemical Finish: chemically cleaned).
- B. Lacquered Mill Finish: AA-M10C10R1x (Mechanical Finish: as fabricated, unspecified; Chemical Finish: chemically cleaned; Organic Coating: as specified below).
 1. Organic Coating: Manufacturer's standard clear organic coating.
- C. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
- D. Clear Mirror Anodic Finish: AA-M21C12A212, 0.005 mm or thicker.
- E. Color-Coated Finish: Manufacturer's standard [**powder-coat**] baked paint complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.
- F. Bright-Reflective Finish: Manufacturer's standard chemical/mechanical bright-reflective metallic finish complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, protective coating, and minimum thickness to produce a finish uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unfinished areas, and other visible defects.

2.12 METALLIC-COATED STEEL SHEET FINISHES

- A. Color-Coated Finish: Manufacturer's standard[**powder-coat**] baked paint complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.

2.13 STEEL SHEET FINISHES

- A. Electroplated Finish: Electroplating process complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, and minimum thickness to produce a coating uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unplated areas, and other visible defects.
- B. Bright-Reflective Finish: Manufacturer's standard chemical/mechanical bright-reflective metallic finish complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, protective coating, and minimum thickness to produce a finish uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unfinished areas, and other visible defects.

2.14 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical metal pan ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical metal pan ceilings.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical metal pans to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width pans

at borders, and comply with layout shown on reflected ceiling plans and coordination drawings.

3.3 INSTALLATION

- A. General: Install acoustical metal pan ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that do not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and hanger type involved. Install hangers in a manner that does not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 8. Do not attach hangers to steel deck tabs.
 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 10. Space hangers not more than **48 inches (1200 mm)** o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than **8 inches (200 mm)** from ends of each member.
 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical metal pans.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than **16 inches (400 mm)** o.c. and not more than **3 inches (75 mm)** from ends, leveling with ceiling suspension system to a tolerance of **1/8 inch in 12 feet (3.2 mm in 3.6 m)**. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Cut acoustical metal pan units for accurate fit at borders and at interruptions and penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet.
- G. Install acoustical metal pans in coordination with suspension system and exposed moldings and trim. Comply with installation tolerances according to Cisca's "Metal Ceilings Technical Guidelines."
1. For lay-in, square-edge pans, install pans with edges fully hidden from view by flanges of suspension-system runners and moldings.
 2. For lay-in, reveal-edge pans on suspension-system runners, install pans with bottom of reveal in firm contact with top surface of runner flanges.
 3. For lay-in, reveal-edge pans on suspension-system members with box-shaped flanges, install pans with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
 4. For **[clip-in] [torsion-spring-hinged]** pans, position pans according to manufacturer's written instructions.
 5. For snap-in pans, fit adjoining units to form flush, tight joints.
 6. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
 7. Fit adjoining units to form flush, tight joints.
 8. Install directionally patterned or textured metal pans in directions indicated.
 9. Install sound-absorbent fabric layers in, and bond to, perforated metal pans.
 10. Install sound-absorbent pads in perforated metal pans[**over metal spacer grids**].
- H. Install sound attenuation panels in areas indicated by reflected ceiling plans or room finish schedules. Lay panels directly on ceiling system and close major openings to form complete coverage in required areas. Lay second sound-absorbent pads on sound attenuation panels.
- I. Install hold-down clips where indicated.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: **[Owner will engage] [Engage]** a qualified special inspector to perform the following special inspections:
 - 1. Seismic design compliance.
- B. Testing Agency: **[Owner will engage] [Engage]** a qualified testing agency to perform tests and inspections.
- C. Perform the following tests and inspections of completed installations of acoustical metal panel ceiling hangers, anchors, and fasteners in successive stages. Do not proceed with installations of acoustical metal panel ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.
 - 1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
 - a. Within each test area, testing agency selects one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and tests them for **200 lbf (890 N)** of tension; it also selects one of every two postinstalled anchors used to attach bracing wires to concrete and tests them for **440 lbf (1957 N)** of tension.
 - b. When tested fasteners and anchors do not comply with requirements, testing agency tests those fasteners and anchors not previously tested until 20 pass consecutively and then resumes initial testing frequency.
- D. Acoustical metal panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 CLEANING

- A. Clean exposed surfaces of acoustical metal pan ceilings, including trim and edge moldings, after removing strippable, temporary protective covering, if any. Comply with manufacturer's written instructions for stripping of temporary protective covering, cleaning, and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 095133

SECTION 095423 - LINEAR METAL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes strip linear metal pans and suspension systems for ceilings.
- B. Related Sections:
 - 1. Section 095113 "Acoustical Panel Ceilings" for ceilings consisting of mineral-base and glass-fiber-base acoustical panels and exposed suspension systems.
 - 2. Section 095123 "Acoustical Tile Ceilings" for ceilings consisting of mineral-base acoustical tiles used with concealed suspension systems, stapling, or adhesive bonding.
 - 3. Section 095133 "Acoustical Metal Pan Ceilings" for clip-in, lay-in, snap-in, and torsion-spring-hinged metal pan ceilings with exposed suspension systems.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. LR: Light Reflectance coefficient.
- B. NRC: Noise Reduction Coefficient.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Exterior linear metal ceilings shall withstand exterior exposure and the effects of gravity loads and the following loads and stresses without showing permanent deformation of ceiling system components including pans and suspension system; noise or metal fatigue caused by vibration, deflection, and displacement of ceiling units; or permanent damage to fasteners and anchors.
 - 1. Wind Load: Uniform pressure [~~of 20 lbf/sq. ft. (960 Pa)~~] [~~of 30 lbf/sq. ft. (1436 Pa)~~] **[as indicated on Drawings]** <Insert pressure>, acting inward or outward.

- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): [120 deg F (67 deg C), **ambient**; 180 deg F (100 deg C)] <Insert temperature range>, material surfaces.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include data substantiating that materials comply with requirements.
- B. Performance Data: For installed products indicated to comply with design loads and other criteria, include structural analysis and other analytical data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Samples for Initial Selection: For components with factory-applied color and other decorative finishes.
- D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below:
 - 1. Linear Metal Pan: Set of 12-inch- (300-mm-) long Samples of each type and color and a 12-inch- (300-mm-) long spliced section.
 - 2. Suspension System Members: 12-inch- (300-mm-) long Sample of each type.
 - 3. Exposed Molding and Trim: Set of 12-inch- (300-mm-) long Samples of each type, finish, and color.
 - 4. Filler Strips: Set of 12-inch- (300-mm-) long Samples of each type, finish, and color.
 - 5. Sound Absorber: 12 inches (300 mm) long.
 - 6. End Cap: Full size.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Linear pattern.
 - 2. Joint pattern.
 - 3. Ceiling suspension members.
 - 4. Method of attaching hangers to building structure.
 - a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
 - 5. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.

6. Ceiling perimeter and penetrations through ceiling; trim and moldings.
7. Minimum Drawing Scale: [1/4 inch = 1 foot (1:48)] [1/8 inch = 1 foot (1:96)] [1:50] [1:100] <Insert scale>.

- B. Qualification Data: For [**professional engineer and**] testing agency.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each linear metal ceiling.
- D. Evaluation Reports: For linear metal ceiling and components [**and anchor type**].
- E. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Linear Metal Ceiling Components: Quantity of each pan, carrier, accessory, and exposed molding and trim equal to [2] <Insert number> percent of quantity installed.

1.9 QUALITY ASSURANCE

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory or an NVLAP-accredited laboratory with the experience and capability to conduct the testing indicated. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.
- B. Source Limitations: Obtain each set of linear metal pans and suspension systems from one source with resources to provide products of consistent quality in appearance, physical properties, and performance.
- C. Surface-Burning Characteristics: Complying with ASTM E 1264 for [**Class A**] <Insert class> materials, as determined by testing identical products according to ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

- D. Seismic Standard: Provide linear metal ceilings designed and installed to withstand the effects of earthquake motions according to the following:
1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
 2. Cisca's Recommendations for Acoustical Ceilings: Comply with Cisca's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings - Seismic Zones 0-2."
 3. Cisca's Guidelines for Systems Requiring Seismic Restraint: Comply with Cisca's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies - Seismic Zones 3 & 4."
 4. UBC Standard 25-2, "Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings."
 5. SEI/ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."
 6. **<Insert requirement of authorities having jurisdiction>.**
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver linear metal pans, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Handle linear metal pans, suspension system components, and accessories carefully to avoid damaging units and finishes in any way.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install linear metal ceilings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.12 COORDINATION

- A. Coordinate layout and installation of linear metal pans and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.13 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 LINEAR METAL CEILING PANS

- A. Acoustical Metal Pan Standard: Provide manufacturer's standard linear metal pans of configuration indicated that comply with ASTM E 1264 classifications as designated by types, acoustical ratings, and light reflectances unless otherwise indicated.
1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is **15-3/4 inches** (400 mm) away from test surface per ASTM E 795.
- B. Sheet Metal Characteristics: For metal components exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, roughness, stains, or discolorations.
1. Aluminum Sheet: Roll-formed aluminum sheet, complying with **ASTM B 209** (ASTM B 209M); alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
 2. Steel Sheet: Commercial-quality, cold-rolled, carbon-steel sheet; stretcher leveled; with protective coating complying with ASTM C 635.
 - a. Painted Finishes: Electrolytic zinc-coated steel complying with ASTM A 591/A 591M, **40Z** (12G) coating; surface treatment as recommended by finish manufacturer for type of use and finish indicated.
 - b. Chemical/Mechanical Finishes: Uncoated steel sheet complying with ASTM A 1008/A 1008M with luster or bright finish as required by finisher for applying electroplating or other metallic-finishing processes.
 3. Stainless-Steel Sheet: Complying with ASTM A 240/A 240M, [**Type 304**] [**Type 430**].
- C. Pan Fabrication: Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated to snap on and be securely retained on carriers without separate fasteners, and finished to comply with requirements indicated.
- D. Pan Splices: Construction same as pans, in lengths **8 to 12 inches** (200 to 300 mm); with manufacturer's standard finish.
- E. End Caps: [**Metal matching pans**] [**Plastic**] [**Manufacturer's standard material**]; fabricated to fit and conceal exposed ends of pans.

- F. Filler Strips: **[Metal matching pans] [Plastic] [Manufacturer's standard material]**; fabricated to uninterrupted close voids between pans.
- G. Moldings and Trim: Provide manufacturer's standard moldings and trim for exposed members, and as indicated or required, for edges and penetrations of ceiling, around fixtures, at changes in ceiling height, and for other conditions; of same metal and finish as linear metal ceiling pans.
- H. Sound-Absorbent Fabric Layer: Provide fabric layer, sized to fit concealed surface of pan, and consisting of black, nonwoven, nonflammable, sound-absorbent material with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing per ASTM E 84.
1. Bond fabric layer to pan in the factory with manufacturer's standard nonflammable adhesive.
- I. Sound-Absorbent Pads: Provide width and length to completely fill between carriers, joined at center of panel, with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing per ASTM E 84, and to comply with the following requirements:
1. Plastic Sheet-Wrapped Mineral-Fiber Insulation: Pads consisting of nonrigid, PVC plastic sheet encapsulating unfaced mineral-fiber insulation complying with ASTM C 553, Type I, II, or III, and as follows:
 - a. Mineral-Fiber Type and Thickness: Glass fiber; [1 inch (25 mm)] [1-1/2 inches (38 mm)] [3 inches (76 mm)] **<Insert thickness>**.
 - b. Mineral-Fiber Density: [3/4 lb/cu. ft. (12 kg/cu. m)] [1 lb/cu. ft. (16 kg/cu. m)] [1-1/2 lb/cu. ft. (24 kg/cu. m)] **<Insert density>**.
 - c. Plastic Sheet Thickness and Color: Not less than 0.003 inch (0.076 mm); [clear] [flat black] [white].
 - d. Plastic Sheet Thickness and Color: **<Insert requirements>**.
 2. Unwrapped, Glass-Fiber Insulation: Black-coated, unfaced, glass-fiber insulation complying with ASTM C 553, Type I, II, or III, not less than 1-lb/cu. ft. (16-kg/cu. m) density, treated to be nondusting, and as follows:
 - a. Thickness: [1 inch (25 mm)] [1-1/2 inches (38 mm)] **<Insert thickness>**.

2.2 METAL SUSPENSION SYSTEMS

- A. Metal Suspension Systems Standard: Provide ceiling manufacturer's standard metal suspension systems of types and finishes indicated that comply with applicable ASTM C 635 requirements.
- B. Suspension Systems: Provide systems complete with carriers, splice sections, connector clips, alignment clips, leveling clips, hangers, molding, trim, retention clips, load-resisting struts, fixture adapters, and other suspension components required to support ceiling units and other ceiling-supported construction.

- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.
1. Cast-in-Place and Postinstalled Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to **[five]** **<Insert safety factor>** times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Type: **[Cast-in-place]** **[Postinstalled expansion]** **[Postinstalled bonded]** anchors.
 - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC service condition (mild).
 - c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchors.
 - d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
 2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to **[10]** **<Insert safety factor>** times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.
- D. Wire Hangers, Braces, and Ties: Provide wire complying with the following requirements:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
 3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
 4. Size: Select wire diameter so its stress at 3 times the hanger design load indicated in ASTM C 635, Table 1, Direct Hung will be less than yield stress of wire, but provide not less than **[0.106-inch-** (2.69-mm-)] **[0.135-inch-** (3.5-mm-)] **<Insert dimension>** diameter wire.
- E. **[Hanger Rods]** **[Flat Hangers]**: Mild steel, zinc coated or protected with rust-inhibitive paint.
- F. Angle Hangers: Angles with legs not less than **7/8 inch** (22 mm) wide; formed from **0.04-inch-** (1.0-mm-) thick, galvanized-steel sheet complying with ASTM A 653/A 653M, **G90** (Z275) coating designation; with bolted connections and **5/16-inch-** (8-mm-) diameter bolts.
- G. Carriers: Factory finished **[with matte-black baked finish]** **<Insert finish description>**.

1. Main Carriers: Aluminum, not less than **0.240-inch** (6.0-mm) rolled sheet, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, complying with **ASTM B 209** (ASTM B 209M).
 2. Main Carriers: Steel, not less than **0.0209-inch** (0.53-mm) nominal thickness, cold-rolled sheet, with factory-applied protective coating, complying with ASTM C 635.
 - a. Electrolytic Zinc-Coated Steel: ASTM A 591/A 591M, not less than [**80Z** (24G)] **<Insert coating designation>** zinc coating.
 - b. Hot-Dip Galvanized Steel: ASTM A 653/A 653M, not less than [**G60** (Z180)] **<Insert coating designation>** zinc coating.
 3. Adaptable Carriers: Manufacturer's standard carriers for direct attachment to existing suspended tees.
 4. Flexible Radial Carriers: Manufacturer's standard radial carriers.
 5. Expansion Carriers: Manufacturer's standard carriers allowing for irregularities or other unusual space conditions.
- H. Carrier Splices: Same metal, profile, and finish as indicated for carriers.
- I. Stabilizer Channels, Tees, and Bars: Manufacturer's standard components for stabilizing main carriers at regular intervals and at light fixtures, air-distribution equipment, access doors, and other equipment; spaced as standard with manufacturer for use indicated; and factory finished with matte-black baked finish.
- J. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- K. Exterior Bracing Channels and Angles: Cold-rolled steel, hot-dip galvanized to comply with ASTM A 653/A 653M, **G60** (Z180) coating designation; size and profile as required to withstand wind load.
- L. Hold-Down Clips: Manufacturer's standard hold-down clips spaced as standard with manufacturer.
- M. Edge Moldings and Trim: Provide exposed members as indicated or required to comply with seismic requirements of authorities having jurisdiction, to conceal edges of penetrations through ceiling, to conceal ends of pans and carriers, for fixture trim and adapters, for fasciae at changes in ceiling height, and for other conditions; of metal and finish matching linear metal pans or extruded plastic unless otherwise indicated.
 1. For Circular Penetrations of Ceiling: Fabricate edge moldings to diameter required to fit penetration exactly.
 2. **<Insert requirements>**.
- 2.3 ALUMINUM PANS AND SUSPENSION SYSTEM FOR LINEAR METAL CEILING
<Insert drawing designation>
- A. Aluminum Pans and Suspension System:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. American Decorative Ceilings; **<Insert product name or designation>**.
 - b. Ceilings Plus; **<Insert product name or designation>**.
 - c. Chicago Metallic Corporation; **<Insert product name or designation>**.
 - d. Hunter Douglas Architectural Products, Inc.; **<Insert product name or designation>**.
 - e. Simplex Ceilings, a division of Intalite Inc.; **<Insert product name or designation>**.
 - f. USG Interiors, Inc.; **<Insert product name or designation>**.
 - g. **<Insert manufacturer's name; product name or designation>**.
 - h. or approved equal.

- B. Classification: Units complying with ASTM E 1264 for **[Type XIII, aluminum strips with mineral- or glass-fiber-base backing; Form 1, perforated] [Type XIII, aluminum strips with mineral- or glass-fiber-base backing; Form 2, unperforated] [Type XX, other types described as perforated aluminum strips with sound-absorbent fabric backing] <Insert Type XX description>**.
 1. Pattern: **<Insert pattern designation for perforated pans and any requirements for perforation alignment, hole shape and size, holes per square foot or inch, and percent open area>**.

- C. Pan Thickness: Not less than **[0.018 inch (0.46 mm)] [0.022 inch (0.56 mm)] [0.024 inch (0.6 mm)] [0.025 inch (0.65 mm)] [0.027 inch (0.7 mm)] [0.032 inch (0.8 mm)] [0.040 inch (1.0 mm)] <Insert thickness>**.

- D. Pan Edge Detail: **[Beveled] [Square] [Round] [Manufacturer's standard edge detail]**.

- E. Linear Module Width and Pan Face Width: **[2-inch (51-mm) module width and 1-1/4-inch (32-mm) face width] [4-inch (102-mm) module width and 3-1/4-inch (83-mm) face width] [6-inch (152-mm) module width and 5-1/4-inch (133-mm) face width] [8-inch (203-mm) module width and 7-1/4-inch (184-mm) face width] [100-mm module width and 80-mm face width] [200-mm module width and 180-mm face width] [300-mm module width and 280-mm face width] [As indicated on Drawings] <Insert dimensions>**.

- F. Pan Depth: **[5/8 inch (16 mm) deep] [3/4 inch (19 mm) deep] [Not less than 1 to 1-1/2 inches (25 to 38 mm) deep] [15 mm deep] [As indicated] <Insert depth>**.

- G. Pan Face Finish: **[Mill] [Lacquered mill] [Clear anodized] [Clear mirror-anodized] [Painted white] [Painted to match color indicated by product designation] [Painted to match DEN Project Manager's sample] [Painted in color selected from manufacturer's full range] [High-performance organic coating in color selected from manufacturer's full range] [Bright-reflective finish selected from manufacturer's full range] <Insert finish>**.

- H. End Cap, Finish of Exposed Portions: **[Matte black] [To match pan] [Manufacturer's standard finish]**.

- I. Filler Strip Design: **[Recessed] [Flush] [An integral extension of pan profile] [Expansion, for use with expansion carriers] [Slotted, for air diffusion].**
 - J. Filler Strip, Finish of Exposed Portions: **[Matte black] [To match pan].**
 - K. LR: Not less than **[0.70] [0.75] <Insert LR>.**
 - L. NRC: Not less than **[0.65] [0.75] [0.95] <Insert NRC>.**
 - M. Suspension-System Main-Carrier Material: **[Aluminum] [Electrolytic zinc-coated steel] [Hot-dip galvanized steel] [Manufacturer's standard material and protective finish].**
- 2.4 STEEL PANS AND SUSPENSION SYSTEM FOR LINEAR METAL CEILING **<Insert drawing designation>**
- A. Steel Pans and Suspension System:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Ceilings Plus; **<Insert product name or designation>.**
 - b. Chicago Metallic Corporation; **<Insert product name or designation>.**
 - c. Hunter Douglas Architectural Products, Inc.; **<Insert product name or designation>.**
 - d. USG Interiors, Inc.; **<Insert product name or designation>.**
 - e. **<Insert manufacturer's name; product name or designation>.**
 - f. or approved equal.
 - B. Classification: Units complying with ASTM E 1264 for **[Type XIII, steel strips with mineral- or glass-fiber-base backing; Form 1, perforated] [Type XIII, steel strips with mineral- or glass-fiber-base backing; Form 2, unperforated] [Type XX, other types described as perforated steel strips with sound-absorbent fabric backing] <Insert Type XX description>.**
 - 1. Pattern: **<Insert pattern designation for perforated pans and any requirements for perforation alignment, hole shape and size, holes per square foot or inch, and percent open area>.**
 - C. Pan Thickness: Not less than **[0.015 inch (0.4 mm)] [0.020 inch (0.5 mm)] [0.024 inch (0.6 mm)] [0.030 inch (0.75 mm)] <Insert thickness>.**
 - D. Pan Edge Detail: **[Beveled] [Square] [Round] [Manufacturer's standard edge detail].**
 - E. Linear Module Width and Pan Face Width: **[2-inch (51-mm) module width and 1-1/4-inch (32-mm) face width] [4-inch (102-mm) module width and 3-1/4-inch (83-mm) face width] [6-inch (152-mm) module width and 5-1/4-inch (133-mm) face width] [8-inch (203-mm) module width and 7-1/4-inch (184-mm) face width] [As indicated on Drawings] <Insert dimensions>.**

- F. Pan Depth: **[5/8 inch (16 mm) deep] [3/4 inch (19 mm) deep] [Not less than 1 to 1-1/2 inches (25 to 38 mm) deep] [15 mm deep] [As indicated] <Insert depth>**.
- G. Pan Face Finish: **[Painted white] [Painted to match color indicated by product designation] [Painted to match DEN Project Manager's sample] [Painted in color selected from manufacturer's full range] [Electroplated finish selected from manufacturer's full range] <Insert finish>**.
- H. End Cap, Finish of Exposed Portions: **[Matte black] [To match pan] [Manufacturer's standard finish]**.
- I. Filler Strip Design: **[Recessed] [Flush] [An integral extension of pan profile] [Expansion, for use with expansion carriers] [Slotted, for air diffusion]**.
- J. Filler Strip, Finish of Exposed Portions: **[Matte black] [To match pan]**.
- K. LR: Not less than **[0.70] [0.75] <Insert LR>**.
- L. NRC: Not less than **[0.65] [0.75] [0.95] <Insert NRC>**.
- M. Suspension-System Main-Carrier Material: **[Aluminum] [Electrolytic zinc-coated steel] [Hot-dip galvanized steel] [Manufacturer's standard material and protective finish]**.
- 2.5 STAINLESS-STEEL PANS AND SUSPENSION SYSTEM FOR LINEAR METAL CEILING **<Insert drawing designation>**
- A. Stainless-Steel Pans and Suspension System:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. American Decorative Ceilings; **<Insert product name or designation>**.
 - b. Ceilings Plus; **<Insert product name or designation>**.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
- B. Classification: Units complying with ASTM E 1264 for **[Type XIII, stainless-steel strips with mineral- or glass-fiber-base backing; Form 1, perforated] [Type XIII, stainless-steel strips with mineral- or glass-fiber-base backing; Form 2, unperforated] [Type XX, other types described as perforated stainless-steel strips with sound-absorbent fabric backing] <Insert Type XX description>**.
1. Pattern: **<Insert pattern designation for perforated pans and any requirements for perforation alignment, hole shape and size, holes per square foot, and percent open area>**.
- C. Pan Thickness: Not less than **[0.016 inch (0.396 mm)] [0.019 inch (0.475 mm)] <Insert thickness>**.
- D. Pan Edge Detail: **[Manufacturer's standard edge detail] <Insert edge detail>**.

- E. Linear Module Width and Pan Face Width: **[2-inch (51-mm) module width and 1-1/4-inch (32-mm) face width] [4-inch (102-mm) module width and 3-1/4-inch (83-mm) face width] [6-inch (152-mm) module width and 5-1/4-inch (133-mm) face width] [8-inch (203-mm) module width and 7-1/4-inch (184-mm) face width] [As indicated on Drawings] <Insert dimensions>.**
- F. Pan Depth: **[5/8 inch (16 mm) deep] [As indicated] <Insert depth>.**
- G. Pan Face Finish: **[Brushed, directional polish] [Satin, directional polish] [Mirrorlike reflective, nondirectional polish] <Insert finish>.**
- H. End Cap, Finish of Exposed Portions: **[Matte black] [To match pan] [Manufacturer's standard finish].**
- I. Filler Strip Design: **[Recessed] [Flush] [An integral extension of pan profile] [Expansion, for use with expansion carriers] [Slotted, for air diffusion].**
- J. Filler Strip, Finish of Exposed Portions: **[Matte black] [To match pan].**
- K. NRC: Not less than **[0.65] [0.75] [0.95] <Insert NRC>.**
- L. Suspension-System Main-Carrier Material: **[Aluminum] [Electrolytic zinc-coated steel] [Hot-dip galvanized steel] [Manufacturer's standard material and protective finish].**

2.6 ACCESSORIES

- A. Access Panels: For access at locations indicated, provide door hinge assembly, retainer clip, and retainer bar, assembled with ceiling panels and carrier sections into access doors of required size, permitting upward or downward opening.

2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

- A. Mill Finish: AA-M10C10.

- B. Lacquered Mill Finish: AA-M10C10R1x with manufacturer's standard clear, organic coating.
- C. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
- D. Clear Mirror Anodic Finish: AA-M21C12A212, 0.005 mm or thicker.
- E. Color-Coated Finish: Manufacturer's standard[**powder-coat**] baked paint finish complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.
- F. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with [**AAMA 2604**] [**AAMA 2605**] and containing not less than [**50**] [**70**] percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- G. Bright-Reflective Finish: Manufacturer's standard chemical/mechanical bright-reflective metallic finish complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, protective coating, and minimum thickness to produce a finish uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unfinished areas, and other visible defects.

2.9 GALVANIZED-STEEL SHEET FINISHES

- A. Color-Coated Finish: Manufacturer's standard[**powder-coat**] baked paint finish complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.

2.10 STEEL SHEET FINISHES

- A. Electroplated Finish: Electroplating process complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, and minimum thickness to produce a coating uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unplated areas, and other visible defects.
- B. Bright-Reflective Finish: Manufacturer's standard chemical/mechanical bright-reflective metallic finish complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, protective coating, and minimum thickness to produce a finish uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unfinished areas, and other visible defects.

2.11 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which linear metal ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of linear metal ceilings.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of linear metal pans to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width or -length pans at borders, and comply with layout shown on reflected ceiling plans and Coordination Drawings.

3.3 INSTALLATION

- A. Comply with **[ASTM C 636]** **[UBC Standard 25-2]** and seismic requirement indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate to which hangers are attached and for type of hanger involved.
 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type

- of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 8. Do not attach hangers to steel deck tabs.
 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 10. Space hangers not more than **48 inches** (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than **8 inches** (200 mm) from ends of each member.
 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers but without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of linear metal ceiling area and where necessary to conceal edges and ends of linear metal pans.
1. Screw attach moldings to substrate at intervals not more than **16 inches** (400 mm) o.c. and not more than **3 inches** (75 mm) from ends, leveling with ceiling suspension system to a tolerance of **1/8 inch in 12 feet** (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system carriers so they are aligned and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Cut linear metal pans for accurate fit at borders and at interruptions and penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet.
- G. Install linear metal pans in coordination with suspension system and exposed moldings and trim.
1. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
 2. Fit adjoining units to form flush, tight joints. Scribe and cut units for accurate fit at borders and around construction penetrating ceiling.
 3. Install pans with butt joints using internal pan splices and in the following joint configuration:
 - a. Aligned.
 - b. Aligned, every other pan length.

- c. Staggered a minimum of **12 inches** (300 mm).
 - d. Random.
 - e. As indicated.
- 4. Install directionally textured metal pans in directions indicated.
 - 5. Where metal pan ends are visible, install end caps unless trim is indicated.
 - 6. Install filler strips where indicated.
 - 7. Install sound-absorbent fabric layers in perforated metal pans.
 - 8. Install sound-absorbent pads at right angle to perforated metal pans so pads do not hang unsupported.
- H. Install hold-down clips where indicated.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: **[Owner will engage]** a qualified special inspector to perform the following special inspections:
- 1. Suspended ceiling system.
 - 2. Hangers, anchors, and fasteners.
 - 3. **<Insert special inspections>**.
- B. Testing Agency: **[Owner will engage]** a qualified testing agency to perform tests and inspections.
- C. Tests and Inspections: Testing and inspecting of completed installations of acoustical panel ceiling hangers and anchors and fasteners shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.
- 1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
 - a. Within each test area, testing agency will select 1 of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for **200 lbf** (890 N) of tension; it will also select one of every 2 postinstalled anchors used to attach bracing wires to concrete and will test them for **440 lbf** (1957 N) of tension.
 - b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- D. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 CLEANING

- A. Clean exposed surfaces of linear metal ceilings, including trim and edge moldings after removing strippable, temporary protective covering if any. Comply with manufacturer's written instructions for stripping of temporary protective covering, cleaning, and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 095423

SECTION 095436 - SUSPENDED DECORATIVE GRIDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes rigid, open-frame, suspended grids, and suspension systems for ceilings.
- B. Related Requirements:
 - 1. Section 095113 "Acoustical Panel Ceilings" for ceilings consisting of mineral-base and glass-fiber-base acoustical panels and exposed suspension systems.
 - 2. Section 095123 "Acoustical Tile Ceilings" for ceilings consisting of mineral-base acoustical tiles used with concealed suspension systems, stapling, or adhesive bonding.
 - 3. Section 095133 "Acoustical Metal Pan Ceilings."
 - 4. Section 095423 "Linear Metal Ceilings."
- C. Products furnished, but not installed, under this Section include anchors, clips, and other ceiling attachment devices to be cast in concrete.
- D. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
- C. Samples: For each exposed product and for each color and texture specified, **6 inches (150 mm)** in size.
- D. Samples for Initial Selection: For units with factory-applied finishes.
- E. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
 1. Cell Grids: Set of **[full-size] [12-inch- (300-mm-) square] <Insert size>** module Samples of each type, finish, and color.
 2. Beam Grids: Set of **12-inch- (300-mm-)** long Samples of each type, finish, and color; a **12-inch- (300-mm-)** long spliced section; and a **6-inch- (150-mm-)** long per leg corner section.
- F. Delegated-Design Submittal: For design of **[seismic restraints and]**attachment devices.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Lighting fixtures.
 2. Air outlets and inlets.
 3. Speakers.
 4. Sprinklers.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Suspended Decorative Grids: Quantity of each suspended decorative grid component, exposed molding, and trim equal to [2] <Insert number> percent of quantity installed.

1.8 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Build mockup of typical ceiling area as shown on Drawings.
 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver suspended decorative grid components to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they are protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Handle suspended decorative grids and accessories carefully to avoid damaging units and finishes in any way.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design [seismic restraints and]attachment devices.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 450 or less.

2.2 SUSPENDED DECORATIVE GRIDS, GENERAL

- A. Recycled Content of Suspended Decorative Grid Ceiling: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25] <Insert number>** percent.
- B. Sheet Metal Characteristics: Provide sheet metal selected for surface flatness, smoothness, and freedom from surface blemishes where exposed to view in finished unit. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, variations in flatness exceeding those permitted by referenced standards for stretcher-leveled metal sheet, stains, discolorations, or other imperfections.
1. Aluminum Sheet: Roll-formed aluminum sheet, complying with [ASTM B 209 \(ASTM B 209M\)](#); alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
 2. Steel Sheet: Commercial-quality, cold-rolled, carbon-steel sheet; stretcher leveled; with protective coating complying with ASTM C 635/C 635M.
 - a. Painted Finishes: Electrolytic zinc-coated steel complying with ASTM A 879/A 879M, [13Z \(40G\)](#) coating, surface treatment as recommended by finish manufacturer for type of use and finish indicated.
 - b. Chemical/Mechanical Finishes: Uncoated steel sheet complying with ASTM A 1008/A 1008M with luster or bright finish as required by finisher for applying electroplating or other metallic-finishing processes.
- C. Grid Fabrication: Components are formed from metal indicated. Manufacturer's standard units of size, shape, and profile indicated; finished to comply with requirements indicated. **[Provide cells factory assembled into modular panel.]**
- D. Cover Profiles and Trim: Provide manufacturer's standard cover profiles and trim for exposed members, and as indicated or required, for edges of grids, at changes in ceiling height, and for other conditions, of same metal and finish as suspended decorative grids.
- E. Metal Suspension-System Standard: Provide ceiling manufacturer's standard metal suspension systems of types and finishes indicated that comply with applicable ASTM C 635/C 635M requirements. Provide systems complete with runners or beams, splice sections, connector clips, alignment clips, leveling clips, hangers, molding, trim, web covers, load-resisting struts, fixture filler pans, clips and adapters, and other suspension components required to support ceiling units and other ceiling-supported construction.
- F. Attachment Devices: Size for 5 times the design load indicated in ASTM C 635/C 635M, Table 1, Direct Hung, unless otherwise indicated.
1. Cast-in-Place and Postinstalled Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to **[5] <Insert number>** times that imposed by ceiling construction, as determined by testing

according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

- a. Type: **[Cast-in-place] [Postinstalled expansion] [Postinstalled bonded]** anchors.
 - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC service condition (mild).
2. Power-Actuated Fasteners in Concrete (If Approved by DEN Project Manager): Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to **[10] <Insert number>** times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing agency.
- G. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 2. Size: Select wire diameter so its stress at 3 times hanger design load indicated in ASTM C 635/C 635M, Table 1, Direct Hung, is less than yield stress of wire, but provide not less than **[0.106-inch- (2.69-mm-)] [0.135-inch- (3.5-mm-)]** diameter wire.
- H. **[Hanger Rods] [Flat Hangers]**: Mild steel, zinc coated or protected with rust-inhibitive paint.
- I. Angle Hangers: Angles with legs not less than **7/8 inch (22 mm)** wide; formed with **0.04-inch- (1.0-mm-)** thick, galvanized-steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation; with bolted connections and **5/16-inch- (8-mm-)** diameter bolts.
- J. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- K. Exposed Metal Edge Moldings, Covers, Trim, and Fixture Filler Panels: Provide exposed members as indicated or required to conceal edges of and penetrations through ceiling, to conceal edges of beams, to cover runner webs, for fixture trim and adapters, for fasciae at changes in ceiling height, and for other conditions; of metal and finish matching suspended decorative grids unless otherwise indicated.
1. For Circular Penetrations of Ceiling: Fabricate edge moldings to diameter required to fit penetration exactly.

- 2.3 ALUMINUM GRID UNITS FOR SUSPENDED DECORATIVE GRIDS <Insert drawing designation>
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [American Decorative Ceilings.](#)
 2. [Ceilings Plus.](#)
 3. [Chicago Metallic Corporation.](#)
 4. [Gordon, Inc..](#)
 5. [Hunter Douglas Architectural Products, Inc..](#)
 6. [Simplex Ceilings, a division of Intalite Inc..](#)
 7. [Steel Ceilings Inc..](#)
 8. <Insert manufacturer's name>.
 9. or approved equal.
- B. Sheet Metal Thickness: Not less than [0.016 inch (0.41 mm)] [0.018 inch (0.46 mm)] [0.020 inch (0.5 mm)] [0.024 inch (0.6 mm)] [0.032 inch (0.8 mm)] <Insert dimension>.
- C. Beam Grid Module: [8 inches (200 mm) square] [12 inches (300 mm) square] [18 inches (460 mm) square] [24 inches (600 mm) square] [30 inches (760 mm) square] [36 inches (900 mm) square] [48 inches (1200 mm) square] [24 by 48 inches (600 by 1200 mm)] [As indicated on Drawings] <Insert dimensions>.
- D. Beam Width by Height: [2 by 2 inches (50 by 50 mm)] [2 by 4 inches (50 by 100 mm)] [3 by 3 inches (75 by 75 mm)] [4 by 4 inches (100 by 100 mm)] [As indicated on Drawings] <Insert dimensions>.
- E. Cell Panel Module: [24 inches (600 mm) square] [24 by 48 inches (600 by 1200 mm)] [As indicated on Drawings] [Manufacturer's standard].
- F. Cell Module: [2 inches (50 mm) square] [3 inches (75 mm) square] [4 inches (100 mm) square] [6 inches (150 mm) square] [8 inches (200 mm) square] [12 inches (300 mm) square] [As indicated on Drawings] <Insert dimension>.
- G. Cell Profile, Width by Height: [3/8 by 2 inches (9.5 by 50 mm)] [3/8 by 4 inches (9.5 by 100 mm)] [9/16 by 2 inches (14 by 50 mm)] [As indicated on Drawings] <Insert dimensions>.
- H. Finish: [Lacquered mill] [Clear anodized] [Clear mirror anodized] [Painted to match color indicated by product designation] [Painted to match DEN Project Manager's sample] [Painted in color selected from manufacturer's full range] [Bright-reflective metallic finish selected from manufacturer's full range] <Insert finish>.

- 2.4 STEEL GRID UNITS FOR SUSPENDED DECORATIVE GRIDS <Insert drawing designation>
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [American Decorative Ceilings.](#)
 2. [Chicago Metallic Corporation.](#)
 3. [Hunter Douglas Architectural Products, Inc..](#)
 4. [Simplex Ceilings, a division of Intalite Inc..](#)
 5. [USG Interiors, Inc..](#)
 6. <Insert manufacturer's name>.
 7. or approved equal.
- B. Sheet Metal Thickness: Not less than [0.020 inch (0.5 mm)] [0.024 inch (0.6 mm)] <Insert dimension>.
- C. Beam Grid Module: [8 inches (200 mm) square] [12 inches (300 mm) square] [18 inches (460 mm) square] [24 inches (600 mm) square] [30 inches (760 mm) square] [36 inches (900 mm) square] [48 inches (1200 mm) square] [24 by 48 inches (600 by 1200 mm)] [As indicated on Drawings] <Insert dimensions>.
- D. Beam Width by Height: [2 by 2 inches (50 by 50 mm)] [2 by 4 inches (50 by 100 mm)] [3 by 3 inches (75 by 75 mm)] [4 by 4 inches (100 by 100 mm)] [As indicated on Drawings] <Insert dimensions>.
- E. Cell Panel Module: [24 inches (600 mm) square] [24 by 48 inches (600 by 1200 mm)] [As indicated on Drawings] [Manufacturer's standard].
- F. Cell Module: [1 inch (25 mm) square] [2 inches (50 mm) square] [3 inches (75 mm) square] [4 inches (100 mm) square] [6 inches (150 mm) square] [8 inches (200 mm) square] [12 inches (300 mm) square] [24 inches (600 mm) square] [As indicated on Drawings] <Insert dimension>.
- G. Cell Profile, Width by Height: [3/8 by 2 inches (9.5 by 50 mm)] [9/16 by 2 inches (14 by 50 mm)] [As indicated on Drawings] <Insert dimensions>.
- H. Finish: [Painted to match color indicated by product designation] [Painted to match DEN Project Manager's sample] [Painted in color selected from manufacturer's full range] [Plated with metallic finish, as selected from manufacturer's full range] [Bright-reflective metallic finish selected from manufacturer's full range] <Insert finish>.
- 2.5 GENERAL FINISH REQUIREMENTS
- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
- B. Clear Mirror Anodic Finish: AA-M21C12A212, Class II, 0.005 mm or thicker.
- C. Color-Coated Finish: Manufacturer's standard[**powder-coat**] baked paint complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.
- D. Bright-Reflective Finish: Manufacturer's standard chemical/mechanical bright-reflective metallic finish complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, protective coating, and minimum thickness to produce a finish uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unfinished areas, and other visible defects.

2.7 METALLIC-COATED STEEL SHEET FINISHES

- A. Color-Coated Finish: Manufacturer's standard[**powder-coat**] baked paint complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.

2.8 STEEL SHEET FINISHES

- A. Electroplated Finish: Electroplating process complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, and minimum thickness to produce a coating uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unplated areas, and other visible defects.
- B. Bright-Reflective Finish: Manufacturer's standard chemical/mechanical bright-reflective metallic finish complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, protective coating, and minimum thickness to produce a finish uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unfinished areas, and other visible defects.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which suspended decorative grids attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling

installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of suspended decorative grids.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of suspended decorative grids to balance border widths at opposite edges of each space. Comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install suspended decorative grids to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and Cisca's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for structure to which hangers are attached and for hanger type involved.
 - 5. Do not support grids directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - 6. Do not attach hangers to steel deck tabs.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of each suspended decorative grid and where necessary to conceal edges of grids.
 - 1. Screw attach moldings to substrate at intervals not more than **16 inches (400 mm)** o.c. and not more than **3 inches (75 mm)** from ends, level with ceiling system to a tolerance of **1/8 inch in 12 feet (3 mm in 3.6 m)**. Miter corners accurately and connect securely.

2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspended decorative grids in coordination with suspension system and exposed moldings and trim. Comply with installation tolerances according to CISCA's "Metal Ceilings Technical Guidelines."
1. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
 2. Fit adjoining units to form flush, tight joints.
 3. Where grid edges are visible, install cover profiles unless other trim is indicated.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: **[Owner will engage] [Engage]** a qualified special inspector to perform the following special inspections:
1. Seismic design compliance.
- B. Testing Agency: **[Owner will engage] [Engage]** a qualified testing agency to perform tests and inspections.
- C. Perform the following tests and inspections of completed installations of grid hangers, anchors, and fasteners in successive stages. Do not proceed with installations of grid hangers for the next area until test results for previously completed installations show compliance with requirements.
1. Extent of Each Test Area: When installation of grid systems on each floor has reached 20 percent completion but no panels have been installed.
 - a. Within each test area, testing agency selects one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and tests them for **200 lbf (890 N)** of tension; it also selects one of every two postinstalled anchors used to attach bracing wires to concrete and tests them for **440 lbf (1957 N)** of tension.
 - b. When tested fasteners and anchors do not comply with requirements, testing agency tests those fasteners and anchors not previously tested until 20 pass consecutively and then resumes initial testing frequency.
- D. Suspended decorative grid hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.
- E. Prepare tests and inspection reports.

3.5 CLEANING

- A. Clean exposed surfaces of suspended decorative grids, including trim and edge moldings, after removing strippable, temporary protective covering if any. Comply with manufacturer's written instructions for stripping of temporary protective covering, cleaning, and touchup of minor finish damage. Remove and replace grid components

that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and deformed grids.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 095436

SECTION 095753 - SECURITY CEILING ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Downward-locking-panel security ceiling assemblies.
 - 2. Security-plank security ceiling assemblies.
- B. Related Requirements:
 - 1. Section 013513.16 "Special Project Procedures for Detention Facilities" for additional requirements for detention facilities.
 - 2. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for field painting security-plank security ceiling assemblies.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 COORDINATION

- A. Coordinate layout and installation of security ceiling assemblies with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data substantiating that materials comply with requirements.

- B. LEED Submittals:
1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 2. Product Data for Credit IEQ 4.1: For sealants, documentation including printed statement of VOC content.
- C. Samples for Verification: For the following products, of size indicated below:
1. Security Ceiling Panel Units: Full cross section by **12 inches** (305 mm) long for each type of panel.
 2. Perimeter Supports, Closures, and Exposed Molding: **12 inches** (305 mm) long for each type.
 3. Suspension System: **12 inches** (305 mm) long.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans drawn, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Layout of panels, joint pattern, transitions.
 2. Suspension system members.
 3. Method of attaching hangers to building structure.
 4. Size and location of access panels.
 5. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- B. Qualification Data: For Installer.
- C. Welding certificates.
- D. Product Test Reports: For each security ceiling assembly, for tests performed by a qualified testing agency.
- E. Attachment Device Test Reports: Indicating capability to sustain, without failure, load indicated without pulling out from substrate.
- F. Evaluation Reports: For security ceiling assembly, from **<Insert applicable model code organization>**.
- G. Field quality-control reports.
- H. Examination reports documenting inspection of substrates, areas, and conditions.
- I. Anchor inspection reports documenting inspections of built-in and cast-in anchors.
- J. Field quality-control certification signed by Contractor[**and Detention Specialist**].

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Security Ceiling Panels: Full-size units equal to **[2.0] <Insert number>** percent of amount installed.
 2. Suspension System Components: Quantity of each grid and exposed component equal to **[2.0] <Insert number>** percent of amount installed.
 3. Security Fasteners: Furnish not less than 1 box for each 50 boxes or fraction thereof, of each type and size of security fastener installed.
 4. Tools: Provide **[two] <Insert number>** sets of tools for installing and removing security fasteners, packaged for easy handling and storage.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 3. AWS D1.3, "Structural Welding Code - Sheet Steel."
 4. AWS D1.6, "Structural Welding Code - Stainless Steel."
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate security performance and aesthetic effects and set quality standards for materials and execution.
1. Build mockup **[48 by 48 inches (1220 by 1220 mm) square] [of size equal to one cell] <Insert size>** of each type of security ceiling assembly. Include ceiling panels, suspension system, perimeter support, **[lighting unit,] [duct penetration,] [access panel,]** and accessories.
 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical metal panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Handle acoustical metal panels, suspension system components, and accessories carefully to avoid damaging units and finishes in any way.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Security ceiling assemblies shall withstand normal thermal movement and structural loads without failure, including permanent deformation of security ceiling assembly components including pans and suspension system; noise or metal fatigue caused by vibration, deflection, and displacement of security ceiling units; and permanent damage to fasteners and anchors.
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25] <Insert number>** percent.
- C. Acoustical Performance: Provide security ceiling assemblies with acoustical ratings indicated, as determined according to ASTM E 1264 and the following:
1. Noise Reduction Coefficient: ASTM C 423 and ASTM E 795 in Type E-400 mounting.
 2. Ceiling Attenuation Class: ASTM E 1414.
- D. Structural Performance: Security ceiling assemblies shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Vertical Load for Security Ceiling Assemblies: **<Insert load>**, acting upward or downward.
 2. Live Load for Security Ceiling Assemblies: Panel dead weight plus a uniform load of **<Insert load>**, acting upward or downward, with a deflection not more than L/360.
- E. Seismic Standard: Provide ceilings designed and installed to withstand the effects of earthquake motions according to **[ASCE/SEI 7] <Insert requirement of authorities having jurisdiction>**.

2.2 DOWNWARD-LOCKING-PANEL SECURITY CEILING ASSEMBLY

- A. Provide a complete, integrated assembly, including security ceiling panels, exposed suspension system, perimeter supports, and accessories.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Chicago Metallic Corporation; MetaLine Security Metal Ceiling System.

- b. Gordon, Inc., Gordon Corrections Division; Lockdown Suspended Metal Panel Ceiling System.
 - c. Steel Ceilings Inc.; Defender Security Panels.
 - d. <Insert manufacturer's name; product name or designation>.
 - e. or approved equal.
- B. Panels: Fabricated from a single sheet of metal, with formed upturned edges on all four sides designed to continuously engage with and lock under rectangular bulb of suspension system.
 1. Steel Panels: [**Cold-rolled**] [**Electrolytic zinc-coated**] [**Metallic-coated**] steel with minimum uncoated sheet thickness of [0.043 inch (1.09 mm)] [0.033 inch (0.84 mm)] [0.021 inch (0.53 mm)].
 2. Aluminum Panels: Nominal sheet thickness of 0.040 inch (1.0 mm).
 3. Stainless-Steel Panels: Nominal sheet thickness of [0.050 inch (1.27 mm)] [0.025 inch (0.65 mm)].
 4. Panel Size: [12 by 24 inches (305 by 610 mm)] [12 by 48 inches (305 by 1220 mm)] [24 by 24 inches (610 by 610 mm)] [24 by 48 inches (610 by 1220 mm)].
 5. Perforation Pattern: [**Manufacturer's standard**] [**Unperforated**] <Insert pattern>.
 6. Noise Reduction Coefficient (NRC): [0.70] [0.80] [0.85] [0.90] [0.95] [1.00].
- C. Sound-Absorptive Pads: Provide sound-absorptive pads for placement over ceiling panels.
 1. Spacer Grids: [**Metallic-coated-steel**] [**Aluminum**] grid units that provide an air cushion between security ceiling panels and sound-absorptive pads and that act to improve sound absorption.
 2. Support Clips: Metal clips designed to hold sound-absorptive pads above bottom face sheet.
- D. Backer Plates: Unperforated units formed from [**metallic-coated steel**] [**aluminum**] sheet that reduces travel of sound through panel and that makes panel assembly comply with the following performance:
 1. Ceiling Attenuation Class (CAC): [40] [45] <Insert CAC rating>.
 2. Sound-Absorptive Pads: Provide secondary sound-absorptive pads, same as specified for primary pads, for placement over backer plates to reduce plenum sound.
- E. Access Panels: Material, perforation pattern, and finish same as security ceiling panels; designed for installation by [**continuously welding access panel frame to security ceiling panel**] [**security fasteners screwed through suspension system**]. Provide panels at [**locations indicated on Drawings**] <Insert location>.
 1. Size: [24 by 24 inches (610 by 610 mm)] [24 by 48 inches (610 by 1220 mm)] [**As indicated on Drawings**].
 2. Lock Preparation: Prepare door panel to accept cylinder specified in [**Section 087100 "Door Hardware"**] [**Section 087111 "Door Hardware (Descriptive Specification)"**] [**Section 087163 "Detention Door Hardware."**]

- F. Suspension System: ASTM C 635/C 635M, heavy-duty exposed system consisting of snap-in main runners supported by hangers attached to building structure.
1. Provide system complete with main runners, splice plates, connector and alignment clips, hangers, trim, seismic- and wind-load clips and struts, and other suspension components required to support security ceiling units and other security ceiling-supported construction.
 2. Main Runners and Cross Tees: Formed from metal sheet, **1-1/2 inches** (38 mm) high, with **15/16-inch** (23.8-mm) flange width and with oversized rectangular bulb for engaging panels.
 - a. Material: **[Galvanized steel, G90 (Z275) zinc coating] [Electrolytic zinc-coated steel, 40Z (12G) zinc coating] [Aluminum] [Stainless steel]**.
 3. Wire Hangers, Braces, and Ties: Zinc-coated, carbon-steel wire, ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - a. Size: Select wire diameter so its stress at **[3] <Insert safety factor>** times the hanger design load (ASTM C 635/C 635M, Table 1, Direct Hung) will be less than yield stress of wire, but provide not less than **0.106-inch-** (2.69-mm-) diameter wire.
 4. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
 5. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
 6. Angle Hangers: Angles with legs not less than **7/8 inch** (22 mm) wide, formed with **0.04-inch-** (1.0-mm-) thick, galvanized-steel sheet, **G90 (Z275)** zinc coating, with bolted connections and **5/16-inch-** (8-mm-) diameter bolts.
 7. Compression Struts: Fabricated from **3/4-inch-** (19-mm-) diameter steel tubing, designed to fit over rectangular bulb of suspension system.
 8. Security Clips: Steel wire, designed to slip over suspension system and through holes in flanges of panel to prevent panel removal.
- G. Perimeter Supports: Wall-mounted channel moldings and wall angles; fabricated from **[0.042-inch-** (1.06-mm-) **thick galvanized steel] [0.016-inch-** (0.4-mm-) **thick galvanized steel] [0.040-inch-** (1.0-mm-) **thick aluminum]**; finished to match suspension system.
- H. Exposed Edge Moldings and Trim: Provide exposed members as indicated or required for edges of security ceiling, fixture trim, beams, fasciae at changes in security ceiling height, and other conditions; of metal and finish matching security ceiling panels.
- I. Materials:
1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS (Commercial Steel), Type B; **[uncoated] [or] [electrolytic zinc coated]** suitable for exposed applications.
 2. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, CS (Commercial Steel), Type B; with **G60 (Z180)** zinc (galvanized) or **A60 (ZF180)** zinc-iron-alloy (galvannealed) coating designation.
 3. Steel Tubing: ASTM A 513, Type B.

4. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666 or ASTM A 240/A 240M, austenitic stainless steel, Type 304.
5. Aluminum Extrusions: [ASTM B 221](#) (ASTM B 221M). Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than **22,000-psi** (150-MPa) ultimate tensile strength.
6. Aluminum Sheet and Plate: [ASTM B 209](#) (ASTM B 209M).

2.3 SECURITY-PLANK SECURITY CEILING ASSEMBLY

- A. Single-Configuration Panels: Fabricated from a single sheet of metal, with a self-locking male/female lap joint for joining panels.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Chicago Metallic Corporation; SecurLine Security Plank Ceiling System.
 - b. DDS Group, Detention Products Division; 7900 Security Ceiling System.
 - c. Eckel Industries Inc.; Eckoustic Security Ceiling.
 - d. Gordon, Inc., Gordon Corrections Division; Celline Suspended Metal Security Plank Ceiling System.
 - e. Steel Ceilings Inc.; Metal Plank Security Ceiling System.
 - f. Trussbilt; BarrierDek.
 - g. **<Insert manufacturer's name; product name or designation>**.
 - h. or approved equal.
 2. Steel Panels: [**Cold-rolled**] [**Electrolytic zinc-coated**] [**Metallic-coated**] steel with minimum uncoated sheet thickness of [**0.097 inch** (2.45 mm)] [**0.068 inch** (1.72 mm)] [**0.053 inch** (1.34 mm)] [**0.043 inch** (1.09 mm)] [**0.033 inch** (0.84 mm)].
 3. Aluminum Panels: Nominal sheet thickness of [**0.125 inch** (3.2 mm)] [**0.100 inch** (2.5 mm)] [**0.080 inch** (2.0 mm)] [**0.063 inch** (1.6 mm)] [**0.050 inch** (1.2 mm)] [**0.040 inch** (1.0 mm)].
 4. Stainless-Steel Panels: Nominal sheet thickness of [**0.109 inch** (2.78 mm)] [**0.078 inch** (1.98 mm)] [**0.062 inch** (1.59 mm)] [**0.050 inch** (1.27 mm)].
 5. Panel Width: [**12 inches** (305 mm)] [**18 inches** (457 mm)] [**24 inches** (610 mm)].
 6. Panel Length: [**Minimum 8 feet** (2.4 m)] [**Minimum 10 feet** (3.0 m)] [**Minimum 12 feet** (3.7 m)] [**Custom lengths to fit areas indicated**].
 7. Perforation Pattern: [**Manufacturer's standard**] [**Unperforated**] **<Insert pattern>**.
 8. Noise Reduction Coefficient: [**0.70**] [**0.80**] [**0.85**] [**0.90**] [**0.95**] [**1.00**].
- B. Double-Configuration Panels: Factory-assembled units with cold-rolled steel top face sheet and metallic-coated steel bottom face sheet, welded to a truss core. Fabricate panels with a self-locking male/female lap joint for joining panels.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Habersham Metal Products Co.; Detention Security Ceiling Panels.
 - b. Trussbilt; TrussDek.
 - c. **<Insert manufacturer's name; product name or designation>**.

- d. or approved equal.
2. Panel Width: [12 inches (305 mm)] [18 inches (457 mm)] [24 inches (610 mm)] wide by length indicated.
 3. Panel Length: **[Custom lengths to fit areas indicated]** <Insert length>.
 4. Overall Panel Thickness: As **[required by indicated spans]** **[indicated on Drawings]**.
 5. Minimum Uncoated Top Face Sheet Thickness: [0.068 inch (1.72 mm)] [0.053 inch (1.34 mm)] [0.043 inch (1.09 mm)] [0.033 inch (0.84 mm)].
 6. Minimum Uncoated Bottom Face Sheet Thickness: [0.068 inch (1.72 mm)] [0.053 inch (1.34 mm)] [0.043 inch (1.09 mm)] [0.033 inch (0.84 mm)].
 7. Truss Core: Fabricated from 0.015-inch- (0.38-mm-) thick, cold-rolled steel sheet bent into corrugated shape; welded to top and bottom face sheets at even spacings across and along length of panel.
 8. Perforation Pattern for Bottom Face Sheet: **[Manufacturer's standard]** **[Unperforated]** <Insert pattern>.
 9. Noise Reduction Coefficient: **[0.65]** **[0.90]** **[1.00]**.
- C. Sound-Absorptive Pads: Provide sound-absorptive pads for placement over ceiling planks.
1. Spacer Grids: **[Metallic-coated-steel]** **[Aluminum]** grid units that provide an air cushion between security ceiling panels and sound-absorptive pads and that act to improve sound absorption.
 2. Support Clips: Metal clips designed to hold sound-absorptive pads above bottom face sheet.
- D. Backer Plates: Unperforated units formed from **[metallic-coated steel]** **[aluminum]** sheet that reduces travel of sound through panel and that makes panel assembly comply with the following performance:
1. Ceiling Attenuation Class: **[40]** **[45]** <Insert CAC rating>.
 2. Sound-Absorptive Pads: Provide secondary sound-absorptive pads, same as specified for primary pads, for placement over backer plates to reduce plenum sound.
- E. Access Panels: Material, perforation pattern, and finish same as security ceiling panels; designed for installation by **[continuously welding access panel frame to security ceiling panel]** **[security fasteners screwed through suspension system]**. Provide at **[locations indicated on Drawings]** <Insert location>.
1. Size: [24 by 24 inches (610 by 610 mm)] [24 by 48 inches (610 by 1220 mm)] **[As indicated]**.
 2. Lock Preparation: Prepare door panel to accept cylinder specified in **[Section 087100 "Door Hardware"]** **[Section 087111 "Door Hardware (Descriptive Specification)"]** **[Section 087163 "Detention Door Hardware."]**
- F. Closures: Fabricated from minimum 0.053-inch- (1.34-mm-) thick steel sheet, finished to match security ceiling panels. Fasten with security fasteners or by welding.

- G. Suspension System: Heavy-duty exposed system consisting of intermediate carriers supported by secondary support system attached to building structure.
1. Intermediate Carriers: Formed from tees with a nominal **4-inch-** (102-mm-) wide exposed face or built up from back-to-back angles or channels each with a nominal **2-inch-** (51-mm-) wide exposed face; fabricated from [**0.068-inch-** (1.72-mm-)] [**0.053-inch-** (1.34-mm-)] thick, cold-rolled steel sheet.
 - a. Finish: Match security ceiling panels.
 2. Secondary Support System:
 - a. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
 - b. Angle Hangers: **1-1/2-by-1-1/2-inch** (38-by-38-mm) galvanized-steel angles, **G90 (Z275)** zinc coating, bolted to intermediate carriers, and building structure.
- H. Perimeter Supports: Wall-mounted angles, tees, and bearing plates; fabricated from minimum **0.068-inch-** (1.72-mm-) thick, cold-rolled steel sheet; finished to match security ceiling panels.
- I. Exposed Edge Moldings and Trim: Provide exposed members as indicated or required for edges of security ceiling, fixture trim, beams, fasciae at changes in security ceiling height, and other conditions, of metal and finish matching security ceiling panels.
- J. Materials:
1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS (Commercial Steel), Type B; [**uncoated**] [**or**] [**electrolytic zinc coated**] suitable for exposed applications.
 2. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, CS (Commercial Steel), Type B; with **G60 (Z180)** zinc (galvanized) or **A60 (ZF180)** zinc-iron-alloy (galvannealed) coating designation.
 3. Steel Tubing: ASTM A 513, Type B.
 4. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666 or ASTM A 240/A 240M, austenitic stainless steel, Type 304.
 5. Aluminum Extrusions: **ASTM B 221** (ASTM B 221M). Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than **22,000-psi** (150-MPa) ultimate tensile strength.
 6. Aluminum Sheet and Plate: **ASTM B 209** (ASTM B 209M).

2.4 SOUND-ABSORPTIVE PADS

- A. Plastic-Sheet-Wrapped, Mineral-Fiber Insulation: Pads consisting of nonrigid, vinyl chloride plastic sheet encapsulating unfaced mineral-fiber insulation.
1. Plastic Sheet: Not less than **0.003 inch** (0.076 mm) thick; flat black.
 2. Mineral Fiber: Glass fiber or fiber made from slag (mineral wool), complying with ASTM C 553, Type I, II, or III.

- a. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent by weight.
 - b. Thickness: [1 inch (25 mm)] [1-1/2 inches (38 mm)] [2 inches (51 mm)] [4 inches (102 mm)] [**As required to meet NRC rating**].
3. Mineral-Fiber Density: [1.0 lb/cu. ft. (16 kg/cu. m)] [1.5 lb/cu. ft. (24 kg/cu. m)] [**As required to meet NRC rating**].
 4. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: [25] **<Insert value>** or less.
 - b. Smoke-Developed Index: [50] [450] **<Insert value>** or less.

2.5 FABRICATION

- A. Panels: Form metal panels from sheet metals selected for their surface flatness, smoothness, and freedom from surface blemishes where exposed to view in finished unit. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, or variations in flatness exceeding those permitted by referenced standards for stretcher-leveled metal sheet.
 1. Security Planks: Factory fabricate double-configuration security planks and join top and bottom face sheets by welding.

2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 1. Color and Gloss: [Manufacturer's standard white] **<Insert color and gloss>**.

2.8 STEEL FINISHES

- A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with **[SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning"]** [or] **[SSPC-SP 8, "Pickling"]** <Insert surface preparation method>.[**After cleaning, apply a conversion coating suited to the organic coating to be applied over it.**]
- B. Factory Prime Finish: After surface preparation and pretreatment, apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer.
- C. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of **2 mils** (0.05 mm).
 - 1. Color and Gloss: **[Manufacturer's standard white]** <Insert color and gloss>.

2.9 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 3. Directional Satin Finish: No. 4.
- C. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

2.10 SECURITY FASTENERS

- A. Operable only by tools produced by fastener manufacturer or other licensed fabricator for use on specific type of fastener. Drive-system type, head style, material, and protective coating as required for assembly, installation, and strength, and as follows:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acument Global Technologies North America.
 - b. Bryce Fastener.
 - c. Safety Socket LLC.
 - d. Tamperproof Screw Co., Inc.
 - e. Tamper-Pruf Screwsk.
 - f. <Insert manufacturer's name>.
 - g. or approved equal.
 - 2. Drive-System Type: **[Pinned Torx-Plus]** **[Pinned Torx]** <Insert system>.

3. Fastener Strength: **120,000 psi** (827 MPa).
4. Socket Button Head Fasteners:
 - a. Heat-treated alloy steel, **ASTM F 835** (ASTM F 835M).
 - b. Stainless steel, **ASTM F 879** (ASTM F 879M), Group 1 CW.
5. Socket Flat Countersunk Head Fasteners:
 - a. Heat-treated alloy steel, **ASTM F 835** (ASTM F 835M).
 - b. Stainless steel, **ASTM F 879** (ASTM F 879M), Group 1 CW.
6. Socket Head Cap Fasteners:
 - a. Heat-treated alloy steel, **ASTM A 574** (ASTM A 574M).
 - b. Stainless steel, **ASTM F 837** (ASTM F 837M), Group 1 CW.
7. Protective Coatings for Heat-Treated Alloy Steel:
 - a. Zinc and clear trivalent chromium where indicated.
 - b. Zinc phosphate with oil, ASTM F 1137, Grade I, or black oxide unless otherwise indicated.

2.11 SECURITY SEALANTS

- A. Polyurethane Security Sealants: Manufacturer's standard, nonsag, tamper-resistant sealant for joints with low movement.
 1. Security sealants shall **[have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).] [comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]**
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals, LLC, Building Systems; Sonolastic Ultra.
 - b. Pecora Corporation; DynaFlex.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
- B. Epoxy Security Sealants: Manufacturer's standard, nonsag, tamper-resistant sealant for joints with no movement.
 1. Security sealants shall **[have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).] [comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]**
 2. Products: Subject to compliance with requirements, provide one of the following:

- a. BASF Construction Chemicals, LLC, Building Systems; Epolith-G.
 - b. Euclid Chemical Company (The), an RPM company; Euco Model No. 452-P.
 - c. Pecora Corporation; DynaPoxy EP-1200.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
- C. Acoustical Sealant: Manufacturer's standard, nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
1. Security sealants shall **[have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).] [comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]**
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pecora Corporation; **[AC-20 FTR] [AIS-919]**.
 - b. USG Corporation; SHEETROCK Acoustical Sealant.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.

2.12 ACCESSORIES

- A. Concealed Bolts: ASTM A 307, Grade A unless otherwise indicated.
- B. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welding.
- C. Attachment Devices: Size for **[five] <Insert safety factor>** times the design load indicated in ASTM C 635/C 635M, Table 1, Direct Hung, unless otherwise indicated.
 1. Cast-in-Place and Postinstalled Expansion Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to **[five] <Insert safety factor>** times the load imposed by security ceiling construction, as determined by testing according to ASTM E 488, conducted by a qualified testing agency.
 - a. Type: **[Cast-in-place] [Postinstalled expansion] [Chemical]** anchors.
 - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC service condition (mild).
 - c. Corrosion Protection: Stainless-steel components complying with **ASTM F 593 and ASTM F 594, Alloy Group 1 or 2** (ASTM F 738M and ASTM F 836M,

- Alloy Group 1 or 4) for bolts and nuts; ASTM A 666 or ASTM A 276, Type 304 or 316, for anchors.
- d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of security ceiling assemblies.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of security ceiling assembly connections before security ceiling assembly installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of security ceiling assemblies.
- D. Inspect built-in and cast-in anchor installations before installing security ceiling assemblies to verify that anchor installations comply with requirements. Prepare inspection reports.
1. Repair, or remove and replace, anchors where inspections indicate noncompliance with specified requirements. Reinspect after repair or replacement.
 2. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.
- E. Verify locations and layouts of security ceiling assemblies with those indicated on reflected ceiling plans and coordination drawings.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other security ceiling anchors whose installation is specified in other Sections.
1. Furnish cast-in-place anchors and similar devices to other trades for installation well in advance of time needed for coordinating other work.
- B. Measure each security ceiling area and establish layout of security ceiling panels to balance border widths at opposite edges of each security ceiling. Avoid using less-than-half-width panels at borders and comply with layout shown on reflected ceiling plans and Coordination Drawings.

3.3 GENERAL INSTALLATION

- A. Comply with CISCA's "Ceiling Systems Handbook" for installation of security ceiling assemblies.
- B. Install perimeter supports around perimeter of security ceiling area.
1. Sealant: Apply [**polyurethane security**] [**epoxy security**] [**acoustical**] sealant in a continuous ribbon concealed on back of vertical legs of supports before they are installed.
 2. Attach supports with anchor bolts or expansion anchors spaced not more than **12 inches** (305 mm) o.c. and not more than **3 inches** (76 mm) from ends. Miter corners accurately.
 - a. Level perimeter supports with suspension system to a tolerance of **1/8 inch in 12 feet** (3 mm in 3.7 m).
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim. If exposed fasteners are unavoidable, obtain approval from DEN Project Manager for their use and use security fasteners.
- C. Install accessories where indicated and as required to comply with performance requirements.
1. Sound-Absorptive Pads: For security ceiling panels indicated, provide sound-absorptive pads of width and length to completely fill inside of each security ceiling panel.
 - a. Install sound-absorptive pads [**over metal spacer grids**] [**with support clips**].
 2. Backer Plates: Install plates in areas indicated on reflected ceiling plans or in room finish schedules. Lay backer plates directly on security ceiling assembly in manner indicated and close major openings to form complete coverage in required areas.[**Lay second sound-absorptive pad on backer plate.**]
- D. Seismic Installation: Comply with seismic standard indicated, manufacturer's written instructions, and CISCA's "Ceiling Systems Handbook."

3.4 DOWNWARD-LOCKING-PANEL SECURITY CEILING ASSEMBLY INSTALLATION

- A. Ceiling Hangers: Suspend from building's structural members and as follows:
1. Install hangers plumb and free from contact with insulation or other objects within security ceiling plenum that are not part of supporting structure or of security ceiling suspension system.
 2. Splay hangers only where required to avoid obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to

- support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to security ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 6. Do not support security ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts or postinstalled mechanical or adhesive anchors.
 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 8. Do not attach hangers to steel deck tabs.
 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 10. Space hangers not more than **48 inches** (1220 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than **8 inches** (200 mm) from ends of each member.
 11. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
 12. Install compression struts extending from main runners to structure above and spaced at **48 inches** (1220 mm) o.c.
- B. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- C. Panel Installation: Install panels to continuously engage with and lock under rectangular bulb of suspension system. Attach panels to perimeter supports with security fasteners not more than **3 inches** (76 mm) from edges of panel. Fasten through exposed face of supports into panel.
1. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
 2. Fit adjoining units to form flush, tight joints. Scribe and cut units for accurate fit at borders and around construction penetrating security ceiling.
 3. Install directionally patterned panels in directions indicated.
 4. Scribe and cut security ceiling panels for accurate fit at borders and at interruptions and penetrations by other work through security ceilings. Stiffen edges of cut panels as required to eliminate evidence of buckling or variations in flatness.
- D. Access Panels: Install each access panel only where indicated and within one security ceiling panel.

3.5 SECURITY-PLANK SECURITY CEILING ASSEMBLY INSTALLATION

- A. Install security planks with long edges continuously interlocked. Adjust security planks to final position before permanently fastening. Provide minimum **1-1/2-inch** (38-mm) end bearing.
1. Attach adjacent security planks to each other with security fasteners spaced not more than **12 inches** (305 mm) o.c. and not more than **6 inches** (152 mm) from ends.
 2. Continuously weld ends of security planks to perimeter supports. Remove exposed projecting burrs, edges, and rough spots resulting from welding operations by grinding smooth.
 3. Attach ends of security planks to perimeter supports with security fasteners not more than **3 inches** (76 mm) from edges of security plank. Fasten through exposed face of supports into security planks.
 4. Provide intermediate carriers for ends of security planks that are not supported by perimeter supports. To attach security planks to intermediate carriers, use same method as that used for attaching security planks to perimeter supports.
 - a. Support intermediate carriers from structure above by secondary support system spaced at **48 inches** (1220 mm) o.c. and bolted to carriers.
- B. Access Panels: Install each access panel only where indicated and within one security plank.
- C. Provide steel angle reinforcement on each side of openings that exceed **12 inches** (305 mm) in any direction.

3.6 FIELD QUALITY CONTROL

- A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.
- B. Remove and replace security ceiling assemblies where inspections indicate that work does not comply with specified requirements.
- C. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.
- D. Prepare field quality-control certification[**endorsed by Detention Specialist**] that states installed products and their installation comply with requirements in the Contract Documents.
- E. Field Quality-Control Testing: [**Owner will engage**] [**Engage**] a qualified independent testing agency to perform field quality-control testing.
- F. Extent and Testing Frequency: Testing will take place in successive stages in areas described below. Proceed with installation of security ceiling assemblies only after test results for previously installed hangers comply with requirements.

1. Extent of Each Test Area: When installation of security ceiling suspension systems on each floor has reached 20 percent completion but no security panel units have been installed.
 2. Within each test area, testing agency will select one of every ten anchors used to attach hangers to concrete and will test them for **200 lbf** (890 N) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for **440 lbf** (1957 N) of tension.
 3. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those fasteners and anchors not previously tested until 20 consecutively pass and then will resume initial testing frequency.
- G. Fasteners and anchors will be considered defective if they do not pass tests and inspections.
- H. Prepare test and inspection reports.
- I. Additional Testing: Where fasteners and anchors are removed and replaced, additional testing will be performed to determine compliance with specified requirements.

3.7 CLEANING

- A. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as that used for shop painting; comply with SSPC-PA 1 for touching up shop-painted surfaces.
1. Apply by brush or spray to provide a minimum dry film thickness of **2 mils** (0.05 mm).
- C. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- D. Metallic-Coated Steel Surfaces: Clean field welds, bolted connections, and abraded areas and repair zinc or zinc-iron coating to comply with ASTM A 780.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 095753

SECTION 096400 - WOOD FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Factory-finished wood flooring.
 - 2. Field-finished wood flooring.
 - 3. Sound control underlayment.
- B. Related Sections:
 - 1. Section 096466 "Wood Athletic Flooring" for resilient systems used in sports-activity areas.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include data substantiating that materials comply with requirements.
- B. Moisture Tests: Submit test results for moisture tests of concrete substrates.
- C. LEED Submittals:
 - 1. Product Data for Credit MR 4: For recycled-rubber underlayment, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Certificates for **[Credit MR 6]** **[Credit MR 7]**: Chain-of-custody certificates certifying that products specified to be made from certified wood comply with forest certification requirements. Include evidence that mill is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.

3. Product Data for Credit IEQ 4.1: For wood flooring installation adhesives, documentation including printed statement of VOC content.
4. Product Data for Credit IEQ 4.2: For field-applied finishes for wood flooring, documentation including printed statement of VOC content.
5. Product Data for Credit IEQ 4.3: For **[wood flooring installation adhesives] [and] [field-applied finishes for wood flooring]**, documentation including printed statement of VOC content.
6. Product Data for Credit IEQ 4.3: For wood flooring, documentation from an independent testing agency indicating compliance with the FloorScore Standard.
7. Product Data for Credit IEQ 4.4: For composite wood products, documentation indicating that the bonding agent contains no urea formaldehyde.
8. Laboratory Test Reports for Credit IEQ 4: For **[adhesives] [field-applied finishes] [flooring system elements] [composite wood products] [and] [wood flooring systems]**, documentation indicating that products comply with California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- D. Shop Drawings: For each type of floor assembly and accessory. Include plans, elevations, sections, details, and attachments to other work. Include expansion provisions and trim details.
- E. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors and finishes available for wood flooring.
- F. Samples for Verification: For each type of wood flooring and accessory, with stain color and finish required, approximately **12 inches** (300 mm) long and of same thickness and material indicated for the Work and showing the full range of normal color and texture variations expected.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Wood Flooring: Equal to **[1] <Insert number>** percent of amount installed for each type of wood flooring indicated.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Hardwood Flooring: Comply with NOFMA's "Official Flooring Grading Rules" for species, grade, and cut.

1. Certification: Provide flooring that carries NOFMA grade stamp on each bundle or piece.
- C. Maple Flooring: Comply with applicable MFMA grading rules for species, grade, and cut.
 1. Certification: Provide flooring that carries MFMA mark on each bundle or piece.
- D. Softwood Flooring: Comply with WCLIB No. 17 grading rules for species, grade, and cut.
- E. Build mockup of typical flooring area as shown on Drawings [**including base and shoe moldings**].
 1. To set quality standards for sanding and application of field finishes, prepare finish mockup of floor area as shown on Drawings.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wood flooring materials in unopened cartons or bundles.
- B. Protect wood flooring from exposure to moisture. Do not deliver wood flooring until after concrete, masonry, plaster, ceramic tile, and similar wet work is complete and dry.
- C. Store wood flooring materials in a dry, warm, ventilated, weathertight location.

1.7 PROJECT CONDITIONS

- A. Conditioning period begins not less than seven days before wood flooring installation, is continuous through installation, and continues not less than seven days after wood flooring installation.
 1. Environmental Conditioning: Maintain an ambient temperature between **65 and 75 deg F** (18 and 24 deg C) and relative humidity planned for building occupants in spaces to receive wood flooring during the conditioning period.
 2. Wood Flooring Conditioning: Move wood flooring into spaces where it will be installed, no later than the beginning of the conditioning period.
 - a. Do not install flooring until it adjusts to relative humidity of, and is at same temperature as, space where it is to be installed.
 - b. Open sealed packages to allow wood flooring to acclimatize immediately on moving flooring into spaces in which it will be installed.

- B. After conditioning period, maintain relative humidity and ambient temperature planned for building occupants.
- C. Install factory-finished wood flooring after other finishing operations, including painting, have been completed.

1.8 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. FloorScore Compliance: Wood floors shall comply with requirements of FloorScore Standard.
- B. Low-Emitting Materials: Wood flooring systems shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 FIELD-FINISHED WOOD FLOORING

- A. Certified Wood: Provide wood flooring produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- B. Solid-Wood Flooring: Kiln dried to 6 to 9 percent maximum moisture content, tongue and groove and end matched, and with backs channeled.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aacer Flooring, LLC.
 - b. Carlisle Wide Plank Floors.
 - c. EcoTimber.
 - d. International Hardwood Flooring, Inc.
 - e. Kentucky Wood Floors.
 - f. Miller and Company, Inc.
 - g. Oregon Lumber Company.
 - h. Sandy Pond Hardwoods, Inc.
 - i. WD Flooring, LLC.
 - j. Yesteryear Floorworks Company.
 - k. <Insert manufacturer's name>.

- I. or approved equal.
 2. Species and Grade: [**Select red oak**] [**No. 1 Common red oak**] [**No. 2 Common red oak**] [**MFMA-RL First Grade hard maple**] [**MFMA-RL Second and Better Grade hard maple**] [**C & BTR - Flooring Douglas fir**] [**D - Flooring Douglas fir**] <Insert species and grade>.
 3. Cut: [**Plain sawn**] [**Quarter/rift sawn**] [**Edge grain**] [**Vertical grain**] <Insert description>.
 4. Thickness: [**25/32 inch (20 mm)**] [**3/4 inch (19 mm)**] <Insert dimension>.
 5. Face Width: [**2-1/4 inches (57 mm)**] [**3-1/8 inches (79 mm)**] [**5-1/8 inches (130 mm)**] <Insert dimension>.
 6. Lengths: [**Manufacturer's standard**] [**Random-length strips complying with applicable grading rules**] [**Lengths required to form pattern indicated**] <Insert requirements>.
 7. Simulated Wood Pegs: Contrasting wood pegs at ends of flooring pieces.
- C. Solid-Wood Parquet Flooring: Kiln dried to 6 to 9 percent maximum moisture content.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle Wide Plank Floors.
 - b. Kentucky Wood Floors.
 - c. <Insert manufacturer's name>.
 - d. or approved equal.
 2. Species: [**Red oak**] [**White oak**] [**Ash**] [**Maple**] [**Black cherry**] <Insert species>.
 3. Grade: <Insert grade>.
 4. Thickness: [**5/16 inch (8 mm)**] [**11/16 inch (17 mm)**] [**1/4 inch (6 mm)**] <Insert dimension>.
 5. Pattern: <Insert description>.
 6. Size: <Insert dimension>.
- D. Engineered-Wood Flooring: HPVA EF[.][, **except bonding agent contains no urea formaldehyde.**][, **that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."**]
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong World Industries, Inc.
 - b. Kentucky Wood Floors.
 - c. Mannington Mills, Inc.
 - d. Oregon Lumber Company.
 - e. <Insert manufacturer's name>.
 - f. or approved equal.

2. Species: **[Red oak] [White oak] [Ash] [Beech] [Maple] [Black cherry]** <Insert species>.
 3. Grade: <Insert grade>.
 4. Thickness: **[1/2 inch (13 mm)] [3/8 inch (9.5 mm)]** <Insert dimension>.
 5. Construction: **[Five] [Three]** ply.
 6. Face Width: **[2-1/4 inches (57 mm)] [3 inches (76 mm)]** <Insert dimension>.
 7. Length: Manufacturer's standard.
- E. Urethane Finish System: Complete **[solvent-based, oil-modified] [water-based]** system of compatible components that is recommended by finish manufacturer for application indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Basic Coatings, Inc.
 - b. BonaKemi USA Inc.
 - c. Dura Seal, Sherwin-Williams Company (The).
 - d. Hillyard, Inc.
 - e. Polo-Plaz Coatings; National Coatings Company.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
 2. VOC Content: When calculated according to 40 CFR 59, Subpart D (EPA Method 24), as follows:
 - a. Finish Coats and Floor Sealers: Not more than 350 g/L.
 - b. Stains: Not more than 250 g/L.
 3. Finish system materials shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 4. Stain: Penetrating and nonfading type.
 - a. Color: **[Match sample] [As selected by DEN Project Manager from manufacturer's full range]** <Insert color>.
 5. Floor Sealer: Pliable, penetrating type.
 6. Finish Coats: Formulated for multicoat application on wood flooring.
- F. Wood Filler: Compatible with finish system components and recommended by filler and finish manufacturers for use indicated. If required to match approved Samples, provide pigmented filler.

2.3 FACTORY-FINISHED WOOD FLOORING

- A. Certified Wood: Provide wood flooring produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- B. Solid-Wood Flooring: Kiln dried to 6 to 9 percent maximum moisture content; tongue and groove and end matched; and with backs channeled.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aacer Flooring, LLC.
 - b. Anderson Hardwood Floors.
 - c. Armstrong World Industries, Inc.
 - d. Bellawood.
 - e. Carlisle Wide Plank FloorsKentucky Wood Floors.
 - f. WD Flooring, LLC.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
 2. Species: **[Red oak] [White oak] [Ash] [Birch] [Maple] [Black cherry] [Hickory] [Walnut] <Insert species>**.
 3. Grade: **<Insert grade>**.
 4. Cut: **[Plain sawn] [Quarter/rift sawn] [Edge grain] [Vertical grain] <Insert description>**.
 5. Thickness: **[3/4 inch (19 mm)] [25/32 inch (20 mm)] <Insert dimension>**.
 6. Face Width: **[2-1/4 inches (57 mm)] [3-1/8 inches (79 mm)] [5-1/8 inches (130 mm)] <Insert dimension>**.
 7. Lengths: **[Random-length strips complying with applicable grading rules] [Lengths required to form pattern indicated] <Insert requirements>**.
 8. Edge Style: **[Square] [Beveled (eased)] <Insert style>**.
 9. Finish: UV urethane.
 - a. Color: **[As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
- C. Solid-Wood Parquet Flooring: Kiln dried to 6 to 9 percent maximum moisture content.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong World Industries, Inc.
 - b. Carlisle Wide Plank Floors.
 - c. Kentucky Wood Floors.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
 2. Species: **[Red oak] <Insert species>**.
 3. Grade: **<Insert grade>**.

4. Thickness: [5/16 inch (8 mm)] [11/16 inch (17 mm)] [1/4 inch (6 mm)] **<Insert dimension>**.
 5. Edge Style: **<Insert style>**.
 6. Pattern: **<Insert description>**.
 7. Size: **<Insert dimension>**.
 8. Finish: [UV urethane] [Acrylic impregnated].
 - a. Color: [As selected by DEN Project Manager from manufacturer's full range] **<Insert color>**.
- D. Engineered-Wood Flooring: HPVA EF[.][, **except bonding agent contains no urea formaldehyde.**][, **that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."**]
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anderson Hardwood Floors.
 - b. Armstrong World Industries, Inc.
 - c. Boen Hardwood Flooring Inc.
 - d. EcoTimber.
 - e. Gammapar.
 - f. Mannington Mills, Inc.
 - g. Oregon Lumber Company.
 - h. Tarkett.
 - i. Wood Flooring International.
 - j. WD Flooring, LLC.
 - k. **<Insert manufacturer's name>**.
 - l. or approved equal.
 2. Species: [Red oak] [White oak] [Ash] [Beech] [Birch] [Maple] [Black cherry] [Hickory] [Walnut] **<Insert species>**.
 3. Grade: **<Insert grade>**.
 4. Thickness: [1/2 inch (13 mm)] [3/8 inch (9.5 mm)] **<Insert dimension>**.
 5. Construction: [Five] [Three] ply.
 6. Face Width: [2-1/4 inches (57 mm)] [3 inches (76 mm)] **<Insert dimension>**.
 7. Length: Manufacturer's standard.
 8. Edge Style: [Square] [Beveled (eased)] **<Insert style>**.
 9. Finish: [UV urethane] [Acrylic impregnated].
 - a. Color: [As selected by DEN Project Manager in manufacturer's full range] **<Insert color>**.
- E. Engineered-Wood Parquet Flooring: HPVA EF[.][, **except bonding agent contains no urea formaldehyde.**][, **that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."**]

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Boen Hardwood Flooring Inc.
 - b. Tarkett.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.
2. Species: **[Red oak] [Ash] [Beech] [Maple] [Walnut] <Insert species>**.
3. Grade: **<Insert grade>**.
4. Thickness: **[3/8 inch (9.5 mm)] [1/2 inch (13 mm)] <Insert dimension>**.
5. Construction: **[Five] [Three] ply**.
6. Edge Style: **<Insert style>**.
7. Pattern: **<Insert description>**.
8. Size: **<Insert dimension>**.
9. Finish: UV urethane.
 - a. Color: **[As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.

2.4 SOUND CONTROL UNDERLAYMENT

- A. Sound Control Underlayment: Sound reducing underlayment consisting of impact-absorbing materials. Minimum Impact Insulation Class (IIC) of **[50] [55] <Insert value>** when tested according to ASTM E 492.
 1. Material: **[Recycled rubber.] [Polyurethane foam.] [Wood fiber.] [Wood fiber made with binder containing no urea formaldehyde.] [Wood fiber that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]** **<Insert material.>**
 2. Thickness: **[3/4 inch (19 mm)] [1/2 inch (13 mm)] [3/8 inch (9 mm)] [1/4 inch (6 mm)] [5/32 inch (4 mm)] <Insert dimension>**.

2.5 ACCESSORY MATERIALS

- A. Wood Underlayment: **[As specified in Section 061000 "Rough Carpentry."]** **<Insert requirements>**.
- B. Vapor Retarder: ASTM D 4397, polyethylene sheet not less than **[6.0 mils (0.15 mm)] [8.0 mils (0.2 mm)]** thick.
- C. Asphalt-Saturated Felt: ASTM D 4869, Type II.
- D. Wood Flooring Adhesive: Mastic recommended by flooring and adhesive manufacturers for application indicated.

1. Adhesive shall have a VOC content of not more than [100] <Insert value> g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by wood flooring manufacturer.
- F. Fasteners: As recommended by manufacturer, but not less than that recommended in [NWFA's "Installation Guidelines: Wood Flooring."] <Insert standard or publication>.
- G. Thresholds and Saddles: To match wood flooring. Tapered on each side.
- H. Reducer Strips: To match wood flooring. [2 inches (51 mm)] <Insert dimension> wide, tapered, and in thickness required to match height of flooring.
- I. Cork Expansion Strip: Composition cork strip.
- J. Feature Strips: [2-inch- (51-mm-) wide, square-edged walnut strips] <Insert description>, furnished in lengths as long as practical and in thickness to match wood flooring.
- K. Metal Feature Strips: [1/8-by-1/8-inch (3-by-3-mm) solid-brass strips] <Insert description>, designed for inlaying into routed reveal in wood flooring surface.
- L. Wood Air Vents and Grilles: To match wood flooring and in sizes and design indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of wood flooring.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Concrete Slabs: Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
1. Moisture Testing: Perform tests so that each test area does not exceed [200 sq. ft. (18.6 sq. m)] <Insert area>, and perform no fewer than two tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Perform anhydrous calcium chloride test per ASTM F 1869, as follows:

- 1) Proceed with installation only after substrates have maximum moisture-vapor-emission rate of [3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)] [4.5 lb of water/1000 sq. ft. (2.04 kg of water/92.9 sq. m)] <Insert emission> in 24 hours.
- b. Perform tests recommended by manufacturer. Submit test results to DEN Project Manager for review.
- c. Proceed with installation only after substrates pass testing and are approved by flooring manufacturer for installation.

3.2 PREPARATION

- A. Concrete Slabs: Grind high spots and fill low spots to produce a maximum 1/8-inch (3-mm) deviation in any direction when checked with a 10-foot (3-m) straight edge.
 1. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- B. Remove coatings, including curing compounds, and other substances on substrates that are incompatible with installation adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- C. Broom or vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Comply with flooring manufacturer's written installation instructions, but not less than applicable recommendations in [NWFA's "Installation Guidelines: Wood Flooring."] <Insert standard or publication>.
- B. Wood Sleepers and Subfloor: [Install according to requirements in Section 061000 "Rough Carpentry."] <Insert requirements>.
- C. Wood Underlayment: [Install according to requirements in Section 061000 "Rough Carpentry."] <Insert requirements>.
- D. Provide expansion space at walls and other obstructions and terminations of flooring [as indicated on Drawings] [of not less than 3/4 inch (19 mm)] <Insert requirements>.
- E. Vapor Retarder: Comply with NOFMA's "Installing Hardwood Flooring" for vapor retarder installation and the following:

1. Wood Flooring Nailed to Wood Subfloor: Install flooring over a layer of asphalt-saturated felt.
 2. Wood Flooring Nailed to Sleepers over Concrete: Install flooring over a layer of polyethylene sheet with edges overlapped over sleepers and turned up behind baseboards.
 3. Wood Flooring Installed Directly on Concrete: Install a layer of polyethylene sheet according to flooring manufacturer's written instructions.
- F. Sound Control Underlayment: Install over vapor retarder in accordance with manufacturer's written instructions.
- G. Solid-Wood Flooring: Blind nail or staple flooring to substrate.
1. For flooring of face width more than **3 inches** (75 mm):
 - a. Install countersunk screws at each end of each piece in addition to blind nailing. Cover screw heads with wood plugs glued flush with flooring.
 - b. Install no fewer than two countersunk nails at each end of each piece, spaced not more than **16 inches** (406 mm) along length of each piece, in addition to blind nailing. Fill holes with matching wood filler.
- H. Solid-Wood Parquet Flooring: Set in adhesive in pattern indicated on Drawings.
- I. Engineered-Wood Flooring: **[Set in adhesive] [Nail or staple] [Install floating floor]**.

3.4 FIELD FINISHING

- A. Machine-sand flooring to remove offsets, ridges, cups, and sanding-machine marks that would be noticeable after finishing. Vacuum and tack with a clean cloth immediately before applying finish.
1. Comply with applicable recommendations in **[NWFA's "Installation Guidelines: Wood Flooring."]** <Insert standard or publication>.
- B. Fill **[open-grained hardwood]** <Insert description of wood to be filled>.
- C. Fill and repair wood flooring seams and defects.
- D. Apply floor-finish materials in number of coats recommended by finish manufacturer for application indicated, but not less than one coat of floor sealer and **[three]** <Insert number> finish coats.
1. Apply stains to achieve an even color distribution matching approved Samples.
 2. For water-based finishes, use finishing methods recommended by finish manufacturer to minimize grain raise.
- E. Cover wood flooring before finishing.
- F. Do not cover wood flooring after finishing until finish reaches full cure, and not before seven days after applying last finish coat.

3.5 PROTECTION

- A. Protect installed wood flooring during remainder of construction period with covering of heavy kraft paper or other suitable material. Do not use plastic sheet or film that might cause condensation.
 - 1. Do not move heavy and sharp objects directly over kraft-paper-covered wood flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 096400

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Resilient base.
2. Resilient stair accessories.
3. Resilient molding accessories.

- B. Related Sections:

1. Section 096516 "Resilient Sheet Flooring" for resilient sheet floor coverings.
2. Section 096516.13 "Linoleum Flooring" for linoleum floor coverings.
3. Section 096519 "Resilient Tile Flooring" for resilient floor tile.
4. Section 096536 "Static-Control Resilient Flooring" for resilient floor coverings designed to control electrostatic discharge.
5. Section 096566 "Resilient Athletic Flooring" for resilient floor coverings for use in athletic-activity or support areas.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1. Include data substantiating that materials comply with requirements.

- B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Samples for Initial Selection: For each type of product indicated.
- D. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than **12 inches** (300 mm) long, of each resilient product color, texture, and pattern required.
- E. Product Schedule: For resilient products.[**Use same designations indicated on Drawings.**]

1.4 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than [**10 linear feet** (3 linear m)] **<Insert length>** for every [**500 linear feet** (150 linear m)] **<Insert length>** or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.6 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Mockups: Provide resilient products with mockups specified in other Sections.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than **50 deg F** (10 deg C) or more than **90 deg F** (32 deg C).

1.8 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than [**70 deg F** (21 deg C)] **<Insert temperature>** or more than [**95 deg F** (35 deg C)] **<Insert temperature>**, in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
 2. During installation.
 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than [55 deg F (13 deg C)] <Insert temperature> or more than [95 deg F (35 deg C)] <Insert temperature>.
- C. Install resilient products after other finishing operations, including painting, have been completed.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 RESILIENT BASE <Insert drawing designation>

- A. Resilient Base:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allstate Rubber Corp.; Stoler Industries.
 - b. Armstrong World Industries, Inc.
 - c. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - d. Endura Rubber Flooring; Division of Burke Industries, Inc.
 - e. Estrie Products International; American Biltrite (Canada) Ltd.
 - f. Flexco, Inc.
 - g. Johnsonite.
 - h. Mondo Rubber International, Inc.
 - i. Musson, R. C. Rubber Co.
 - j. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
 - k. PRF USA, Inc.
 - l. Roppe Corporation, USA.
 - m. VPI, LLC; Floor Products Division.
 - n. <Insert manufacturer's name>.
 - o. or approved equal.
- B. Resilient Base Standard: ASTM F 1861.
1. Material Requirement: [Type TV (vinyl, thermoplastic)] [Type TS (rubber, vulcanized thermoset)] [Type TP (rubber, thermoplastic)] [Type TS (rubber, vulcanized thermoset) or Type TP (rubber, thermoplastic)].

2. Manufacturing Method: [**Group I (solid, homogeneous)**] [**Group II (layered)**] [**Group I (solid, homogeneous) or Group II (layered)**].
 3. Style: [**Cove (base with toe)**] [**Straight (flat or toeless)**] [**Butt to (fit-to-floor)**] **<Insert special style>**.
- C. Minimum Thickness: [**0.125 inch (3.2 mm)**] [**0.080 inch (2.0 mm)**] **<Insert thickness>**.
- D. Height: [**2-1/2 inches (64 mm)**] [**4 inches (102 mm)**] [**6 inches (152 mm)**] [**As indicated on Drawings**].
- E. Lengths: [**Cut lengths, 48 inches (1219 mm) long**] [**Coils in manufacturer's standard length**] [**Cut lengths 48 inches (1219 mm) long or coils in manufacturer's standard length**].
- F. Outside Corners: [**Job formed**] [**Preformed**] [**Job formed or preformed**].
- G. Inside Corners: [**Job formed**] [**Preformed**] [**Job formed or preformed**].
- H. Finish: [**Satin**] [**Matte**] [**Low luster**] [**As selected by DEN Project Manager from manufacturer's full range**].
- I. Colors and Patterns: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors**].

2.2 RESILIENT STAIR ACCESSORIES **<Insert drawing designation>**

- A. Resilient Stair Treads:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - b. Endura Rubber Flooring; Division of Burke Industries, Inc.
 - c. Estrie Products International; American Biltrite (Canada) Ltd.
 - d. Flexco, Inc.
 - e. Johnsonite.
 - f. Mondo Rubber International, Inc.
 - g. Musson, R. C. Rubber Co.
 - h. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
 - i. PRF USA, Inc.
 - j. R.C.A. Rubber Company (The).
 - k. Roppe Corporation, USA.
 - l. VPI, LLC; Floor Products Division.
 - m. **<Insert manufacturer's name>**.
 - n. or approved equal.
- B. Resilient Stair Treads Standard: ASTM F 2169.

1. Material Requirement: **[Type TV (vinyl, thermoplastic)] [Type TS (rubber, vulcanized thermoset)] [Type TP (rubber, thermoplastic)] [Type TS (rubber, vulcanized thermoset) or Type TP (rubber, thermoplastic)].**
 2. Surface Design:
 - a. Class 1, Smooth (flat).
 - b. Class 2, Pattern: **[Raised-disc design] [Raised-square design] [Raised-chevron design] [Raised-diamond design] [Raised-rib design] [Raised-rib design with abrasive strips] <Insert pattern>.**
 3. Manufacturing Method: **[Group 1, tread with embedded abrasive strips] [Group 2, tread with contrasting color for the visually impaired].**
- C. Nosing Style: **[Square, adjustable to cover angles between 60 and 90 degrees] [Square] [Round].**
- D. Nosing Height: **[1-1/2 inches (38 mm)] [2 inches (51 mm)] [2-3/16 inches (56 mm)] <Insert dimension>.**
- E. Thickness: **[1/4 inch (6 mm) and tapered to back edge] <Insert thickness>.**
- F. Size: Lengths and depths to fit each stair tread in **[one piece] [one piece or, for treads exceeding maximum lengths manufactured, in equal-length units].**
- G. Risers: Smooth, flat, **[coved-toe, 7 inches (178 mm) high by length matching treads] [toeless, height and length to cover risers];** produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
1. Thickness: **[0.125 inch (3.2 mm)] [0.080 inch (2.0 mm)] <Insert thickness>.**
- H. Stringers: Of same thickness as risers, height and length after cutting to fit risers and treads and to cover stair stringers; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
- I. Colors and Patterns: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager** from full range of industry colors].
- 2.3 RESILIENT MOLDING ACCESSORY **<Insert drawing designation>**
- A. Resilient Molding Accessory:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - b. Flexco, Inc.
 - c. Johnsonite.
 - d. R.C.A. Rubber Company (The).
 - e. Roppe Corporation, USA.

- f. VPI, LLC; Floor Products Division.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
- B. Description: [**Cap for cove carpet**] [**Cap for cove resilient floor covering**] [**Carpet bar for tackless installations**] [**Carpet edge for glue-down applications**] [**Nosing for carpet**] [**Nosing for resilient floor covering**] [**Reducer strip for resilient floor covering**] [**Joiner for tile and carpet**] [**Transition strips**] **<Insert description>**.
- C. Material: [**Vinyl**] [**Rubber**].
- D. Profile and Dimensions: [**As indicated**] **<Insert profile and dimensions>**.
- E. Colors and Patterns: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager** from full range of industry colors].

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
- 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)[, **except that adhesive for rubber stair treads shall have a VOC content of 60 g/L or less**].
 - 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.
- D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.
- E. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Treads and Accessories: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
 - 4. Moisture Testing: Perform tests recommended by manufacturer[**and as follows**]. Proceed with installation only after substrates pass testing.
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of [3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)] **<Insert emission>** in 24 hours.
 - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have maximum [75 percent] **<Insert acceptable percentage>** relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are same temperature as the space where they are to be installed.
 - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Accessories:
 - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
 - 2. Tightly adhere to substrates throughout length of each piece.
 - 3. For treads installed as separate, equal-length units, install to produce a flush joint between units.
- C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of [**carpet**] [**resilient floor covering**] that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
 2. Sweep and vacuum surfaces thoroughly.
 3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.
1. Apply [two] [three] <Insert requirement> coat(s).
- E. Cover resilient products until Substantial Completion.

PART 4 - MEASUREMENT

A. METHOD OF MEASUREMENT

1. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

A. METHOD OF PAYMENT

1. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 096513

SECTION 096516 - RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Vinyl sheet floor covering, [**with**] [**and**] [**without**] backing.
2. Rubber sheet floor covering, [**with**] [**and**] [**without**] backing.

B. Related Sections:

1. Section 096513 "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.
2. Section 096516.13 "Linoleum Flooring" for linoleum sheet floor coverings.
3. Section 096519 "Resilient Tile Flooring" for resilient floor tile.
4. Section 096536 "Static-Control Resilient Flooring" for resilient floor coverings designed to control electrostatic discharge.
5. Section 096566 "Resilient Athletic Flooring" for resilient floor coverings for use in athletic-activity or support areas.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include data substantiating that materials comply with requirements.

B. Moisture Tests: Submit test results for moisture tests of concrete substrates.

C. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For [**adhesives**] [**and**] [**chemical-bonding compounds**], documentation including printed statement of VOC content.
2. Product Data for Credit IEQ 4.3: For adhesives [**and chemical-bonding compounds**], documentation including printed statement of VOC content.

3. Product Data for Credit IEQ 4.3: For resilient sheet flooring, documentation from an independent testing agency indicating compliance with the FloorScore Standard.
 4. Laboratory Test Reports for Credit IEQ 4: For adhesives **[flooring system]** **[and]** **[chemical-bonding compounds]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Shop Drawings: For each type of floor covering. Include floor covering layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
1. Show details of special patterns.
- E. Samples for Initial Selection: For each type of floor covering indicated.
- F. Samples for Verification: In manufacturer's standard size, but not less than **[6-by-9-inch (150-by-230-mm)]** **<Insert size>** sections of each different color and pattern of floor covering required.
1. For heat-welding bead, manufacturer's standard-size Samples, but not less than **[9 inches (230 mm)]** **<Insert dimension>** long, of each color required.
- G. Seam Samples: For seamless-installation technique indicated and for each floor covering product, color, and pattern required; with seam running lengthwise and in center of **[6-by-9-inch (150-by-230-mm)]** **<Insert size>** Sample applied to a rigid backing and prepared by Installer for this Project.
- H. Product Schedule: For floor coverings. **[Use same designations indicated on Drawings.]**
- 1.4 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For qualified Installer.
- 1.5 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For each type of floor covering to include in maintenance manuals.
 - B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".
- 1.6 MAINTENANCE MATERIAL SUBMITTALS
- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Covering: Furnish quantity not less than [10 linear feet (3 linear m)] <Insert length> for every [500 linear feet (150 linear m)] <Insert length> or fraction thereof, in roll form and in full roll width for each color, pattern, and type of floor covering installed.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor covering installation [and seaming method] indicated.
 1. Engage an installer who employs workers for this Project who are trained or certified by floor covering manufacturer for installation techniques required.
- B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Build mockups for floor coverings including [resilient base and] accessories.
 - a. Size: Minimum 100 sq. ft. (9.3 sq. m) for each type, color and pattern [in locations indicated] [in locations directed by DEN Project Manager] <Insert location requirements>.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store floor coverings and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store rolls upright.

1.9 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than [70 deg F (21 deg C)] <Insert temperature> or more than [85 deg F (29 deg C)] <Insert temperature>, in spaces to receive floor coverings during the following time periods:
 1. 48 hours before installation.
 2. During installation.
 3. 48 hours after installation.

- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than [55 deg F (13 deg C)] <Insert temperature> or more than [95 deg F (35 deg C)] <Insert temperature>.
- C. Close spaces to traffic during floor covering installation.
- D. Close spaces to traffic for 48 hours after floor covering installation.
- E. Install floor coverings after other finishing operations, including painting, have been completed.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. FloorScore Compliance: Resilient sheet flooring shall comply with requirements of FloorScore Standard.
- B. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 VINYL SHEET FLOOR COVERING <Insert drawing designation>

- A. Products: Subject to compliance with requirements, provide one of the following:
 1. Altro Group; <Insert product name or designation>.
 2. Armstrong World Industries, Inc.; <Insert product name or designation>.
 3. Congoleum Corporation; <Insert product name or designation>.
 4. DzynSpec, Division of Matsinc.; <Insert product name or designation>.
 5. Forbo Flooring, Inc.; <Insert product name or designation>.
 6. Gerflor, Architectural Floor Systems, Inc.; <Insert product name or designation>.
 7. Lonseal, Inc.; <Insert product name or designation>.
 8. Mannington Mills, Inc.; <Insert product name or designation>.
 9. Polyflor, Ltd., Distributed by Gerbert Limited; <Insert product name or designation>.
 10. Tarkett, Inc.; <Insert product name or designation>.
 11. TOLI International; <Insert product name or designation>.
 12. <Insert manufacturer's name; product name or designation>.

13. or approved equal.
- B. Unbacked Vinyl Sheet Floor Covering: ASTM F 1913, [0.080 inch (2.0 mm)] **<Insert dimension>** thick.
- C. Vinyl Sheet Floor Covering with Backing: ASTM F 1303.
1. Type (Binder Content): [**Type I, minimum binder content of 90 percent**] [**Type II, minimum binder content of 34 percent**].
 2. Wear-Layer Thickness: Grade 1.
 3. Overall Thickness: [**As standard with manufacturer**] **<Insert thickness>**.
 4. Interlayer Material: [**Foamed plastic**] [**None**].
 5. Backing Class: [**Class A (fibrous)**] [**Class B (nonfoamed plastic)**] [**Class C (foamed plastic)**].
- D. Wearing Surface: [**Smooth**] [**Embossed**] [**Smooth with embedded abrasives**] [**Embossed with embedded abrasives**].
- E. Sheet Width: [**As standard with manufacturer**] [**4.9 feet (1.5 m)**] [**6 feet (1.8 m)**] [**6.5 feet (1.98 m)**] [**6.6 feet (2.0 m)**] [**9 feet (2.7 m)**] [**12 feet (3.6 m)**].
- F. Seaming Method: [**Heat welded**] [**Chemically bonded**] [**Standard**] **<Insert requirements>**.
- G. Colors and Patterns: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors**].

2.3 RUBBER SHEET FLOOR COVERING **<Insert drawing designation>**

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Estrie Products International, American Biltrite (Canada) Ltd.; **<Insert product name or designation>**.
 2. Flexco; **<Insert product name or designation>**.
 3. Johnsonite; **<Insert product name or designation>**.
 4. Mondo Rubber International, Inc.; **<Insert product name or designation>**.
 5. Nora Rubber Flooring, Freudenberg Building Systems, Inc.; **<Insert product name or designation>**.
 6. PRF USA Inc.; **<Insert product name or designation>**.
 7. R.C.A. Rubber Company (The); **<Insert product name or designation>**.
 8. **<Insert manufacturer's name; product name or designation>**.
 9. or approved equal.
- B. Unbacked Rubber Sheet Floor Covering: ASTM F 1859.
1. Type: [**Type I (homogeneous rubber sheet)**] [**Type II (layered rubber sheet)**].
 2. Thickness: [**As standard with manufacturer**] **<Insert thickness>**.
- C. Rubber Sheet Floor Covering with Backing: ASTM F 1860.

1. Type: **[Type I, homogeneous rubber sheet with backing] [Type II, layered rubber sheet with backing]**.
 2. Wear-Layer Thickness: **[As standard with manufacturer] <Insert thickness>**.
 3. Overall Thickness: **[As standard with manufacturer] <Insert thickness>**.
 4. Interlayer Material: **[As standard with manufacturer] [None]**.
 5. Backing Type: **[Fibrous)] [Foamed rubber]**.
- D. Hardness: **[Not less than required by ASTM F 1859] [Not less than required by ASTM F 1860] [Manufacturer's standard hardness, measured using Shore, Type A durometer per ASTM D 2240]**.
- E. Wearing Surface: **[Smooth] [Textured] [Molded pattern]**.
1. Molded-Pattern Figure: **[Raised discs] [Raised squares] <Insert pattern>**.
- F. Sheet Width: **[As standard with manufacturer] [4.9 feet (1.5 m)] [6 feet (1.8 m)] [6.5 feet (1.98 m)] [6.6 feet (2.0 m)] [9 feet (2.7 m)] [12 feet (3.6 m)]**.
- G. Seaming Method: **[Heat welded] [Chemically bonded] [Standard] <Insert requirements>**.
- H. Colors and Patterns: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors]**.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit floor covering and substrate conditions indicated.
1. Adhesives shall have a VOC content of not more than **[50] [60] <Insert value>** g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Seamless-Installation Accessories:
1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
 - a. Color: **[As selected by DEN Project Manager from manufacturer's full range to contrast with floor covering] [Match floor covering] <Insert color>**.

2. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.
 - a. VOC Content: Not more than 510 g/L. when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Bonding compound shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Integral-Flash-Cove-Base Accessories:
 1. Cove Strip: 1-inch (25-mm) radius provided or approved by manufacturer.
 2. Cap Strip: [**Square metal, vinyl, or rubber cap**] [**Tapered vinyl cap**] <Insert requirements> provided or approved by manufacturer.
 3. Corners: Metal inside and outside corners and end stops provided or approved by manufacturer.
- E. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor coverings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of floor coverings.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

4. Moisture Testing: Perform tests recommended by manufacturer[**and as follows**]. Proceed with installation only after substrates pass testing.
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of [3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)] **<Insert emission>** in 24 hours.
 - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum **[75 percent]** **<Insert acceptable percentage>** relative humidity level measurement.
 - c. Submit test results to DEN Project Manager.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor coverings until they are same temperature as space where they are to be installed.
 1. Move floor coverings and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation.

3.3 FLOOR COVERING INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor coverings.
- B. Unroll floor coverings and allow them to stabilize before cutting and fitting.
- C. Lay out floor coverings as follows:
 1. Maintain uniformity of floor covering direction.
 2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least **6 inches** (152 mm) away from parallel joints in floor covering substrates.
 3. Match edges of floor coverings for color shading at seams.
 4. Avoid cross seams.
- D. Scribe and cut floor coverings to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, and doorframes.
- E. Extend floor coverings into toe spaces, door reveals, closets, and similar openings.
- F. Maintain reference markers, holes, or openings that are in place or marked for future cutting by repeating on floor coverings as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor coverings on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of

floor coverings installed on covers and adjoining floor covering. Tightly adhere floor covering edges to substrates that abut covers and to cover perimeters.

- H. Adhere floor coverings to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- I. Seamless Installation:
 - 1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.
 - 2. Chemically-Bonded Seams: Bond seams with chemical-bonding compound to permanently fuse sections into a seamless floor covering. Prepare seams and apply compound to produce tightly-fitted seams without gaps, overlays, or excess bonding compound on floor covering surfaces.
- J. Integral-Flash-Cove Base: Cove floor coverings [6 inches (152 mm)] [dimension indicated] <Insert dimension> up vertical surfaces. Support floor coverings at horizontal and vertical junction by cove strip. Butt at top against cap strip.
 - 1. Install metal corners at inside and outside corners.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor coverings.
- B. Perform the following operations immediately after completing floor covering installation:
 - 1. Remove adhesive and other blemishes from floor covering surfaces.
 - 2. Sweep and vacuum floor coverings thoroughly.
 - 3. Damp-mop floor coverings to remove marks and soil.
- C. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor covering before applying liquid floor polish.
 - 1. Apply [one] [two] [three] <Insert requirement> coat(s).
- E. Cover floor coverings until Substantial Completion.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 096516

SECTION 096516.13 - LINOLEUM FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Linoleum [**floor tile**] [**sheet flooring**] [**floor tile and sheet flooring**].
- B. Related Sections:
 - 1. Section 096513 "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with linoleum floor covering.
 - 2. Section 096536 "Static-Control Resilient Flooring" for resilient floor coverings designed to control electrostatic discharge.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include data substantiating that materials comply with requirements.
- B. Moisture Tests: Submit test results for moisture tests of concrete substrates.
- C. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC contents.
 - 2. Product Data for Credit IEQ 4.3: For adhesives, documentation including printed statement of VOC contents.
 - 3. Product Data for Credit IEQ 4.3: For linoleum, documentation from an independent testing agency indicating compliance with the FloorScore Standard.
 - 4. Laboratory Test Reports for Credit IEQ 4: For [**flooring system**] [**and**] [**adhesives**], documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard

Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- D. Shop Drawings: For each type of floor covering. Include floor covering layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - 1. Show details of special patterns.
- E. Samples for Initial Selection: For each type of floor covering indicated.
 - 1. Include similar Samples of installation accessories involving color selection.
- F. Samples for Verification: In manufacturer's standard size, but not less than [6-by-9-inch (152-by-230-mm)] <Insert size> sections of each color and pattern of floor covering required.
 - 1. Heat-Welding Bead: Include manufacturer's standard-size Samples, but not less than [9 inches (230 mm)] <Insert dimension> long, of each color required.
- G. Heat-Welded Seam Samples: For each floor covering product and welding bead color and pattern combination required; with seam running lengthwise and in center of [6-by-9-inch (152-by-230-mm)] <Insert size> Sample applied to rigid backing and prepared by Installer for this Project.
- H. Product Schedule: For floor covering.[**Use same designations indicated on Drawings.**]

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor covering to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish 1 box for every [50] <Insert number> boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

2. Sheet Flooring: Furnish not less than [10 linear feet (3 linear m)] **<Insert length>** for every [500 linear feet (150 linear m)] **<Insert length>** or fraction thereof, in roll form and in full roll width for each color, pattern, and type of sheet flooring installed.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor covering installation.
 1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.
- B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- C. Delete paragraph (and subparagraphs below) if mockups not required. If retaining, indicate location, size, and other details of mockups on drawings or with inserts. Verify mockup requirements with DEN Project Manager. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Build mockups for floor coverings including[**integral-flash-cove-base and**] [**resilient base and**] accessories.
 - a. Size: Minimum 100 sq. ft. (9.2 sq. m) for each type, color, and pattern [in locations indicated] [in locations directed by DEN Project Manager] **<Insert location requirements>**.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store floor coverings and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 65 deg F (18 deg C) or more than 90 deg F (32 deg C).
 1. Floor Tile: Store on flat surfaces.
 2. Sheet Flooring: Store rolls upright.

1.9 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than [70 deg F (21 deg C)] **<Insert temperature>** or more than [95 deg F (35 deg C)] **<Insert temperature>**, in spaces to receive floor coverings during the following time periods:
 1. 72 hours before installation.

2. During installation.
 3. 72 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than [55 deg F (13 deg C)] <Insert temperature> or more than [95 deg F (35 deg C)] <Insert temperature>.
- C. Close spaces to traffic during floor covering installation.
- D. Close spaces to traffic for 72 hours after floor covering installation.
- E. Install floor coverings after other finishing operations, including painting, have been completed.
- 1.10 CONSTRUCTION WASTE MANAGEMENT
- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Armstrong World Industries, Inc.; <Insert product name or designation>.
 2. Forbo Flooring, Inc.; <Insert product name or designation>.
 3. Tarkett Inc.; <Insert product name or designation>.
 4. <Insert manufacturer's name; product name or designation>.
 5. or approved equal.

2.2 PERFORMANCE REQUIREMENTS

- A. FloorScore Compliance: Linoleum shall comply with requirements of FloorScore Standard.
- B. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 LINOLEUM FLOOR COVERING <Insert drawing designation>

- A. Floor Tile: ASTM F 2195, [**Type I, linoleum floor tile with fibrous backing**] [**Type II, linoleum floor tile with special backing**] [**Type III, linoleum floor tile without backing**].
- Nominal Floor Tile Size: [**Manufacturer's standard**] [**12 by 12 inches** (300 by 300 mm)] [**18 by 18 inches** (460 by 460 mm)] [**20 by 20 inches** (500 by 500 mm)] [**24 by 24 inches** (600 by 600 mm)] <Insert size>.
- B. Sheet Flooring: ASTM F 2034, [**Type I, linoleum sheet with backing**] [**Type III, linoleum sheet with special backing**].
- Roll Size: In manufacturer's standard length by not less than **78 inches** (1980 mm) wide.
- C. Seaming Method: [**Standard**] [**Heat welded**].
- D. Thickness: [**0.08 inch** (2.0 mm)] [**0.10 inch** (2.5 mm)] [**0.13 inch** (3.2 mm)] [**0.16 inch** (4.0 mm)] [**0.18 inch** (4.5 mm)] <Insert thickness>.
- E. Colors and Patterns: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors**].

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit products and substrate conditions indicated.
- Adhesives shall have a VOC content of not more than [**50**] <Insert value> g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Heat-Welding Bead: Solid-strand product of linoleum floor covering manufacturer.
- [**As selected by DEN Project Manager from manufacturer's full range to contrast with linoleum floor covering**] [**Match linoleum floor covering**] <Insert color>.
- D. Integral-Flash-Cove-Base Accessories:
- Cove Strip: **1-inch** (25.4-mm) radius provided or approved by manufacturer.

2. Cove-Base Cap Strip: **[Square metal, vinyl, or rubber cap] <Insert requirements>** provided or approved by manufacturer.
- E. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor coverings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of floor coverings.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with floor covering adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 4. Moisture Testing: Perform tests recommended by manufacturer **[and as follows]**. Proceed with installation only after substrates pass testing.
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of **[3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)] <Insert emission>** in 24 hours.
 - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have maximum **[75 percent] <Insert acceptable percentage>** relative humidity level measurement.
 - c. Submit test results to DEN Project Manager.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

- D. Do not install floor coverings until they are same temperature as space where they are to be installed.
 - 1. Move floor coverings and installation materials into spaces where they will be installed at least 72 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation.

3.3 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions for installing floor coverings.
- B. Scribe and cut floor coverings to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings.
- C. Extend floor coverings into toe spaces, door reveals, closets, and similar openings.
- D. Maintain reference markers, holes, or openings that are in place or marked for future cutting by repeating on floor coverings as marked on subfloor. Use chalk or other nonpermanent marking device.
- E. Install floor coverings on covers for telephone and electrical ducts and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of floor covering installed on covers and adjoining floor covering. Tightly adhere floor covering edges to substrates that abut covers and to cover perimeters.
- F. Adhere floor coverings to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- G. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.

3.4 LINOLEUM FLOOR TILE INSTALLATION

- A. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so floor tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay floor tiles [**square with room axis**] [**at a 45-degree angle with room axis**] [**in pattern indicated**] <Insert requirements>.
- B. Match floor tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed floor tiles.

1. Lay floor tiles [**with grain running in one direction**] [**with grain direction alternating in adjacent floor tiles (basket-weave pattern)**] [**in pattern of colors and sizes indicated**] <Insert requirements>.

3.5 LINOLEUM SHEET FLOORING INSTALLATION

- A. Unroll sheet floorings and allow them to stabilize before cutting and fitting.
- B. Lay out sheet floorings as follows:
 1. Maintain uniformity of floor covering direction.
 2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least **6 inches** (152 mm) away from parallel joints in floor covering substrates.
 3. Match edges of floor coverings for color shading at seams.
 4. Avoid cross seams.
 5. Eliminate deformations that result from hanging method used during drying process (stove bar marks).
- C. Integral-Flash-Cove Base: Cove linoleum floor covering [**6 inches** (152 mm)] [**dimension indicated**] <Insert dimension> up vertical surfaces. Support floor covering at horizontal and vertical junction with cove strip. Butt at top against cap strip.

3.6 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor coverings.
- B. Perform the following operations immediately after completing floor covering installation:
 1. Remove adhesive and other blemishes from exposed surfaces.
 2. Sweep and vacuum surfaces thoroughly.
 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor coverings before applying liquid floor polish.
 1. Apply [**two**] [**three**] <Insert requirement> coat(s).
- E. After allowing drying room film (yellow film caused by linseed oil oxidation) to disappear, cover floor coverings until Substantial Completion.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 096516.13

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Solid vinyl floor tile.
2. Rubber floor tile.
3. Vinyl composition floor tile.
4. Resilient terrazzo floor tile.

- B. Related Sections:

1. Section 096513 "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.
2. Section 096516 "Resilient Sheet Flooring" for resilient sheet floor coverings.
3. Section 096516.13 "Linoleum Flooring" for linoleum floor coverings.
4. Section 096536 "Static-Control Resilient Flooring" for resilient floor coverings designed to control electrostatic discharge.
5. Section 096566 "Resilient Athletic Flooring" for resilient floor coverings for use in athletic-activity or support areas.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1. Include data substantiating that materials comply with requirements.

- B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For **[adhesives] [sealants] [and] [chemical-bonding compounds]**, documentation including printed statement of VOC content.
2. Product Data for Credit IEQ 4.3: For adhesives **[and chemical-bonding compounds]**, documentation including printed statement of VOC content.

3. Product Data for Credit IEQ 4.3: For resilient tile flooring, documentation from an independent testing agency indicating compliance with the FloorScore Standard.
 4. Laboratory Test Reports for Credit IEQ 4: For **[flooring system] [adhesives] [sealants] [and] [chemical-bonding compounds]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
1. Show details of special patterns.
- D. Samples for Initial Selection: For each type of floor tile indicated.
- E. Samples for Verification: Full-size units of each color and pattern of floor tile required.
1. For heat-welding bead, manufacturer's standard-size Samples, but not less than **[9 inches (230 mm)] <Insert dimension>** long, of each color required.
- F. Seam Samples: For seamless-installation technique indicated and for each flooring product, color, and pattern required; with seam running lengthwise and in center of **[6-by-9-inch (150-by-230-mm)] <Insert size>** Sample applied to a rigid backing and prepared by Installer for this Project.
- G. Product Schedule: For floor tile. **[Use same designations indicated on Drawings.]**
- 1.4 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For qualified Installer.
- 1.5 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".
- 1.6 MATERIALS MAINTENANCE SUBMITTALS
- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Floor Tile: Furnish 1 box for every **[50] <Insert number>** boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation[**and seaming method**] indicated.
1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.
- B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockups for floor tile including[**resilient base and**] accessories.
 - a. Size: Minimum **100 sq. ft.** (9.3 sq. m) for each type, color, and pattern [in locations indicated] [in locations directed by DEN Project Manager] <Insert location requirements>.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than **50 deg F** (10 deg C) or more than **90 deg F** (32 deg C). Store floor tiles on flat surfaces.

1.9 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than [**70 deg F** (21 deg C)] <Insert temperature> or more than [**95 deg F** (35 deg C)] <Insert temperature>, in spaces to receive floor tile during the following time periods:
1. 48 hours before installation.
 2. During installation.
 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than [**55 deg F** (13 deg C)] <Insert temperature> or more than [**95 deg F** (35 deg C)] <Insert temperature>.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.

- E. Install floor tile after other finishing operations, including painting, have been completed.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. FloorScore Compliance: Resilient tile flooring shall comply with requirements of FloorScore Standard.
- B. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 SOLID VINYL FLOOR TILE <Insert drawing designation>

- A. Products: Subject to compliance with requirements, provide one of the following:
 1. Altro Group; <Insert product name or designation>.
 2. Amtico Studio (The), Amtico International Inc.; <Insert product name or designation>.
 3. Armstrong World Industries, Inc.; <Insert product name or designation>.
 4. Burke Mercer Flooring Products, Division of Burke Industries Inc.; <Insert product name or designation>.
 5. Estrie Products International, American Biltrite (Canada) Ltd.; <Insert product name or designation>.
 6. Flexco; <Insert product name or designation>.
 7. Gemtec Inc.; <Insert product name or designation>.
 8. Gerflor, Architectural Floor Systems, Inc.; <Insert product name or designation>.
 9. Johnsonite; <Insert product name or designation>.
 10. Polyflor, Ltd., Distributed by Gerbert Limited; <Insert product name or designation>.
 11. Roppe Corporation, USA; <Insert product name or designation>.
 12. Tarkett, Inc.; <Insert product name or designation>.
 13. TOLI International; <Insert product name or designation>.
 14. VPI, LLC, Floor Products Division; <Insert product name or designation>.
 15. <Insert manufacturer's name; product name or designation>.
 16. or approved equal.

- B. Tile Standard: ASTM F 1700.
1. Class: **[As indicated by product designations]** **[Class I, monolithic vinyl tile]** **[Class II, surface-decorated vinyl tile]** **[Class III, printed film vinyl tile]**.
 2. Type: **[Type A, smooth surface]** **[Type B, embossed surface]**.
- C. Thickness: **[0.080 inch (2.0 mm)] [0.100 inch (2.5 mm)] [0.120 inch (3.0 mm)] [0.125 inch (3.2 mm)]** **<Insert thickness>**.
- D. Size: **[12 by 12 inches (305 by 305 mm)] [18 by 18 inches (457 by 457 mm)] [24 by 24 inches (610 by 610 mm)] [36 by 36 inches (914 by 914 mm)] [3 by 36 inches (76 by 914 mm)]** **<Insert size>**.
- E. Seaming Method: **[Heat welded]** **[Chemically bonded]** **[Standard]** **<Insert requirements>**.
- F. Colors and Patterns: **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from full range of industry colors]**.

2.3 RUBBER FLOOR TILE **<Insert drawing designation>**

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Burke Mercer Flooring Products, Division of Burke Industries Inc.; **<Insert product name or designation>**.
 2. Endura Rubber Flooring, a division of Burke Industries Inc.; **<Insert product name or designation>**.
 3. Estrie Products International, American Biltrite (Canada) Ltd.; **<Insert product name or designation>**.
 4. Flexco; **<Insert product name or designation>**.
 5. Johnsonite; **<Insert product name or designation>**.
 6. Mondo Rubber International, Inc.; **<Insert product name or designation>**.
 7. Nora Rubber Flooring, Freudenberg Building Systems, Inc.; **<Insert product name or designation>**.
 8. PRF USA Inc.; **<Insert product name or designation>**.
 9. R.C.A. Rubber Company (The); **<Insert product name or designation>**.
 10. Roppe Corporation, USA; **<Insert product name or designation>**.
 11. **<Insert manufacturer's name; product name or designation>**.
 12. or approved equal.
- B. Tile Standard: ASTM F 1344, **[Class I-A, homogeneous rubber tile, solid color]** **[Class I-B, homogeneous rubber tile, through mottled]** **[Class II-A, laminated rubber tile, solid-color wear layer]** **[Class II-B, laminated rubber tile, mottled wear layer]**.
- C. Hardness: **[Not less than 85 as required by ASTM F 1344, measured using Shore, Type A durometer per ASTM D 2240]** **[Manufacturer's standard hardness]**.

- D. Wearing Surface: **[Smooth]** **[Textured]** **[Molded pattern]**.
 - 1. Molded-Pattern Figure: **[Raised discs]** **[Raised squares]** **<Insert pattern>**.
- E. Thickness: **[0.125 inch (3.2 mm)]** **<Insert thickness>**.
- F. Size: **[12 by 12 inches (305 by 305 mm)]** **[24 by 24 inches (610 by 610 mm)]** **<Insert size>**.
- G. Seaming Method: **[Heat welded]** **[Chemically bonded]** **[Standard]** **<Insert requirements>**.
- H. Colors and Patterns: **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from full range of industry colors]**.

2.4 VINYL COMPOSITION FLOOR TILE **<Insert drawing designation>**

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. AB ColorPlus, American Biltrite (Canada) Ltd.; **<Insert product name or designation>**.
 - 2. Armstrong World Industries, Inc.; **<Insert product name or designation>**.
 - 3. Congoleum Corporation; **<Insert product name or designation>**.
 - 4. Mannington Mills, Inc.; **<Insert product name or designation>**.
 - 5. Tarkett, Inc.; **<Insert product name or designation>**.
 - 6. Vinylasa Tile, Distributed by American Tile Inc.; **<Insert product name or designation>**.
 - 7. **<Insert manufacturer's name; product name or designation>**.
 - 8. or approved equal.
- B. Tile Standard: ASTM F 1066, **[Class 1, solid-color tile]** **[Class 2, through-pattern tile]** **[Class 3, surface-pattern tile]**.
- C. Wearing Surface: **[Smooth]** **[Embossed]**.
- D. Thickness: **[0.125 inch (3.2 mm)]** **<Insert thickness>**.
- E. Size: **12 by 12 inches (305 by 305 mm)**.
- F. Colors and Patterns: **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from full range of industry colors]**.

2.5 RESILIENT TERRAZZO FLOOR TILE **<Insert drawing designation>**

- A. Resilient Terrazzo Floor Tile: Marble or granite chips embedded in flexible, thermoset-polyester-resin matrix; electrically nonconductive and chemical, oil, and

corrosion resistive, with smooth wearing surface and manufacturer's standard factory-applied, protective urethane coating.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fritz Industries; <Insert product name or designation>.
 - b. <Insert manufacturer's name; product name or designation>.
 - c. or approved equal.

B. Thickness: [1/8 inch (3.0 mm)] [3/16 inch (4.8 mm)].

C. Size: 12 by 12 inches (305 by 305 mm).

D. Performance Characteristics:

1. Compressive Strength: 2900 to 5000 psi (20 to 34.5 MPa), ASTM C 109/C 109M or ASTM D 695.
2. Abrasion Resistance: Maximum 0.0196 cubic centimeters volume loss, ASTM F 510, Taber abrader, S-39 wheels, at 500 cycles with 1000-gram load.
3. Static Load Limit: 0.0007-inch (0.0177-mm) maximum indentation, ASTM F 970 at 125 lb (57 kg).
4. Resin Matrix Hardness: Not less than 78, as measured using Shore, Type D durometer per ASTM D 2240.

E. Colors and Patterns: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors].

2.6 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

1. Adhesives shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. VCT and Asphalt Tile Adhesives: Not more than 50 g/L.
 - b. Rubber Floor Adhesives: Not more than 60 g/L.
 - c. Terrazzo Floor Tile Adhesives: Not more than [65] <Insert value> g/L.
2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Seamless-Installation Accessories:

1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
 - a. Color: **[As selected by DEN Project Manager from manufacturer's full range to contrast with floor tile] [Match floor tile] <Insert color>**.
2. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.
 - a. Chemical-bonding compound shall have a VOC content of **[350] [510] <Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Chemical-bonding compound shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.
- E. Joint Sealant for Resilient Terrazzo Floor Tile: Silicone sealant of type and grade as recommended in writing by manufacturer to suit resilient terrazzo floor tile.
 1. Sealant shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 3. Joint-Sealant Color: **[White] [As selected by DEN Project Manager from manufacturer's full range to match floor tile] [Match floor tile] <Insert color>**.
- F. Sealers and Finish Coats for Resilient Terrazzo Floor Tile: Premium-type products as recommended by manufacturer for resilient terrazzo floor tile.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 - 4. Moisture Testing: Perform tests recommended by manufacturer[**and as follows**]. Proceed with installation only after substrates pass testing.
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of [3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)] **<Insert emission>** in 24 hours.
 - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum [75%] **<Insert acceptable percentage>** relative humidity level measurement.
- C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.
- D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- E. Do not install floor tiles until they are same temperature as space where they are to be installed.
 - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay tiles [**square with room axis**] [**at a 45-degree angle with room axis**] [**in pattern indicated**] **<Insert requirements>**.

- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles [**with grain running in one direction**] [**with grain direction alternating in adjacent tiles (basket-weave pattern)**] [**in pattern of colors and sizes indicated**].
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and doorframes.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- I. Seamless Installation:
 - 1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and heat weld with welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.
 - 2. Chemically Bonded Seams: Bond seams with chemical-bonding compound to permanently fuse sections into a seamless floor covering. Prepare seams and apply compound to produce tightly fitted seams without gaps, overlays, or excess bonding compound on floor covering surfaces.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.

- C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, visible adhesive and surface blemishes from floor tile surfaces before applying liquid floor polish.
 - 1. Apply [**one**] [**two**] [**three**] <Insert requirements> coat(s).
- E. Joint Sealant: Apply sealant to resilient terrazzo floor tile perimeter and around columns, at doorframes, and at other joints and penetrations.
- F. Sealers and Finish Coats: Remove soil, visible adhesive, and surface blemishes from resilient terrazzo floor tile surfaces before applying liquid cleaners, sealers, and finish products.
 - 1. Sealer: Apply two base coats of liquid sealer.
 - 2. Finish: Apply [**two**] [**three**] <Insert requirements> coats of liquid floor finish.
- G. Cover floor tile until Substantial Completion.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 096519

SECTION 096566 - RESILIENT ATHLETIC FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Interlocking, rubber floor tile.
2. Interlocking, suspended, polymer floor tile.
3. Interlocking, open-grid, vinyl floor tile.
4. Rubber mats.
5. Rubber floor tile.
6. Rubber-strip floor tile.
7. Rubber sheet flooring.
8. Sheet vinyl flooring.

- B. Related Sections:

1. Section 096466 "Wood Athletic Flooring" for resilient wood flooring.
2. Section 096513 "Resilient Base and Accessories" for wall base and accessories installed with flooring.
3. Section 096766 "Fluid-Applied Athletic Flooring" for liquid polyurethane flooring applied directly to substrates or pads.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1. Include data substantiating that materials comply with requirements.

- B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
 3. Product Data for Credit IEQ 4.2: For game-line and marker paints, documentation including printed statement of VOC content.
 4. Product Data for Credit IEQ 4.3: For adhesives [**and game-line and marker paints**], documentation including printed statement of VOC content.
 5. Product Data for Credit IEQ 4.3: For resilient athletic flooring, documentation from an independent testing agency indicating compliance with the FloorScore Standard.
 6. Laboratory Test Reports for Credit IEQ 4: For [**adhesives**] [**game-line and marker paints**] [**and**] [**flooring system**], documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Show installation details and locations of the following:
1. Border tiles.
 2. Floor patterns.
 3. Layout, colors, widths, and dimensions of game lines and markers.
 4. Locations of floor inserts for athletic equipment installed through flooring.
 5. Seam locations for sheet flooring.
- D. Samples for Initial Selection: For each type of flooring indicated.
1. Game-Line and Marker Paint: Include charts showing available colors and glosses.
- E. Samples for Verification: For each type, color, and pattern of flooring indicated, [6-inch- (150-mm-)] <Insert dimension> square Samples of same thickness and material indicated for the Work.
1. Game-Line- and Marker-Paint Samples: Include Sample sets showing game-line- and marker-paint colors applied to flooring.
 2. Seam Samples: For each vinyl sheet flooring color and pattern required; with seam running lengthwise and in center of [6-by-9-inch (150-by-230-mm)] <Insert dimensions> Sample applied to a rigid backing and prepared by Installer for this Project.
- 1.4 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For qualified sheet vinyl flooring Installer.
- 1.5 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For flooring to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300

"Submittal Procedures".

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Floor Tile: Furnish no fewer than [**1 box for each 50 boxes**] <Insert quantity> or fraction thereof, of each type, color, pattern, and size of floor tile installed.
 2. Sheet Flooring: Furnish full-width rolls of not less than [**10 linear feet** (3 linear m) **for each 500 linear feet** (150 linear m)] <Insert quantity> or fraction thereof, of each type, color, and pattern of flooring installed.

1.7 QUALITY ASSURANCE

- A. Sheet Vinyl Flooring Installer Qualifications: An experienced Installer who has completed sheet vinyl flooring installations using seaming methods indicated for this Project and similar in material, design, and extent to that indicated for this Project; who is acceptable to manufacturer; and whose work has resulted in installations with a record of successful in-service performance.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storing.
- B. Store materials to prevent deterioration. Store [**tiles on flat surfaces**] [**and**] [**rolls upright**].

1.9 FIELD CONDITIONS

- A. Adhesively Applied Products:
1. Maintain temperatures during installation within range recommended in writing by manufacturer, but not less than [**70 deg F** (21 deg C)] <Insert temperature> or more than [**95 deg F** (35 deg C)] <Insert temperature>, in spaces to receive flooring 48 hours before installation, during installation, and 48 hours after installation unless longer period is recommended in writing by manufacturer.
 2. After postinstallation period, maintain temperatures within range recommended in writing by manufacturer, but not less than [**55 deg F** (13 deg C)] <Insert temperature> or more than [**95 deg F** (35 deg C)] <Insert temperature>.
 3. Close spaces to traffic during flooring installation.
 4. Close spaces to traffic for 48 hours after flooring installation unless manufacturer recommends longer period in writing.
- B. Install flooring after other finishing operations, including painting, have been

completed.

1.10 COORDINATION

- A. Coordinate layout and installation of flooring with floor inserts for gymnasium equipment.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. FloorScore Compliance: Resilient athletic flooring shall comply with requirements of FloorScore Standard.
- B. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 INTERLOCKING, RUBBER FLOOR TILE <Insert drawing designation>

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Action Floor Systems, LLC.
 - 2. Amarco Products.
 - 3. American Floor Products Company, Inc.
 - 4. E CORE International.
 - 5. Flexco.
 - 6. Horner Flooring Company, Inc.
 - 7. Johnsonite; a Tarkett company.
 - 8. Mondo America Inc.
 - 9. Musson Rubber Co.
 - 10. Pawling Corporation; Architectural Products Division.
 - 11. <Insert manufacturer's name>.
 - 12. or approved equal.
- B. Description: Athletic flooring consisting of modular rubber tiles with precision cut, interlocking edges, for free-lay installation.

- C. Material: **[Rubber] [Recycled-rubber compound]**.
- D. Tile Interlock: **[Visible] [Hidden]**.
- E. Traffic-Surface Texture: **[Smooth] [Nondirectional, stipple texture] [Textured]**
<Insert texture>.
1. Provide reversible tiles (with traffic-surface texture on both sides).
- F. Size: **[Manufacturer's standard-size square tile] [24 inches (610 mm) square]**
<Insert dimension>.
- G. Thickness: **[3/8 inch (9.5 mm)] [7/16 inch (11.1 mm)] [1/2 inch (13 mm)] [9/16 inch (14.3 mm)] [3/4 inch (19 mm)] <Insert dimension>**.
- H. Weight: Not less than **<Insert weight>** per tile.
- I. Color and Pattern: **[As selected by DEN Project Manager from manufacturer's full range] [As indicated by manufacturer's designations] <Insert color and pattern>**.
- J. Border: Interlocking, beveled-edge tiles, of same material as floor tile; with bevels that transition from thickness of floor tile to surface below it; with straight outside edges; and for use where flooring corners and edges do not abut vertical surfaces.
1. Border Color and Pattern: **[Matching floor tile] [As selected by DEN Project Manager from manufacturer's full range to contrast with floor tile] [As indicated by manufacturer's designations] <Insert color and pattern>**.
- 2.3 INTERLOCKING, SUSPENDED, POLYMER FLOOR TILE **<Insert drawing designation>**
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amarco Products.
 2. Mateflex.
 3. Sport Court; Subsidiary of Connor Sport Court International.
 4. Surface America Incorporated.
 5. **<Insert manufacturer's name>**.
 6. or approved equal.
- B. Description: Athletic flooring consisting of modular, polymer tiles raised above substrate on gusseted ribs or posts; with hidden, interlocking connectors; for free-lay installation **[over adhered rubber sheet underlayment]**.
- C. Material: **[Solid polypropylene] [Polypropylene supports with vinyl insert] <Insert material>**.
- D. Tile Interlock: Manufacturer's standard.

- E. Traffic-Surface Texture: [**Solid**] [**Raised disc**] <Insert texture>.
 - F. Size: [**Manufacturer's standard-size square tile**] [**12 inches** (305 mm) **square**] [**9.8 inches** (250 mm) **square**] <Insert dimension>.
 - G. Thickness: [**1/2 inch** (13 mm)] <Insert dimension>.
 - H. Weight: Not less than <Insert weight> per tile.
 - I. Color and Pattern: [**As selected by DEN Project Manager from manufacturer's full range**] [**As indicated by manufacturer's designations**] <Insert color and pattern>.
 - J. Underlayment:
 - 1. Material: [**Manufacturer's standard rubber sheet**] [**Recycled-rubber sheet**].
 - a. Thickness: [**0.08 inch** (2 mm)] [**0.12 inch** (3 mm)] <Insert dimension>.
 - K. Border: Interlocking, beveled-edge tiles, of same material as floor tile; with bevels that transition from thickness of floor tile to surface below it; with straight outside edges; and for use where flooring corners and edges do not abut vertical surfaces.
 - 1. Border Color and Pattern: [**Matching floor tile**] [**As selected by DEN Project Manager from manufacturer's full range to contrast with floor tile**] [**As indicated by manufacturer's designations**] <Insert color and pattern>.
- 2.4 INTERLOCKING, OPEN-GRID, VINYL FLOOR TILE <Insert drawing designation>
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amarco Products.
 - 2. American Floor Products Company, Inc.
 - 3. Mateflex.
 - 4. Musson Rubber Co.
 - 5. Surface America Incorporated.
 - 6. <Insert manufacturer's name>.
 - 7. or approved equal.
 - B. Description: Athletic flooring consisting of modular, polymer tiles with openings to permit free drainage of water; with hidden, interlocking connectors; for free-lay installation.
 - C. Material: [**Vinyl**] [**Recycled-vinyl compound**] <Insert description>.
 - D. Tile Interlock: Manufacturer's standard.
 - E. Size: **12 inches** (305 mm) square.

- F. Thickness: [1/4 inch (6.4 mm)] [3/8 inch (9.5 mm)] [7/16 inch (11.1 mm)] [3/4 inch (19 mm)] <Insert dimension>.
- G. Color and Pattern: [As selected by DEN Project Manager from manufacturer's full range] [As indicated by manufacturer's designations] <Insert color and pattern>.
- H. Border: Interlocking, beveled-edge tiles, of same material as floor tile; with bevels that transition from thickness of floor tile to surface below it; with straight outside edges; and for use where flooring corners and edges do not abut vertical surfaces.
 - 1. Border Color and Pattern: [Matching floor tile] [As selected by DEN Project Manager from manufacturer's full range to contrast with floor tile] [As indicated by manufacturer's designations] <Insert color and pattern>.

2.5 RUBBER MATS <Insert drawing designation>

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amarco Products.
 - 2. American Floor Products Company, Inc.
 - 3. Musson Rubber Co.
 - 4. Pawling Corporation; Architectural Products Division.
 - 5. Surface America Incorporated.
 - 6. Tuflex Rubber Flooring; a division of Tuflex Rubber Products, Inc.
 - 7. <Insert manufacturer's name>.
 - 8. or approved equal.
- B. Description: Individual rubber mats specifically designed for free-lay athletic flooring applications.
- C. Material: Recycled-rubber compound.
- D. Traffic-Surface Texture: Smooth.
- E. Size: [48 by 72 inches (1219 by 1829 mm)] <Insert dimensions>.
- F. Thickness: [3/8 inch (9.5 mm)] [1/2 inch (13 mm)] <Insert dimension>.
- G. Color: [As selected by DEN Project Manager from manufacturer's full range] [As indicated by manufacturer's designations] <Insert color and pattern>.

2.6 RUBBER FLOOR TILE <Insert drawing designation>

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acer Flooring, LLC.
 - 2. Action Floor Systems, LLC.

3. Amarco Products.
 4. American Floor Products Company, Inc.
 5. E CORE International.
 6. Flexco.
 7. Horner Flooring Company, Inc.
 8. Johnsonite; a Tarkett company.
 9. Mondo America Inc.
 10. Musson Rubber Co.
 11. nora systems, Inc.
 12. Robbins Sports Surfaces.
 13. Roppe Corporation.
 14. Sport Court; Subsidiary of Connor Sport Court International.
 15. Surface America Incorporated.
 16. Tuflex Rubber Flooring; a division of Tuflex Rubber Products, Inc.
 17. **<Insert manufacturer's name>**.
 18. or approved equal.
- B. Description: Athletic flooring consisting of modular rubber tiles with smooth edges for adhered application.
- C. Material: **[Rubber] [Recycled-rubber compound] [Rubber wear layer and rubber shock-absorbent layer, vulcanized together] <Insert description>**.
- D. Traffic-Surface Texture: **[Smooth] [Nondirectional, stipple texture] [Textured] <Insert description>**.
- E. Size: **[Manufacturer's standard-size square tile] [18 inches (457 mm) square] [24 inches (610 mm) square] [36 inches (914 mm) square] <Insert dimension>**.
- F. Thickness: **[5/32 inch (4 mm)] [1/4 inch (6.4 mm)] [3/8 inch (9.5 mm)] [1/2 inch (13 mm)] <Insert dimension>**.
- G. Weight: Not less than **<Insert weight>** per tile.
- H. Color and Pattern: **[As selected by DEN Project Manager from manufacturer's full range] [As indicated by manufacturer's designations] <Insert color and pattern>**.
- I. Border: Interlocking, beveled-edge tiles, of same material as floor tile; with bevels that transition from thickness of floor tile to surface below it; with straight outside edges; and for use where flooring corners and edges do not abut vertical surfaces.
1. Border Color and Pattern: **[Matching floor tile] [As selected by DEN Project Manager from manufacturer's full range to contrast with floor tile] [As indicated by manufacturer's designations] <Insert color and pattern>**.
- 2.7 RUBBER-STRIP FLOOR TILE **<Insert drawing designation>**
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amarco Products.
 2. American Floor Products Company, Inc.
 3. Flexco.
 4. Johnsonite; a Tarkett company.
 5. Musson Rubber Co.
 6. Roppe Corporation.
 7. **<Insert manufacturer's name>**.
 8. or approved equal.
- B. Description: Modular, close-nap, carpetlike tiles of rubber-fabric strips; made from recycled tires; bonded to a backing; for adhered installation.
- C. Materials: Recycled rubber.
- D. Fire-Test-Response Characteristics: Passing 16 CFR 1630 (DOC FF-1-70).
- E. Size: **12 inches** (305 mm) square.
- F. Thickness: **3/8 inch** (9.5 mm).
- G. Color and Pattern: **[As selected by DEN Project Manager from manufacturer's full range] [As indicated by manufacturer's designations] <Insert color and pattern>**.

2.8 RUBBER SHEET FLOORING **<Insert drawing designation>**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Acer Flooring, LLC.
 2. Action Floor Systems, LLC.
 3. Amarco Products.
 4. American Floor Products Company, Inc.
 5. E CORE International.
 6. Flexco.
 7. Horner Flooring Company, Inc.
 8. Johnsonite; a Tarkett company.
 9. Mondo America Inc.
 10. nora systems, Inc.
 11. Robbins Sports Surfaces.
 12. Roppe Corporation.
 13. Sport Court; Subsidiary of Connor Sport Court International.
 14. Surface America Incorporated.
 15. **<Insert manufacturer's name>**.
 16. or approved equal.
- B. Description: Rubber athletic flooring provided as rolled goods for adhered installation.
- C. Material: **[Recycled-rubber compound] [Rubber wear layer and rubber shock-absorbent layer, vulcanized together] <Insert description>**.

- D. Traffic-Surface Texture: [**Smooth**] <Insert description>.
- E. Roll Size: [**Not less than 48 inches** (1219 mm)] <Insert dimension> wide by longest length that is practical to minimize splicing during installation.
 - 1. Thickness: [**1/4 inch** (6.4 mm)] [**3/8 inch** (9.5 mm)] <Insert dimension>.
- F. Color and Pattern: [**As selected by DEN Project Manager from manufacturer's full range**] [**As indicated by manufacturer's designations**] <Insert color and pattern>.
- G. Border: Interlocking, beveled-edge tiles, of same material as floor tile; with bevels that transition from thickness of floor tile to surface below it; with straight outside edges; and for use where flooring corners and edges do not abut vertical surfaces.
 - 1. Border Color and Pattern: [**Matching floor tile**] [**As selected by DEN Project Manager from manufacturer's full range to contrast with floor tile**] [**As indicated by manufacturer's designations**] <Insert color and pattern>.

2.9 SHEET VINYL FLOORING <Insert drawing designation>

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amarco Products.
 - 2. Gerflor/Taraflex Sports Flooring.
 - 3. Johnsonite; a Tarkett company.
 - 4. Lonseal, Inc.
 - 5. Robbins Sports Surfaces.
 - 6. Sport Court; Subsidiary of Connor Sport Court International.
 - 7. <Insert manufacturer's name>.
 - 8. or approved equal.
- B. Description: Sheet vinyl flooring specifically designed for adhered athletic flooring applications.
- C. Unbacked Sheet Vinyl Flooring: ASTM F 1913, [**0.08 inch** (2 mm)] <Insert dimension> thick.
 - 1. Separate underlayment pad of bonded recycled rubber and polyurethane particles.
- D. Sheet Vinyl Flooring with Backing: ASTM F 1303.
 - 1. Type (Binder Content): [**Type I, minimum binder content of 90 percent**] [**Type II, minimum binder content of 34 percent**].
 - 2. Wear-Layer Thickness: Grade 1.
 - 3. Overall Thickness: <Insert dimension>.
 - 4. Interlayer Material: [**Foamed plastic**] [**None**].
 - 5. Backing Class: [**Class B (nonfoamed plastic)**] [**Class C (foamed plastic)**].

- E. Seaming Method: **[Heat welded] [Chemically bonded]**.
- F. Traffic-Surface Texture: **[Smooth] [Embossed] <Insert description>**.
- G. Applied Finish: **[Factory-applied UV urethane] [Field-applied polyurethane] <Insert description>**.
- H. Roll Size: **[Not less than 48 inches (1219 mm)] <Insert dimension>** wide by longest length that is practical to minimize splicing during installation.
- I. Color and Pattern: **[As selected by DEN Project Manager from manufacturer's full range] [As indicated by manufacturer's designations] <Insert color and pattern>**.

2.10 ACCESSORIES

- A. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.
- B. Adhesives: Water-resistant type recommended in writing by manufacturer for substrate and conditions indicated.
 - 1. Adhesives shall have a VOC content of **[50] [60] <Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Game-Line and Marker Paint: Complete system including primer, if any, compatible with flooring and recommended in writing by flooring and paint manufacturers for use indicated.
 - 1. VOC Content: Not more than 150 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Paint shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements

specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of flooring.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Alkalinity Testing: Perform pH testing according to ASTM F 710. Proceed with installation only if pH readings are not less than 7.0 and not greater than 8.5.
 - 3. Moisture Testing:
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of [3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)] <Insert rate> in 24 hours.
 - 1) Perform tests so that each test area does not exceed [200 sq. ft. (18.6 sq. m)] <Insert area>, and perform no fewer than two tests in each installation area and with test areas evenly spaced in installation areas.
 - b. Perform relative humidity test using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum [75] <Insert number> percent relative humidity level measurement.
- C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.
- D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- E. Move flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation unless manufacturer recommends a longer period in writing.
 - 1. Do not install flooring until they are same temperature as space where they are to be installed.
- F. Sweep and vacuum clean substrates to be covered by flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust.

- G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 FLOORING INSTALLATION, GENERAL

- A. Comply with manufacturer's written installation instructions.
- B. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.
- C. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.
- D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on flooring. Use nonpermanent, nonstaining marking device.

3.4 FLOOR TILE INSTALLATION

- A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay tiles [**square with room axis**] [**at a 45-degree angle with room axis**] [**in pattern indicated**] <Insert requirements>.
- B. Discard broken, cracked, chipped, or deformed tiles.
- C. Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged if so numbered.
 - 1. Lay tiles [**with grain running in one direction**] [**with grain direction alternating in adjacent tiles (basket-weave pattern)**] [**in pattern of colors and sizes indicated**].
- D. Adhered Flooring: Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
 - 1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- E. Free-Lay Flooring: Place flooring at locations indicated with all units securely interconnected and fully seated on substrate to form a smooth, level surface.

3.5 SHEET FLOORING INSTALLATION

- A. Unroll sheet flooring and allow it to stabilize before cutting and fitting.
- B. Lay out sheet flooring as follows:
 - 1. Maintain uniformity of flooring direction.
 - 2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least **6 inches** (150 mm) away from parallel joints in flooring substrates.
 - 3. Match edges of flooring for color shading at seams.
 - 4. Locate seams per approved Shop Drawings.
- C. Adhered Flooring: Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
 - 1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- D. Vinyl Sheet Flooring Seams: Prepare and finish seams to produce surfaces flush with adjoining flooring surfaces.
 - 1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless flooring.
 - 2. Chemically Bonded Seams: Comply with ASTM F 693. Seal seams to prevent openings from forming between cut edges and to prevent penetration of dirt, liquids, and other substances into seams.

3.6 GAME LINES AND MARKERS

- A. Mask flooring at game lines and markers, and apply paint to produce sharp edges. Where crossing, break minor game line at intersection; do not overlap lines.
- B. Lay out game lines and markers to comply with rules and diagrams published by **[National Collegiate Athletic Association (NCAA)] [National Federation of State High School Associations]** <Insert organization> for athletic activities indicated.

3.7 FIELD-APPLIED FINISHES

- A. Apply finish after game-line and marker paint is fully cured.
- B. Apply finish according to manufacturer's written instructions to produce a sealed surface that is ready for use.
- C. Do not cover flooring after finishing until finish reaches full cure.

3.8 CLEANING AND PROTECTING

- A. Perform the following operations immediately after completing flooring installation:
1. Remove adhesive and other blemishes from flooring surfaces.
 2. Sweep and vacuum flooring thoroughly.
 3. Damp-mop flooring to remove marks and soil after time period recommended in writing by manufacturer.
- B. Protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 096566

SECTION 096613 - PORTLAND CEMENT TERRAZZO FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Poured-in-place Portland cement terrazzo flooring[**and base**].
2. Poured-in-place rustic terrazzo flooring.
3. Precast terrazzo units.

- B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealants installed with terrazzo.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. Aggregate: Marble chips[**or other types of aggregate**].

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>**.
 1. Review methods and procedures related to terrazzo including, but not limited to, the following:
 - a. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
 - b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - c. Review special terrazzo designs and patterns.
 - d. Review procedures for coping with unfavorable forecasted weather conditions.

e. <Insert agenda items>.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
 3. Product Data for Credit IEQ 4.3: For sealers, documentation including printed statement of VOC content.
 4. Product Data for Credit IEQ 4.3: For terrazzo flooring, documentation from an independent testing agency indicating compliance with the FloorScore Standard.
 5. Laboratory Test Reports for Credit IEQ 4: For **[adhesives] [and] [flooring system]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Include terrazzo installation requirements. Include plans, elevations, sections, component details, and attachments to other work. Show layout of the following:
1. Divider strips.
 2. Control-joint strips.
 3. Expansion-joint strips.
 4. Accessory strips.
 5. Abrasive strips.
 6. Stair treads, risers, and landings.
 7. Precast terrazzo jointing and edge configurations.
 8. Terrazzo patterns.
 9. **<Insert requirements>**.
- D. Samples: For each exposed product and for each color and texture specified, **[6 inches (150 mm)] <Insert dimension>** in size.
- E. Samples for Initial Selection: NTMA color plates showing the full range of colors and patterns available for each terrazzo type.
- F. Samples for Verification: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each terrazzo sample to identify manufacturer's matrix color and

aggregate types, sizes, and proportions. Prepare Samples of same thickness and from same material to be used for the Work, in size indicated below:

1. Terrazzo: [6-inch- (150-mm-)] <Insert dimension> square Samples.
2. Precast Terrazzo: [6-inch- (150-mm-)] <Insert dimension> square Samples.
3. Accessories: [6-inch- (150-mm-)] <Insert dimension> long Samples of each exposed strip item required.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Material Certificates: For each type of terrazzo material or product, from manufacturer.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For terrazzo to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An installer who is a contractor member of NTMA.
- B. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of granular materials from single source with resources to provide materials of consistent quality in appearance and physical properties.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Build mockups for terrazzo including accessories.
 - a. Size: Minimum **100 sq. ft.** (9 sq. m) of typical poured-in-place flooring condition for each color and pattern [**in locations indicated**] [**in locations directed by DEN Project Manager**] <Insert location requirements>.
 - b. Include [**base**] [**first three stair treads**] <Insert item>.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with sources or manufacturer's name, material or product brand name, and lot number if any.
- B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Maintain temperature above 50 deg F (10 deg C) for 48 hours before and during terrazzo installation.
- B. Weather Limitations: Proceed with rustic terrazzo installation only when forecasted weather conditions permit work to be performed according to NTMA's written recommendations and temperatures remain above 45 deg F (7.2 deg C).
- C. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.
- D. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.
- E. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.
- F. Control and collect water and dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NTMA Standards: Comply with NTMA's "Terrazzo Specifications and Design Guide" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.
- B. FloorScore Compliance: Terrazzo floors shall comply with requirements of FloorScore Standard.

- C. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 PORTLAND CEMENT TERRAZZO

- A. Portland Cement Terrazzo System **<Insert designation>**: [**Sand cushion**] [**Bonded**] [**Monolithic**].

1. Underbed: Comply with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo system indicated for component proportions and mixing.
2. Topping: Comply with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo system indicated for matrix and aggregate proportions and mixing.
 - a. Terrazzo Topping Thickness: [**As indicated**] **<Insert dimension>**.
 - b. Formulated Mix Color and Pattern: [**As selected by DEN Project Manager from NTMA standard-terrazzo plates**] [**As selected by DEN Project Manager from NTMA Venetian-terrazzo plates**] **<Insert NTMA color plate designation>**.
 - c. Custom Mix Color and Pattern: [**Match DEN Project Manager's sample**] [**Match existing**] **<Insert custom design-mix attributes>**.

- B. Materials:

1. Portland Cement: ASTM C 150, Type 1.
 - a. Color for Exposed Matrix: [**As required by mix indicated**] [**White**] [**Gray**] **<Insert requirements>**.
2. Water: Potable.
3. Sand: ASTM C 33/C 33M.
4. Aggregates: Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.
 - a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C 131[**and ASTM C 535**].
 - b. 24-Hour Absorption Rate: Less than 0.75 percent.
 - c. Dust Content: Less than 1.0 percent by weight.
 - d. Recycled Content of Portland Cement Terrazzo Flooring: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
5. Matrix Pigments: Pure mineral or synthetic pigments, alkali resistant, durable under exposure to sunlight, and compatible with terrazzo matrix.
6. Bonding Agent: Neat Portland cement, or epoxy or acrylic bonding agents formulated for use with topping indicated.

7. Underbed Reinforcement: Galvanized welded-wire reinforcement, wire **2 by 2 inches** (51 by 51 mm) by **0.062 inch** (1.57 mm) in diameter, complying with ASTM A 185/A 185M and ASTM A 82/A 82M, except for minimum wire size.
8. Isolation Membrane: Polyethylene sheeting, ASTM D 2103, Type 13300, **4 mils** (0.1 mm) thick; or unperforated asphalt felt, ASTM D 226, Type I (No. 15).

2.3 RUSTIC TERRAZZO

A. Rustic Terrazzo System <Insert designation>: **[Bonded] [Monolithic]**.

1. Underbed: Comply with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo system indicated for component proportions and mixing.
2. Terrazzo Topping: Comply with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo system indicated for matrix and aggregate proportions and mixing.
 - a. Terrazzo Topping Thickness: **[As indicated] <Insert dimension>**.
 - b. Formulated Mix Color and Pattern: **[As selected by DEN Project Manager from NTMA rustic-terrazzo plates] <Insert NTMA color plate designation>**.
 - c. Custom Mix Color and Pattern: **[Match DEN Project Manager's sample] [Match existing] <Insert custom design-mix attributes>**.

B. Materials:

1. Portland Cement: ASTM C 150, Type 1.
 - a. Color for Exposed Matrix: **[As required by mix indicated] <Insert requirements>**.
2. Water: Potable.
3. Sand: ASTM C 33/C 33M.
4. Aggregates: As required for mix indicated, sizes comply with NTMA gradation standards and a 0.25 percent maximum 24-hour absorption rate, and aggregates contain no deleterious or foreign matter.
 - a. Recycled Content of Rustic Terrazzo Flooring: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
5. Matrix Pigments: Pure mineral or synthetic pigments, alkali resistant, durable under exposure to sunlight and weather, and compatible with matrix binder.
6. Air-Entraining Agent: Complies with NTMA's written recommendations and supplier recommendations for intended use.
7. Underbed Bonding Agent: Neat Portland cement.
8. Topping Bonding Agent: Neat Portland cement, or epoxy or acrylic bonding agents formulated for use with topping indicated.

2.4 PRECAST TERRAZZO

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Precast Terrazzo Enterprises, Inc.
 2. Romoco Precast Terrazzo Products.
 3. Wausau Tile, Inc.; Terra Paving Products Division.
 4. **<Insert manufacturer's name>**.
 5. or approved equal.
- B. Precast Terrazzo Base **<Insert designation>**: Minimum **3/4-inch-** (19-mm-) thick, reinforced, Portland cement terrazzo units cast in maximum lengths possible, but not less than **36 inches** (900 mm). Comply with NTMA's written recommendations for fabricating precast terrazzo base units in sizes and profiles indicated.
1. Type: **[As indicated] [Coved with minimum 3/4-inch (19-mm) radius] [Straight] [Splayed] <Insert requirements>**.
 2. Top Edge: **[Straight, unfinished] [Beveled with polished top surface] [Radius edge with polished top surface] <Insert requirements>**.
 3. Metal Toe Strip: **[Zinc] [Brass]**.
 4. Outside Corner Units: With finished returned edges at outside corner.
 5. Color, Pattern, and Finish: **[As selected by DEN Project Manager from full range of industry colors] [Match DEN Project Manager's sample] [Match adjacent poured-in-place terrazzo flooring] <Insert requirements>**.
- C. Precast Terrazzo Units **<Insert designation>**: Minimum **[3/4-inch- (19-mm-)] <Insert dimension>** thick, reinforced, Portland cement terrazzo units. Comply with NTMA's written recommendations for fabricating precast terrazzo units in sizes and profiles indicated. Reinforce units as required by unit sizes, profiles, and thicknesses and as recommended by manufacturer. Finish exposed-to-view edges and reveals to match face finish. Ease exposed edges to **1/8-inch** (3.2-mm) radius.
1. Tiles.
 2. Planks.
 3. Stair treads[**and landings**].
 4. Thresholds.
 5. Sills.
 6. Benches.
 7. Planters.
 8. Countertops.
 9. Shower bases.
 10. **<Insert item>**.
 11. Color, Pattern, and Finish: **[As selected by DEN Project Manager from full range of industry colors] [Match DEN Project Manager's sample] [Match adjacent poured-in-place terrazzo flooring] <Insert requirements>**.

2.5 STRIP MATERIALS

- A. Standard Divider Strips: One-piece, flat-type strips for grouting into sawed joints prepared in substrate.
1. Material: **[As indicated]** **[White-zinc alloy]** **[Brass]** **<Insert requirements>**.
 2. Depth: **[As indicated]** **[3/4 inch (19 mm)]** **[1-1/4 inches (32 mm)]** **[2 inches (51 mm)]** **<Insert dimension>**.
 3. Width: **[As indicated]** **[0.05 inch (1.27 mm)]** **[1/8 inch (3.2 mm)]** **[1/4 inch (6.4 mm)]** **<Insert dimension>**.
- B. Heavy-Top Divider Strips: One-piece, flat-type strips for grouting into sawed joints prepared in substrate.
1. Base-Section Material: **[As indicated]** **[White-zinc alloy]** **[Galvanized steel]** **<Insert requirements>**.
 2. Top-Section Material: **[As indicated]** **[White-zinc alloy]** **[Brass]** **[Plastic, in color selected from full range of industry colors]** **<Insert requirements>**.
 3. Depth: **[As indicated]** **[3/4 inch (19 mm)]** **[1-1/4 inches (32 mm)]** **[2 inches (51 mm)]** **<Insert dimension>**.
 4. Top-Section Width: **[As indicated]** **[1/8 inch (3.2 mm)]** **[1/4 inch (6.4 mm)]** **[1/2 inch (12.7 mm)]** **<Insert dimension>**.
- C. Heavy-Top Angle Divider Strips: One-piece, L-type angle strips with anchoring device and in depth required for topping thickness indicated.
1. Material: **[As indicated]** **[White-zinc alloy]** **[Brass]** **[Plastic, in color selected from full range of industry colors]** **<Insert requirements>**.
 2. Top-Section Width: **[As indicated]** **[1/8 inch (3.2 mm)]** **[1/4 inch (6.4 mm)]** **[3/8 inch (9.5 mm)]** **[1/2 inch (12.7 mm)]** **<Insert dimension>**.
- D. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.
- E. Expansion-Joint Strips: **[Brass]** **[Plastic strips in color selected from full range of industry colors]**, with removable zip-strip top for installing sealant; **[in width indicated]** **[minimum 1/2 inch (12.7 mm) wide]** **<Insert width>**.
- F. Accessory Strips: Match divider-strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:
1. Base-bead strips for exposed top edge of terrazzo base.
 2. Edge-bead strips for exposed edges of terrazzo.
 3. Nosings for terrazzo stair treads and landings.
 4. **<Insert requirements>**.

- G. Abrasive Strips: **[Three-line] [Two-line] [One-line] [Abrasive nosing strip and two-line] <Insert requirements>** abrasive inserts at nosings. Silicon carbide or aluminum oxide, or combination of both, in epoxy-resin binder and set in channel.
1. Width: **[1/2 inch (12.7 mm)] <Insert dimension>**.
 2. Depth: As required by terrazzo thickness.
 3. Length: **[4 inches (100 mm) less than stair width] [As indicated] <Insert dimension>**.
 4. Color: **[As selected by DEN Project Manager from full range of industry colors] <Insert requirements>**.

2.6 MISCELLANEOUS ACCESSORIES

- A. Strip Adhesive: Recommended by manufacturer for this use.
1. Adhesives shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Anchoring Devices:
1. Strips: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and as required for secure attachment to substrate.
 2. Precast Terrazzo: Provide mechanical anchoring devices as recommended by fabricator for proper anchorage and support of units for conditions of installation and support.
- C. Isolation and Expansion-Joint Material: Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, and non-outgassing in unruptured state; butyl rubber; rubber; or cork; **[in width indicated] [minimum 1/2 inch (12.7 mm) wide] <Insert dimension>**.
- D. Portland Cement Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by cleaner manufacturer for use on terrazzo type indicated.
- E. Rustic Terrazzo Cleaner: Solution of muriatic acid and water for use on terrazzo type indicated.
- F. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; is recommended by sealer manufacturer; and complies with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated.
1. Surface Friction: Not less than 0.6 according to ASTM D 2047.
 2. Acid-Base Properties: With pH factor between 7 and 10.

3. Sealers shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
4. Rustic Terrazzo: Use solvent acrylic-type sealer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions, including levelness tolerances, have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.
 1. Roughen concrete substrates before installing terrazzo system according to NTMA's written recommendations.
- B. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
 1. Moisture Testing: Perform tests indicated below.
 - a. Calcium Chloride Test: Perform anhydrous calcium chloride test per ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of [3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)] <Insert rate> in 24 hours.
 - 1) Perform tests so that each test area does not exceed [200 sq. ft. (18.6 sq. m)] <Insert area>, and perform not less than two tests in each installation area and with test areas evenly spaced in installation areas.
 - b. In-Situ Probe Test: Perform relative-humidity test using in-situ probes per ASTM F 2170. Proceed with installation only after substrates have a maximum [75] <Insert number> percent relative-humidity-level measurement.
 - c. Test Method: Test for moisture content by [method recommended in writing by terrazzo manufacturer] <Insert test method>. Proceed with installation only after substrates pass testing.

- C. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.
 - 1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

3.3 INSTALLATION, GENERAL

- A. Comply with NTMA's written recommendations for terrazzo and accessory installation.
- B. Installation Tolerance: Limit variation in terrazzo surface from level to [1/4 inch in 10 feet (6.4 mm in 3 m)] **<Insert dimensions>**; noncumulative.
- C. Rustic Terrazzo: Install isolation and expansion material where abutting adjacent construction and directly above substrate expansion joints.
- D. Underbed:
 - 1. Comply with NTMA's "Terrazzo Specifications and Design Guide" for underbed installation.
 - 2. Cover entire surface to receive terrazzo with dusting of sand.
 - 3. Install isolation membrane over sand, overlapping ends and edges a minimum of **3 inches** (75 mm).
 - 4. Install welded-wire reinforcement, overlapping at edges and ends at least two squares. [**Stop mesh a minimum of 1 inch** (25 mm) **short of expansion joints.**]
 - 5. Place underbed and screed to elevation indicated below finished floor elevation.
- E. Strip Materials:
 - 1. Divider and Control-Joint Strips:
 - a. Locate divider strips [**over each edge of steel beams and girders**] [**centered over steel beams and joists**] [**directly over control joints, breaks, and saw cuts in concrete slabs**] [**in locations indicated**] **<Insert requirements>**.
 - b. Install control-joint strips [**back to back and directly above concrete-slab control joints**] [**in locations indicated**] **<Insert requirements>**.
 - c. Install control-joint strips with [1/4-inch (6.4-mm)] **<Insert dimension>** gap between strips, and install sealant in gap.
 - d. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.
 - 2. Expansion-Joint Strips: Form expansion joints using divider strips and install directly above concrete-slab expansion joints.
 - 3. Accessory Strips: Install as required to provide a complete installation.
 - 4. Abrasive Strips: Install with surface of abrasive strip positioned [1/16 inch (1.6 mm)] **<Insert dimension>** higher than terrazzo surface.

3.4 POURED-IN-PLACE TERRAZZO INSTALLATION

- A. Pour in place and seed additional aggregates in matrix to uniformly distribute granular material and produce a surface with a minimum of 70 percent aggregate exposure. Cure and finish Portland cement terrazzo according to NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated.
- B. Grinding: Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted.

3.5 PRECAST TERRAZZO INSTALLATION

- A. Install precast terrazzo units using method recommended by NTMA and manufacturer unless otherwise indicated.
- B. Do not install units that are chipped, cracked, discolored, or improperly finished.
- C. Seal joints between units with **[cement grout matching precast terrazzo matrix]** **[joint sealant]** <Insert requirements>.

3.6 REPAIR

- A. Cut out and replace terrazzo areas that evidence lack of bond with substrate or underbed, including areas that emit a "hollow" sound if tapped. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by DEN Project Manager.

3.7 CLEANING AND PROTECTION

- A. Terrazzo Cleaning:
 - 1. Remove grinding dust from installation and adjacent areas.
 - 2. Wash surfaces with cleaner immediately after final cleaning of terrazzo flooring according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.
- B. Rustic Terrazzo Cleaning: Clean surfaces with 1:10 solution of muriatic acid in water. Legally contain and dispose of runoff from cleaning operations. Rinse surfaces with water and allow them to dry thoroughly.
- C. Sealing:
 - 1. Seal surfaces according to NTMA's written recommendations.
 - 2. Apply sealer according to sealer manufacturer's written instructions.
- D. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 096613

SECTION 096623 - RESINOUS MATRIX TERRAZZO FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Thin-set, epoxy-resin terrazzo flooring[**and base**].
- 2. Precast epoxy-resin terrazzo units.

- B. Related Requirements:

- 1. Section 079200 "Joint Sealants" for sealants installed with terrazzo.
- 2. Section 096723 "Resinous Flooring" for decorative resinous flooring systems applied as self-leveling slurries or as troweled or screeded mortars.
- 3. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. Aggregate: Marble chips[**or other types of aggregate**].

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.
 - 1. Review methods and procedures related to terrazzo including, but not limited to, the following:
 - a. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
 - b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - c. Review special terrazzo designs and patterns.
 - d. **<Insert agenda items>**.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
 3. Product Data for Credit IEQ 4.3: For sealers, documentation including printed statement of VOC content.
 4. Product Data for Credit IEQ 4.3: For terrazzo flooring, documentation from an independent testing agency indicating compliance with the FloorScore Standard.
 5. Laboratory Test Reports for Credit IEQ 4: For **[adhesives] [and] [flooring system]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Include terrazzo installation requirements. Include plans, elevations, sections, component details, and attachments to other work. Show layout of the following:
1. Divider strips.
 2. Control-joint strips.
 3. Accessory strips.
 4. Abrasive strips.
 5. Stair treads, risers, and landings.
 6. Precast terrazzo jointing and edge configurations.
 7. Terrazzo patterns.
 8. **<Insert requirements>**.
- D. Samples: For each exposed product and for each color and texture specified, **[6 inches (150 mm)] <Insert dimension>** in size.
- E. Samples for Initial Selection: NTMA color plates showing the full range of colors and patterns available for each terrazzo type.
- F. Samples for Verification: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each terrazzo sample to identify manufacturer's matrix color and aggregate types, sizes, and proportions. Prepare Samples of same thickness and from same material to be used for the Work, in size indicated below:
1. Terrazzo: **[6-inch- (150-mm-)] <Insert dimension>** square Samples.

2. Precast Terrazzo: [6-inch- (150-mm-)] <Insert dimension> square Samples.
3. Accessories: [6-inch- (150-mm-)] <Insert dimension> long Samples of each exposed strip item required.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Material Certificates: For each type of terrazzo material or product, from manufacturer.
- C. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For terrazzo to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Engage an installer who is a contractor member of NTMA.
 2. Engage an installer who is certified in writing by terrazzo manufacturer as qualified to install manufacturer's products.
- B. Source Limitations: Obtain primary terrazzo materials from single source from single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.
- C. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of granular materials from single source with resources to provide materials of consistent quality in appearance and physical properties.
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Build mockups for terrazzo including accessories.
 - a. Size: Minimum 100 sq. ft. (9 sq. m) of typical poured-in-place flooring[and base] condition for each color and pattern [in locations indicated] [in locations directed by DEN Project Manager] <Insert location requirements>.
 - b. Include [base] [first three stair treads] <Insert item>.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with sources or manufacturer's name, material or product brand name, and lot number if any.
- B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.
- B. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.
- C. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.
- D. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.
- E. Control and collect water and dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NTMA Standards: Comply with NTMA's "Terrazzo Specifications and Design Guide" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.

- B. FloorScore Compliance: Terrazzo floors shall comply with requirements of FloorScore Standard.
- C. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 EPOXY-RESIN TERRAZZO

- A. Epoxy-Resin Terrazzo **<Insert designation>**: Comply with NTMA's "Terrazzo Specifications and Design Guide" and manufacturer's written instructions for matrix and aggregate proportions and mixing.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Crossfield Products Corp., Dex-O-Tex Division; [**Cheminert**] [**Spectrum**] Terrazzo.
 - b. General Polymers Corporation; Terrazzo 1100.
 - c. Key Resin Company; Key Epoxy Terrazzo.
 - d. Master Terrazzo Technologies LLC; Morricite.
 - e. Quadrant Chemical Corporation; Quadset Epoxy Terrazzo.
 - f. TEC Specialty Construction Brands, Inc.; Tuff-Lite Epoxy Terrazzo.
 - g. Terrazzo & Marble Supply Companies; Terroxy Resin Systems.
 - h. **<Insert manufacturer's name; product name or designation>**.
 - i. or approved equal.
 - 2. Thickness: [**1/4 inch** (6.4 mm)] [**3/8 inch** (9.5 mm)] [**As indicated**] **<Insert dimension>** nominal.
 - 3. Formulated Mix Color and Pattern: [**As selected by DEN Project Manager from full range of industry colors**] [**As selected by DEN Project Manager from NTMA standard-terrazzo plates**] [**As selected by DEN Project Manager from NTMA thin-set terrazzo plates**] **<Insert manufacturer's or NTMA's color plate designation>**.
 - 4. Custom Mix Color and Pattern: [**Match DEN Project Manager's sample**] [**Match existing**] **<Insert custom design-mix attributes>**.
- B. Materials:
 - 1. Flexible Reinforcing Membrane: Manufacturer's resinous membrane for substrate-crack preparation and reflective-crack reduction.
 - a. Reinforcement: Fiberglass scrim.
 - 2. Primer: [**Manufacturer's product recommended for substrate and use indicated**] **<Insert requirements>**.
 - 3. Epoxy-Resin Matrix: [**Manufacturer's standard recommended for use indicated**] **<Insert requirements>** and in color required for mix indicated.

- a. Physical Properties without Aggregates:
 - 1) Hardness: 60 to 85 per ASTM D 2240, Shore D.
 - 2) Minimum Tensile Strength: **3000 psi** (20.7 MPa) per ASTM D 638 for a **2-inch** (51-mm) specimen made using a "C" die per ASTM D 412.
 - 3) Minimum Compressive Strength: **10,000 psi** (6.9 MPa) per ASTM D 695, Specimen B cylinder.
 - 4) Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D 1308.
 - a) Distilled water.
 - b) Mineral water.
 - c) Isopropanol.
 - d) Ethanol.
 - e) 0.025 percent detergent solution.
 - f) 1.0 percent soap solution.
 - g) 10 percent sodium hydroxide.
 - h) 10 percent hydrochloric acid.
 - i) 30 percent sulfuric acid.
 - j) 5 percent acetic acid.
 - b. Physical Properties with Aggregates: For resin blended with Georgia white marble, ground, grouted, and cured per requirements in NTMA's "Terrazzo Specifications and Design Guide"; comply with the following:
 - 1) Flammability: Self-extinguishing, maximum extent of burning **1/4 inch** (6.35 mm) per ASTM D 635.
 - 2) Thermal Coefficient of Linear Expansion: **0.0025 inch/inch per deg F** (0.0025 mm/mm per 0.5556 deg C) for temperature range of **minus 12 to plus 140 deg F** (minus 24 to plus 60 deg C) per ASTM D 696.
4. Aggregates: Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.
 - a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C 131.
 - b. 24-Hour Absorption Rate: Less than 0.75 percent.
 - c. Dust Content: Less than 1.0 percent by weight.
 - d. Recycled Content of Epoxy-Resin Terrazzo: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
 5. Finishing Grout: Resin based.

2.3 PRECAST EPOXY-RESIN TERRAZZO

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Precast Terrazzo Enterprises, Inc.
 2. Romoco Precast Terrazzo Products.
 3. Wausau Tile, Inc.; Terra Paving Products Division.
 4. **<Insert manufacturer's name>**.
 5. or approved equal.
- B. Precast Terrazzo Base **<Insert designation>**: Minimum **3/4-inch-** (19-mm-) thick, reinforced portland cement terrazzo units cast in maximum lengths possible, but not less than **36 inches** (900 mm). Comply with NTMA's written recommendations for fabricating precast terrazzo base units in sizes and profiles indicated.
1. Type: **[As indicated] [Coved with minimum 3/4-inch (19-mm) radius] [Straight] [Splayed] <Insert requirements>**.
 2. Top Edge: **[Straight, unfinished] [Beveled with polished top surface] [Radius edge with polished top surface] <Insert requirements>**.
 3. Metal Toe Strip: **[Zinc] [Brass]**.
 4. Outside Corner Units: With finished returned edges at outside corner.
 5. Color, Pattern, and Finish: **[As selected by DEN Project Manager from full range of industry colors] [Match DEN Project Manager's sample] [Match adjacent poured-in-place terrazzo flooring] <Insert requirements>**.
- C. Precast Terrazzo Units **<Insert designation>**: Comply with NTMA's written recommendations for fabricating precast terrazzo units in sizes and profiles indicated. Reinforce units as required by unit sizes, profiles, and thicknesses and as recommended by manufacturer. Finish exposed-to-view edges and reveals to match face finish. Ease exposed edges to **1/8-inch** (3.2-mm) radius.
1. Tiles.
 2. Planks.
 3. Stair treads[**and landings**].
 4. Thresholds.
 5. Sills.
 6. Benches.
 7. Planters.
 8. Countertops.
 9. Shower bases.
 10. **<Insert item>**.
 11. Color, Pattern, and Finish: **[As selected by DEN Project Manager from full range of industry colors] [Match DEN Project Manager's sample] [Match adjacent poured-in-place terrazzo flooring] <Insert requirements>**.

2.4 STRIP MATERIALS

- A. Thin-Set Divider Strips: L-type angle, **1/4 inch** (6.4 mm) deep.
1. Material: **[As indicated] [White-zinc alloy] [Brass] [Aluminum] [Plastic, in color selected from full range of industry colors] <Insert requirements>**.
 2. Top Width: **[As indicated] [1/8 inch (3.2 mm)] [1/4 inch (6.4 mm)] <Insert dimension>**.

- B. Heavy-Top Divider Strips: L-type angle in depth required for topping thickness indicated.
1. Bottom-Section Material: **[As indicated] [Galvanized steel] [Matching top-section material]** <Insert requirements>.
 2. Top-Section Material: **[As indicated] [White-zinc alloy] [Brass] [Aluminum] [Plastic, in color selected from full range of industry colors]** <Insert requirements>.
 3. Top-Section Width: **[As indicated] [1/8 inch (3.2 mm)] [1/4 inch (6.4 mm)] [3/8 inch (9.5 mm)] [1/2 inch (12.7 mm)]** <Insert dimension>.
- C. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.
- D. Accessory Strips: Match divider-strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:
1. Base-bead strips for exposed top edge of terrazzo base.
 2. Edge-bead strips for exposed edges of terrazzo.
 3. Nosings for terrazzo stair treads and landings.
 4. **<Insert requirements>**.
- E. Abrasive Strips: **[Three-line] [Two-line] [One-line] [Abrasive nosing strip and two-line]** <Insert requirements> abrasive inserts at nosings. Silicon carbide or aluminum oxide, or combination of both, in epoxy-resin binder and set in channel.
1. Width: **[1/2 inch (12.7 mm)]** <Insert dimension>.
 2. Depth: As required by terrazzo thickness.
 3. Length: **[4 inches (100 mm) less than stair width] [As indicated]** <Insert dimension>.
 4. Color: **[As selected by DEN Project Manager from full range of industry colors]** <Insert requirements>.

2.5 MISCELLANEOUS ACCESSORIES

- A. Strip Adhesive: Epoxy-resin adhesive recommended by adhesive manufacturer for this use.
1. Adhesives shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Anchoring Devices:

1. Strips: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and required for secure attachment to substrate.
 2. Precast Terrazzo: Provide mechanical anchoring devices as recommended by fabricator for proper anchorage and support of units for conditions of installation and support.
- C. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- D. Joint Compound: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- E. Resinous Matrix Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated.
- F. Sealer: **[Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; is recommended by sealer manufacturer; and complies with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated] [Acrylic] [Urethane] [Chemical-resistant epoxy] <Insert requirements>.**
1. Surface Friction: Not less than 0.6 according to ASTM D 2047.
 2. Acid-Base Properties: With pH factor between 7 and 10.
 3. Sealers shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions, including levelness tolerances, have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.
- B. Concrete Slabs:
 1. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants

incompatible with terrazzo.

- a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
- b. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written recommendations.
- c. Use patching and fill material to fill holes and depressions in substrates according to terrazzo manufacturer's written instructions.

C. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

1. Moisture Testing: Perform tests indicated below.

- a. Calcium Chloride Test: Perform anhydrous calcium chloride test per ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of [3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)] <Insert rate> in 24 hours.
 - 1) Perform tests so that each test area does not exceed [200 sq. ft. (18.6 sq. m)] <Insert area>, and perform not less than two tests in each installation area and with test areas evenly spaced in installation areas.
- b. In-Situ Probe Test: Perform relative-humidity test using in-situ probes per ASTM F 2170. Proceed with installation only after substrates have a maximum [75] <Insert number> percent relative-humidity-level measurement.
- c. Test Method: Test for moisture content by [method recommended in writing by terrazzo manufacturer] <Insert test method>. Proceed with installation only after substrates pass testing.

D. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.

1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

3.3 EPOXY-RESIN TERRAZZO INSTALLATION

- A. Comply with NTMA's written recommendations for terrazzo and accessory installation.
- B. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions and NTMA's "Terrazzo Specifications and Design Guide."
- C. Installation Tolerance: Limit variation in terrazzo surface from level to [1/4 inch in 10 feet (6.4 mm in 3 m)] <Insert dimensions>; noncumulative.

- D. Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.
- E. Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted.
- F. Flexible Reinforcing Membrane:
 - 1. Prepare and prefill substrate cracks with membrane material.
 - 2. Install membrane **[at substrate cracks] [to produce full substrate coverage]** in areas to receive terrazzo.
 - 3. Reinforce membrane with fiberglass scrim.
 - 4. Prepare membrane according to manufacturer's written instructions before applying substrate primer.
- G. Primer: Apply to terrazzo substrates according to manufacturer's written instructions.
- H. Strip Materials:
 - 1. Divider and Control-Joint Strips:
 - a. Locate divider strips **[in locations indicated]** **<Insert requirements>**.
 - b. Install control-joint strips **[back to back directly above concrete-slab control joints] [in locations indicated]** **<Insert requirements>**.
 - c. Install control-joint strips with **[1/4-inch (6.4-mm)]** **<Insert dimension>** gap between strips, and install sealant in gap.
 - d. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.
 - 2. Accessory Strips: Install **[as required to provide a complete installation] [in locations indicated]** **<Insert requirements>**.
 - 3. Abrasive Strips: Install with surface of abrasive strip positioned **[1/16 inch (1.6 mm)]** **<Insert dimension>** higher than terrazzo surface.

3.4 PRECAST TERRAZZO INSTALLATION

- A. Install precast terrazzo units using method recommended by NTMA and manufacturer unless otherwise indicated.
- B. Do not install units that are chipped, cracked, discolored, or not properly finished.
- C. Seal joints between units with **[joint compound matching precast terrazzo matrix] [joint sealant]** **<Insert requirements>**.

3.5 REPAIR

- A. Cut out and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or

repair panels according to NTMA's written recommendations, as approved by DEN Project Manager.

3.6 CLEANING AND PROTECTION

A. Cleaning:

1. Remove grinding dust from installation and adjacent areas.
2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.

B. Sealing:

1. Seal surfaces according to NTMA's written recommendations.
2. Apply sealer according to sealer manufacturer's written instructions.

C. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 096623

SECTION 096723 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Decorative resinous flooring systems.
- 2. Industrial resinous flooring systems.
- 3. High-performance resinous flooring systems.

- B. Related Sections:

- 1. Section 079200 "Joint Sealants" for sealants installed at joints in resinous flooring systems.
- 2. Section 096623 "Resinous Matrix Terrazzo Flooring" for thin-set, resinous matrix terrazzo.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

- 1. Include data substantiating that materials comply with requirements.

- B. LEED Submittals:

- 1. Product Data for Credit IEQ 4.2: For liquid-applied flooring components, documentation including printed statement of VOC content.
- 2. Laboratory Test Reports for Credit IEQ 4: For flooring systems, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Samples for Initial Selection: For each type of exposed finish required.
- D. Samples for Verification: For each resinous flooring system required, **6 inches** (150 mm) square, applied to a rigid backing by Installer for this Project.
- E. Product Schedule: For resinous flooring.[**Use same designations indicated on Drawings.**]

1.4 INFORMATIONAL SUBMITTALS

- A. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- B. Material Certificates: For each resinous flooring component, from manufacturer.
- C. Material Test Reports: For each resinous flooring system.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For resinous flooring to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of flooring systems required for this Project.
 - 1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
- B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.
- C. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Apply full-thickness mockups on **48-inch-** (1200-mm-) square floor area selected by DEN Project Manager.
 - a. Include **48-inch** (1200-mm) length of integral cove base with inside[**and outside**] corner.

2. Simulate finished lighting conditions for DEN Project Manager's review of mockups.
 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application unless manufacturer recommends a longer period.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Hi-Tech Flooring Company.
 2. Arizona Polymer Flooring, Inc.
 3. Atlas Minerals & Chemicals, Inc.; Polymer Flooring Division.
 4. BASF Construction Chemicals, Inc.; BASF Building Systems.
 5. ChemMasters.
 6. CornerStone Flooring & Linings.
 7. Crawford Laboratories Inc.; Florock.

8. Crossfield Products Corp.; Dex-O-Tex.
9. Crown Polymers, LLC.
10. Delta Polymers, Inc.
11. DUDICK Inc.
12. Dur-A-Flex, Inc.
13. Epoxy Systems, Inc.
14. ICS Garland Inc.
15. International Coatings Inc.
16. ITW Resin Technologies.
17. Key Resin Company.
18. Marbelite International Corp.
19. Micor Company, Inc.
20. NEOGARD; Division of JONES-BLAIR.
21. Northern Industries, Inc.
22. Nox-Crete Products Group.
23. Pacific Polymers, Inc.
24. Palma, Inc.
25. POLY-CARB, Inc.
26. Polymerica, Incorporated.
27. PolySpec.
28. PPG Industries, Inc.
29. Protective Floorings & Linings, Inc.; a division of Chesterton.
30. RBC Industries, Inc.
31. ROCK-TRED Corporation.
32. Rust-Oleum Corporation.
33. Sauereisen.
34. Sherwin-Williams Company; General Polymers.
35. Specifier Products Inc.; Stonecarpet.
36. Stonhard, Inc.
37. Tamms Industries, Inc.; a division of The Euclid Chemical Company.
38. Tnemec Company, Inc.
39. Tufco International Inc.
40. Valspar Flooring.
41. **<Insert manufacturer's name>**.
42. or approved equal.

2.2 MATERIALS

- A. VOC Content of Liquid-Applied Flooring Components: Not more than 100 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
- B. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 DECORATIVE RESINOUS FLOORING[<RF-#>]

- A. Resinous Flooring: Abrasion-, impact- and chemical-resistant, decorative-aggregate-filled, epoxy-resin-based, monolithic floor surfacing designed to produce a seamless floor[**and integral cove base**].
- B. System Characteristics:
1. Color and Pattern: [**As selected by DEN Project Manager from manufacturer's full range**] [**As indicated by product designation listed above**] [**Match DEN Project Manager's sample**] <Insert description>.
 2. Wearing Surface: [**Textured for slip resistance**] [**Orange-peel texture**] [**Smooth**] [**Manufacturer's standard wearing surface**] <Insert description>.
 3. Overall System Thickness: [**1/16 inch** (1.6 mm)] [**1/8 inch** (3.2 mm)] [**3/16 inch** (4.8 mm)] [**1/4 inch** (6.4 mm)] <Insert thickness>.
 4. Federal Agency Approvals: [**USDA**] [**FDA**] approved for food-processing environments.
- C. Body Coats:
1. Resin: [**Epoxy**] <Insert resin>.
 2. Formulation Description: [**100 percent solids**] [**High solids**] [**Water based**] <Insert requirements>.
 3. Application Method: [**Self-leveling slurry with broadcast aggregates**] [**Self-leveling slurry**] [**Troweled or screeded**].
 - a. Thickness of Coats: [**1/16 inch** (1.6 mm)] [**1/8 inch** (3.2 mm)] [**3/16 inch** (4.8 mm)] [**1/4 inch** (6.4 mm)] <Insert thickness>.
 - b. Number of Coats: [**One**] [**Two**] <Insert number>.
 4. Aggregates: [**Manufacturer's standard**] [**Colored quartz (ceramic-coated silica)**] [**Vinyl flakes**] [**Granite**] [**Natural silica**] <Insert requirements>.
- D. Topcoat: Sealing or finish coats.
1. Resin: [**Epoxy**] [**Urethane**] [**Vinyl ester**] <Insert resin>.
 2. Formulation Description: [**100 percent solids**] [**High solids**] [**Water based**] <Insert requirements>.
 3. Type: [**Clear**] [**Pigmented**] <Insert description>.
 4. Finish: [**Matte**] [**Gloss**].
 5. Number of Coats: [**One**] [**Two**] <Insert number>.
- E. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
1. Compressive Strength: <Insert value> per ASTM C 579.
 2. Tensile Strength: <Insert value> per ASTM C 307.
 3. Flexural Modulus of Elasticity: <Insert value> per ASTM C 580.
 4. Water Absorption: <Insert value> per ASTM C 413.

5. Coefficient of Thermal Expansion: **<Insert value>** per ASTM C 531.
 6. Indentation: **<Insert number>** percent maximum per MIL-D-3134.
 7. Impact Resistance: No chipping, cracking, or delamination and not more than **1/16-inch** (1.6-mm) permanent indentation per MIL-D-3134.
 8. Resistance to Elevated Temperature: No slip or flow of more than **1/16 inch** (1.6 mm) per MIL-D-3134.
 9. Abrasion Resistance: **<Insert value>** maximum weight loss per ASTM D 4060.
 10. Flammability: Self-extinguishing per ASTM D 635.
 11. Critical Radiant Flux: **[0.45 W/sq. cm] [0.22 W/sq. cm]** or greater per NFPA 253.
 12. Hardness: **<Insert value>**, Shore D per ASTM D 2240.
 13. Bond Strength: **<Insert value>**, 100 percent concrete failure per ACI 503R.
- F. System Chemical Resistance: Test specimens of cured resinous flooring system are unaffected when tested according to **[ASTM D 1308 for 50 percent immersion] [ASTM D 543, Procedure A, for immersion] [ASTM C 267 for immersion] <Insert testing requirements>** in the following reagents for no fewer than seven days:
1. **<Insert list of reagents that Owner has determined are likely to contact resinous flooring during in-service use>**.

2.4 INDUSTRIAL RESINOUS FLOORING[**<RF-#>**]

- A. Resinous Flooring: Abrasion-, impact- and chemical-resistant, industrial-aggregate-filled, resin-based, monolithic floor surfacing designed to produce a seamless floor[**and integral cove base**].
- B. System Characteristics:
1. Color and Pattern: **[As selected by DEN Project Manager from manufacturer's full range] [As indicated by product designation listed above] [Match DEN Project Manager's sample] <Insert description>**.
 2. Wearing Surface: **[Textured for slip resistance] [Orange-peel texture] [Smooth] [Manufacturer's standard wearing surface] <Insert description>**.
 3. Overall System Thickness: **[1/16 inch (1.6 mm)] [1/8 inch (3.2 mm)] [3/16 inch (4.8 mm)] [1/4 inch (6.4 mm)] <Insert thickness>**.
 4. Federal Agency Approvals: **[USDA] [FDA]** approved for food-processing environments.
- C. Body Coats:
1. Resin: **[Epoxy] [Urethane] [Vinyl ester] <Insert resin>**.
 2. Formulation Description: **[100 percent solids] [High solids] [Water based] <Insert requirements>**.
 3. Application Method: **[Self-leveling slurry with broadcast aggregates] [Self-leveling slurry] [Troweled or screeded]**.
 - a. Thickness of Coats: **[1/16 inch (1.6 mm)] [1/8 inch (3.2 mm)] [3/16 inch (4.8 mm)] [1/4 inch (6.4 mm)] <Insert thickness>**.
 - b. Number of Coats: **[One] [Two] <Insert number>**.

4. Aggregates: **[Manufacturer's standard] [Colored quartz (ceramic-coated silica)] [Vinyl flakes] [Granite] [Natural silica] <Insert requirements>**.

D. Topcoat: Sealing or finish coats.

1. Resin: **[Epoxy] [Urethane] [Vinyl ester] <Insert resin>**.
2. Formulation Description: **[100 percent solids] [High solids] [Water based] <Insert requirements>**.
3. Type: **[Clear] [Pigmented] <Insert description>**.
4. Finish: **[Matte] [Gloss]**.
5. Number of Coats: **[One] [Two] <Insert number>**.

E. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

1. Compressive Strength: **<Insert value>** per ASTM C 579.
2. Tensile Strength: **<Insert value>** per ASTM C 307.
3. Flexural Modulus of Elasticity: **<Insert value>** per ASTM C 580.
4. Water Absorption: **<Insert value>** per ASTM C 413.
5. Coefficient of Thermal Expansion: **<Insert value>** per ASTM C 531.
6. Indentation: **<Insert number>** percent maximum per MIL-D-3134.
7. Impact Resistance: No chipping, cracking, or delamination and not more than **1/16-inch (1.6-mm)** permanent indentation per MIL-D-3134.
8. Resistance to Elevated Temperature: No slip or flow of more than **1/16 inch (1.6 mm)** per MIL-D-3134.
9. Abrasion Resistance: **<Insert value>** maximum weight loss per ASTM D 4060.
10. Flammability: Self-extinguishing per ASTM D 635.
11. Critical Radiant Flux: **[0.45 W/sq. cm] [0.22 W/sq. cm]** or greater per NFPA 253.
12. Hardness: **<Insert value>**, Shore D per ASTM D 2240.
13. Bond Strength: **<Insert value>**, 100 percent concrete failure per ACI 503R.

F. System Chemical Resistance: Test specimens of cured resinous flooring system are unaffected when tested according to **[ASTM D 1308 for 50 percent immersion] [ASTM D 543, Procedure A, for immersion] [ASTM C 267 for immersion] <Insert testing requirements>** in the following reagents for no fewer than seven days:

1. **<Insert list of reagents that Owner has determined are likely to contact resinous flooring during in-service use>**.

2.5 HIGH-PERFORMANCE RESINOUS FLOORING[**<RF-#>**]

A. Resinous Flooring: Abrasion-, impact- and chemical-resistant, high-performance-aggregate-filled, resin-based, monolithic floor surfacing designed to produce a seamless floor[**and integral cove base**].

B. System Characteristics:

1. Color and Pattern: **[As selected by DEN Project Manager from**

- manufacturer's full range** [As indicated by product designation listed above] [Match DEN Project Manager's sample] <Insert description>.
2. Wearing Surface: [Textured for slip resistance] [Orange-peel texture] [Smooth] [Manufacturer's standard wearing surface] <Insert description>.
 3. Overall System Thickness: [1/16 inch (1.6 mm)] [1/8 inch (3.2 mm)] [3/16 inch (4.8 mm)] [1/4 inch (6.4 mm)] <Insert thickness>.
 4. Federal Agency Approvals: [USDA] [FDA] approved for food-processing environments.

C. Body Coats:

1. Resin: [Epoxy] [Epoxy novolac] [Urethane] [Vinyl ester] [Methyl methacrylate] <Insert resin>.
2. Formulation Description: [100 percent solids] [High solids] [Water based] <Insert requirements>.
3. Application Method: [Self-leveling slurry with broadcast aggregates] [Self-leveling slurry] [Troweled or screeded].
 - a. Thickness of Coats: [1/16 inch (1.6 mm)] [1/8 inch (3.2 mm)] [3/16 inch (4.8 mm)] [1/4 inch (6.4 mm)] <Insert thickness>.
 - b. Number of Coats: [One] [Two] <Insert number>.
4. Aggregates: [Manufacturer's standard] [Colored quartz (ceramic-coated silica)] [Vinyl flakes] [Granite] [Natural silica] <Insert requirements>.

D. Topcoat: Sealing or finish coats.

1. Resin: [Epoxy] [Epoxy novolac] [Urethane] [Vinyl ester] [Methyl methacrylate] <Insert resin>.
2. Formulation Description: [100 percent solids] [High solids] [Water based] <Insert requirements>.
3. Type: [Clear] [Pigmented] <Insert description>.
4. Finish: [Matte] [Gloss].
5. Number of Coats: [One] [Two] <Insert number>.

E. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

1. Compressive Strength: <Insert value> per ASTM C 579.
2. Tensile Strength: <Insert value> per ASTM C 307.
3. Flexural Modulus of Elasticity: <Insert value> per ASTM C 580.
4. Water Absorption: <Insert value> per ASTM C 413.
5. Coefficient of Thermal Expansion: <Insert value> per ASTM C 531.
6. Indentation: <Insert number> percent maximum per MIL-D-3134.
7. Impact Resistance: No chipping, cracking, or delamination and not more than 1/16-inch (1.6-mm) permanent indentation per MIL-D-3134.
8. Resistance to Elevated Temperature: No slip or flow of more than 1/16 inch (1.6 mm) per MIL-D-3134.
9. Abrasion Resistance: <Insert value> maximum weight loss per ASTM D 4060.

10. Flammability: Self-extinguishing per ASTM D 635.
11. Critical Radiant Flux: **[0.45 W/sq. cm] [0.22 W/sq. cm]** or greater per NFPA 253.
12. Hardness: **<Insert value>**, Shore D per ASTM D 2240.
13. Bond Strength: **<Insert value>**, 100 percent concrete failure per ACI 503R.

F. System Chemical Resistance: Test specimens of cured resinous flooring system are unaffected when tested according to **[ASTM D 1308 for 50 percent immersion] [ASTM D 543, Procedure A, for immersion] [ASTM C 267 for immersion] <Insert testing requirements>** in the following reagents for no fewer than seven days:

1. **<Insert list of reagents that Owner has determined are likely to contact resinous flooring during in-service use>**.

2.6 ACCESSORIES

A. Primer: Type recommended by manufacturer for substrate and body coats indicated.

1. Formulation Description: **[100 percent solids] [High solids] [Water based] <Insert requirements>**.

B. Waterproofing Membrane: Type recommended by manufacturer for substrate and primer and body coats indicated.

1. Formulation Description: **[100 percent solids] [High solids] <Insert requirements>**.

C. Reinforcing Membrane: Flexible resin formulation that is recommended by manufacturer for substrate and primer and body coats indicated and that prevents substrate cracks from reflecting through resinous flooring.

1. Formulation Description: **[100 percent solids] [High solids] <Insert requirements>**.

- a. Provide fiberglass scrim embedded in reinforcing membrane.

D. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.

- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
1. Roughen concrete substrates as follows:
 - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - b. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.
 2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
 3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of [3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)] **<Insert emission rate>** of slab area in 24 hours.
 - b. Perform plastic sheet test, ASTM D 4263. Proceed with application only after testing indicates absence of moisture in substrates.
 - c. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum [75] **<Insert number>** percent relative humidity level measurement.
 4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

3.2 APPLICATION

- A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.

2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
 3. At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Apply waterproofing membrane, where indicated, in manufacturer's recommended thickness.
1. Apply waterproofing membrane to integral cove base substrates.
- D. Apply reinforcing membrane to **[substrate cracks]** **[entire substrate surface]**.
- E. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
1. Integral Cove Base: **[4 inches (100 mm)]** **<Insert dimension>** high.
- F. Apply self-leveling slurry body coats in thickness indicated for flooring system.
1. Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.
- G. Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, remove trowel marks and roughness using method recommended by manufacturer.
- H. Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat and to produce wearing surface indicated.
- I. Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.3 FIELD QUALITY CONTROL

- A. Core Sampling: At the direction of Owner and at locations designated by Owner, take one core sample per **1000 sq. ft. (92.9 sq. m)** of resinous flooring, or portion of, to verify thickness. For each sample that fails to comply with requirements, take two additional samples. Repair damage caused by coring and correct deficiencies.
- B. Material Sampling: Owner may at any time and any number of times during resinous flooring application require material samples for testing for compliance with requirements.
1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.

2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

3.4 PROTECTION

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 096723

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes modular, [**fusion-bonded**] [**tufted**] <Insert construction> carpet tile.
- B. Related Requirements:
 - 1. Section 024119 "Selective Structure Demolition" for removing existing floor coverings.
 - 2. [**Section 096513 "Resilient Base and Accessories"**] [**Section 096519 "Resilient Tile Flooring"**] for resilient wall base and accessories installed with carpet tile.
 - 3. Section 096816 "Sheet Carpeting."
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at [**Project site**] [**location and time as determined by DEN Project Manager**]<Insert location>.
 - 1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
 - a. Review delivery, storage, and handling procedures.
 - b. Review ambient conditions and ventilation procedures.
 - c. Review subfloor preparation procedures.
 - d. <Insert agenda items>.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on all physical characteristics, durability, static performance, fire-test response characteristics, static performance, and

- fade resistance, and fire-test response characteristics.
- 2. Include installation recommendations for each type of substrate.
- 3. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

- 1. Product Data for Credit EQ 4.3:
 - a. For carpet tile, documentation indicating compliance with testing and product requirements of CRI's "Green Label Plus" program.
 - b. For installation adhesive, documentation including printed statement of VOC content.
- 2. LEED Requirements:
 - a. Products supplied under this section shall meet the requirements of LEED for:
 - b. Low Emitting Materials Carpet.
 - c. Low Emitting Adhesives, Sealants, and Primers.
 - d. Rapidly Renewable Materials.
 - e. Regional Materials.
 - f. Recycled Content.
 - g. Construction Waste Management.

C. Shop Drawings: Show the following:

- 1. Existing flooring materials to be removed.
- 2. Existing flooring materials to remain.
- 3. Columns, doorways, enclosing walls, or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
- 4. Carpet tile type, color, and dye lot.
- 5. Type of subfloor.
- 6. Type of installation.
- 7. Pattern of installation.
- 8. Pattern type, location, direction, and starting point.
- 9. Pile direction.
- 10. Seam locations, types, and methods.
- 11. Type of cushion.
- 12. Type, color, and location of insets and borders.
- 13. Type, color, and location of edge, transition, and other accessory strips.
- 14. Transition details to other flooring materials.

D. Samples: For each of the following products and for each color and texture required. Prepare Samples from the same material to be used for the Work. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

- 1. Carpet Tile: Full-size Sample.
- 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.

- E. Product Schedule: For carpet tile. Use same designations indicated on Drawings.
- F. Sustainability: Provide the Statement of the Achievement Level the carpet has attained for **[Bronze, 28 to 36]** **[Silver, 37 to 51]** **[Gold, 52 to 70]** points, based on specific Sustainable Attribute Performance for all product stages according to ANSI/NSF 140.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to **[five (5)]** **<Insert number>** percent of amount installed for each type indicated, but not less than **10 sq. yd.** (8.3 sq. m).

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the **[Commercial II]** **[Master II]** **<Insert description>** certification level.
- B. Single-Source Responsibility: Obtain each type of carpet from one source and by a single manufacturer.

- C. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockups at locations and in sizes shown on Drawings, and if not indicated, as directed by DEN Project Manager.
 - 2. Notify DEN Project Manager one (1) week in advance of the dates and times when mockups will be constructed.
 - 3. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 4. Obtain DEN Project Manager's approval of mockups before start of final unit of Work.
 - 5. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.
- B. Deliver materials to Project site in original factory wrappings and containers, labeled with identification of manufacturer, brand name, and lot number.
- C. Store materials on-site in original undamaged packages, inside well-ventilated area protected from weather, moisture, soilage, extreme temperatures, and humidity. Lay flat, with continuous blocking off ground.

1.10 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer, and not less than the following requirements:
 - 1. Subfloor Moisture Conditions: Moisture emission rate of not more than 3 lb/1000 sq. ft./24 hours (14.6 kg/1000 sq. m/24 hours) when tested by calcium chloride moisture test in compliance with CRI 104, 6.2.1, with subfloor temperatures not less than 55oF (12.7oC).
 - 2. Subfloor Alkalinity Conditions: A pH range of 5 to 9 when subfloor is wetted with potable water and phydron paper is applied.

- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.11 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, **[dimensional stability,] [excess static discharge,] [loss of tuft bind strength,]** loss of face fiber, **<Insert failure characteristic>** and delamination.
 3. Warranty Period: Minimum **[ten (10)] <Insert number>** years from date of Substantial Completion.
- B. CONSTRUCTION WASTE MANAGEMENT
1. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 CARPET TILE **<Insert drawing designation>**

- A. Products: Subject to compliance with requirements, provide one of the following:
1. **<Insert manufacturer's name; product name or designation>**.
 2. or approved equal.
- B. Color: **[Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
- C. Pattern: **[Match DEN Project Manager's samples] <Insert pattern>**.
- D. Fiber Content: **[100 percent nylon 6, 6] [100 percent nylon 6] [100 percent polypropylene] [100 percent wool] [80 percent wool; 20 percent nylon 6, 6] [80 percent wool; 20 percent nylon 6] <Insert percentage>**.
- E. Fiber Type: **<Insert proprietary fiber type>**.
- F. Pile Characteristic: **[Level-loop] [Cut] [Cut-and-loop] <Insert construction>** pile.
- G. Yarn Twist: **<Insert TPI (TPCM)>**.

- H. Yarn Count: <Insert count>.
- I. Density: <Insert oz./cu. yd. (g/cu. cm)>.
- J. Pile Thickness: <Insert inches (mm)> for finished carpet tile[according to ASTM D 6859].
- K. Stitches: <Insert stitches per inch (mm)>.
- L. Gage: <Insert ends per inch (mm)>.
- M. Surface Pile Weight: <Insert oz./sq. yd. (g/sq. m)>.
- N. Total Weight: <Insert oz./sq. yd. (g/sq. m)> for finished carpet tile.
- O. Primary Backing/Backcoating: [Manufacturer's standard composite materials] [PVC] [Fiberglass-reinforced PVC] [Fiberglass-reinforced amorphous resin] [Reinforced polyurethane composite cushion] [Reinforced polyurethane composite] [Reinforced thermoplastic copolymer] <Insert specific primary backing materials; consult manufacturers>.
- P. Secondary Backing: [Manufacturer's standard material] <Insert specific secondary backing material>.
- Q. Backing System: <Insert proprietary name>.
- R. Size: [18 by 18 inches (457 by 457 mm)] [24 by 24 inches (610 by 610 mm)] [18 by 36 inches (457 by 914 mm)] [36 by 36 inches (914 by 914 mm)] <Insert dimensions>.
- S. Applied Soil-Resistance Treatment: [Manufacturer's standard material] <Insert treatment>.
- T. Antimicrobial Treatment: [Manufacturer's standard material] <Insert treatment>.
- U. Performance Characteristics: As follows:
1. Appearance Retention Rating: [Moderate traffic, 2.5] [Heavy traffic, 3.0] [Severe traffic, 3.5] <Insert number> minimum according to ASTM D 7330.
 2. Critical Radiant Flux Classification: Not less than [0.45 W/sq. cm] [0.22 W/sq. cm].
 3. Dry Breaking Strength: Not less than 100 lbf (445 N) according to ASTM D 2646.
 4. Tuft Bind: Not less than [3 lbf (13 N)] [5 lbf (22 N)] [6.2 lbf (28 N)] [8 lbf (36 N)] [10 lbf (45 N)] <Insert value> according to ASTM D 1335.
 5. Delamination: Not less than [3.5 lbf/in. (15 N/mm)] [4 lbf/in. (18 N/mm)] <Insert value> according to ASTM D 3936.
 6. Dimensional Tolerance: Within 1/32 inch (0.8 mm) of specified size dimensions, as determined by physical measurement.
 7. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
 8. Resistance to Insects: Comply with AATCC 24.
 9. Noise Reduction Coefficient (NRC): <Insert NRC> according to ASTM C 423.
 10. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC

165.

11. Colorfastness to Light: Not less than 4 after [40] [60] <Insert number> AFU (AATCC fading units) according to AATCC 16, Option E.
12. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.
13. Electrostatic Propensity: Less than [3.5] [2] <Insert number> kV according to AATCC 134.
14. Emissions: Provide carpet tile that complies with testing and product requirements of CRI's "Green Label Plus" program.
15. Emissions: Provide carpet tile that complies with the product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 INSTALLATION ACCESSORIES

- A. Concrete-Slab Primer: Nonstaining type as recommended by [**Carpet manufacturer**] [**Carpet cushion manufacturer.**]
- B. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- C. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Metal Edge/Transition Strips: Extruded aluminum with [mill] <Insert finish> finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.
- E. Extruded or molded vinyl or rubber, colors selected by DEN Project Manager from standard colors available within the industry.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with

requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

- B. Verify that subfloors and conditions are satisfactory for carpet installation and comply with requirements specified in this Section and those of the carpet manufacturer.
- C. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
 - 2. Subfloor finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" for slabs receiving carpet tile.
 - 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- D. For wood subfloors, verify the following:
 - 1. Underlayment over subfloor complies with requirements specified in Section 061000 "Rough Carpentry."
 - 2. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.
- E. For metal subfloors, verify the following:
 - 1. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.
- F. For painted subfloors, verify the following:
 - 1. Perform bond test recommended in writing by adhesive manufacturer.
- G. For raised access flooring systems, verify the following:
 - 1. Access floor substrate is compatible with carpet tile and adhesive if any.
 - 2. Underlayment surface is flat, smooth, evenly planed, tightly jointed, and free of irregularities, gaps greater than [1/8 inch (3 mm)] **<Insert dimension>**, protrusions more than 1/32 inch (0.8 mm), and substances that may interfere with adhesive bond or show through surface.
- H. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with carpet manufacturer's installation recommendations to prepare substrates indicated to receive carpet installation.
- B. Examine surfaces to receive carpeting for holes, debris, or other defects that will

- adversely affect the execution and quality of Work. Do not proceed until conditions are satisfactory.
- C. Allow concrete surfaces to cure a minimum of 30 days.
 - D. Do not install carpeting until masonry **[and drywall] [and plastering] [is] [are]** complete.
 - E. Install carpeting prior to installation of demountable or movable partitions, fixtures, or telephone and electrical pedestal floor outlets.
 - F. Install carpet within allowable temperature range stated by manufacturer.
 - G. Level subfloor within 1/4 inch in 10 feet (6 mm in 3 m), noncumulative, in all directions. Sand or grind protrusions, bumps, and ridges. Patch and repair cracks and rough areas. Fill depressions.
 - H. Use leveling and patching compounds to fill cracks, holes, and depressions in subfloor as recommended by the carpet manufacturer.
 - I. Remove subfloor coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone.
 - J. Broom or vacuum clean subfloors to be covered with carpet. Following cleaning, examine subfloors for moisture, alkaline salts, carbonation, or dust.
 - K. Concrete-Subfloor Preparation: Apply concrete-slab primer, according to manufacturer's directions, where recommended by carpet manufacturer.
 - L. Resilient-Flooring Substrate Preparation: Replace missing pieces of existing resilient flooring or patch to level. Cut out peaked seams and fill with latex underlayment as recommended by manufacturer. Repair depressions with material recommended by carpet manufacturer..
 - M. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
 - N. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions **1/8 inch (3 mm)** wide or wider and protrusions more than **1/32 inch (0.8 mm)** unless more stringent requirements are required by manufacturer's written instructions.
 - O. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
 - P. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand

aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

- Q. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: **[As recommended in writing by carpet tile manufacturer] [Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive] [Partial glue down; install periodic tiles with releasable, pressure-sensitive adhesive] [Free lay; install carpet tiles without adhesive].**
- C. Maintain dye lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Where demountable partitions or other items are indicated for installation on top of finished carpet floor, install carpet before installation of these items.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders.
- I. Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 2. Remove yarns that protrude from carpet tile surface.
 3. Vacuum carpet tile using commercial machine with face-beater element.
 4. Vacuum carpet, and clean if necessary, just prior to acceptance by Owner.
- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."

- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 096813

SECTION 096816 - SHEET CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Tufted carpet.
2. Woven carpet.
3. Carpet cushion.
4. **<Insert type>**

- B. Related Requirements:

1. Section 024119 "Selective Structure Demolition" for removing existing floor coverings.
2. **[Section 096519 "Resilient Tile Flooring"] [Section 096513 "Resilient Base and Accessories"]** for resilient wall base and accessories installed with carpet.
3. Section 096813 "Tile Carpeting."

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.

1. Review methods and procedures related to carpet installation including, but not limited to, the following:
 - a. Review delivery, storage, and handling procedures.
 - b. Review ambient conditions and ventilation procedures.
 - c. Review subfloor preparation procedures.
 - d. **<Insert agenda items>**.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following, including installation recommendations for each type of substrate:
1. Carpet: For each type indicated. Include manufacturer's written data on physical characteristics, durability, fire-test response characteristics, static performance, and fade resistance.
 2. Carpet Cushion: For each type indicated. Include manufacturer's written data on physical characteristics and durability.
 3. Submit methods of installation for each type of substrate.
 4. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
1. Product Data for Credit EQ 4.3:
 - a. For carpet, documentation indicating compliance with testing and product requirements of CRI's "Green Label Plus" program.
 - b. For carpet cushion, documentation indicating compliance with testing and product requirements of CRI's "Green Label" program.
 - c. For installation adhesive, including printed statement of VOC content.
 2. LEED Requirements:
 - a. Products supplied under this section shall meet the requirements of LEED for:
 - b. Low Emitting Materials Carpet.
 - c. Low Emitting Adhesives, Sealants, and Primers.
 - d. Rapidly Renewable Materials.
 - e. Regional Materials.
 - f. Recycled Content.
 - g. Construction Waste Management.
- C. Shop Drawings: Show the following:
1. Existing flooring materials to be removed.
 2. Existing flooring materials to remain.
 3. Columns, doorways, enclosing walls, or partitions, built-in cabinets, and locations where cutouts are required in carpet.
 4. Carpet type, color, and dye lot.
 5. Type of cushion.
 6. Locations where dye lot changes occur.
 7. Seam locations, types, and methods.
 8. Type of subfloor.
 9. Type of installation.
 10. Pattern type, repeat size, location, direction, and starting point.
 11. Pile direction.
 12. Type, color, and location of insets and borders.
 13. Type, color, and location of edge, transition, and other accessory strips.

14. Transition details to other flooring materials.
15. Type of carpet cushion.

- D. Samples: For each of the following products and for each color and texture required. Prepare Samples from the same material to be used for the Work. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
1. Carpet: **12-inch-** (300-mm-) square Sample.
 2. Exposed Edge, Transition, and Other Accessory Stripping: **12-inch-** (300-mm-) long Samples.
 3. Carpet Cushion: **6-inch-** (150-mm-) square Sample.
 4. Carpet Seam: **6-inch** (150-mm) Sample.
 5. Mitered Carpet Border Seam: **12-inch-** (300-mm-) square Sample. Show carpet pattern alignment.
- E. Product Schedule: For carpet[**and carpet cushion**]. Use same designations indicated on Drawings.
- F. Sustainability: Provide the Statement of the Achievement Level the carpet has attained for [**Bronze, 28 to 36**] [**Silver, 37 to 51**] [**Gold, 52 to 70**] points, based on specific Sustainable Attribute Performance for all product stages according to ANSI/NSF 140.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Test Reports: For carpet[**and carpet cushion**], for tests performed by a qualified testing agency.
- C. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet to include in maintenance manuals. Include the following:
 1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 2. Precautions for cleaning materials and methods that could be detrimental to carpet[**and carpet cushion**].
 3. Methods for maintaining carpet cushion, including manufacturer's recommended frequency for maintaining carpet.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Carpet: Full-width rolls equal to **[five (5)] <Insert number>** percent of amount installed for each type indicated, but not less than **10 sq. yd.** (8.3 sq. m).
 2. Deliver usable scraps of carpet to Owner's designated storage space, properly packaged and identified. Usable scraps are defined to include roll ends of less than 9'0" length, and pieces of more than 3 square foot area and more than 8 inches wide. Dispose of smaller pieces as "construction waste."

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced Installer who is certified by the International Certified Floorcovering Installers Association at the **[Commercial II] [Master II] <Insert description>** certification level.
- B. Single-Source Responsibility: Obtain each type of carpet from one source and by a single manufacturer.
- C. Fire-Test-Response Ratings: Where indicated, provide carpet[**and carpet cushion**] identical to those of assemblies tested for fire response per NFPA 253 by a qualified testing agency.
1. Provide carpet with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify carpet with appropriate markings of applicable testing and inspecting agency.
 - a. Surface Flammability: Passes CPSC 16 CFR, Part 1630.
 - b. Flame Spread: 25 or less per ASTM E84.
 - c. Smoke Developed: 450 or less per ASTM E84.
 2. Carpet Cushion Fire-Test-Response Characteristics: Provide carpet cushion with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify carpet cushion with appropriate markings of applicable testing and inspecting agency.
 - a. Surface Flammability: Passes CPSC 16 CFR, Part 1630.
 - b. Flame Spread: 25 or less per ASTM E84.
 - c. Smoke Developed: 450 or less per ASTM E84.
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockups at locations and in sizes shown on Drawings, and if not indicated, as directed by DEN Project Manager.
2. Notify DEN Project Manager one (1) week in advance of the dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain DEN Project Manager's approval of mockups before start of final unit of Work.
5. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.
- B. Deliver materials to Project site in original factory wrappings and containers, labeled with identification of manufacturer, brand name, and lot number.
- C. Store materials on-site in original undamaged packages, inside well-ventilated area protected from weather, moisture, soilage, extreme temperatures, and humidity. Lay flat, with continuous blocking off ground.

1.10 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet[**and carpet cushion**] until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- C. Do not install carpet[**and carpet cushion**] over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer, and not less than the following requirements:
 1. Subfloor Moisture Conditions: Moisture emission rate of not more than 3 lb/1000 sq. ft./24 hours (14.6 kg/1000 sq. m/24 hours) when tested by calcium chloride moisture test in compliance with CRI 104, 6.2.1, with subfloor temperatures not less than 55 deg F (12.7 deg C).
 2. Subfloor Alkalinity Conditions: A pH range of 5 to 9 when subfloor is wetted with potable water and phydron paper is applied.

- D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

1.11 WARRANTY

- A. Special Warranty for Carpet: Manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, **[loss of tuft bind strength,] [excess static discharge,] <Insert failure characteristic>** and delamination.
3. Warranty Period: Minimum **[ten (10)] <Insert number>** years from date of Substantial Completion.

- B. Special Warranty for Carpet Cushion: Manufacturer agrees to repair or replace components of carpet cushion installation that fail in materials or workmanship within specified warranty period.

1. Warranty includes consequent removal and replacement of carpet and accessories.
2. Warranty does not include deterioration or failure of carpet cushion due to unusual traffic, failure of substrate, vandalism, or abuse.
3. Failure includes, but is not limited to, permanent indentation or compression.
4. Warranty Period: Minimum **[ten (10)] <Insert number>** years from date of Substantial Completion.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 TUFTED CARPET <Insert designation>

- A. Products: Subject to compliance with requirements, provide one of the following:

1. **<Insert manufacturer's name; product name or designation>**.
2. or approved equal.

- B. Color: **[Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.

- C. Pattern: **[Match DEN Project Manager's samples]** <Insert pattern>.
- D. Fiber Content: **[100 percent nylon 6, 6]** **[100 percent nylon 6]** **[100 percent polypropylene]** <Insert fiber and content by percentage>.
- E. Fiber Type: <Insert proprietary fiber type>.
- F. Pile Characteristic: **[Level-loop]** **[Cut]** **[Cut-and-loop]** **[Multilevel-loop]** **[Level tip shear]** **[Random shear]** **[Frieze]** **[Sculptured]** <Insert characteristic> pile.
- G. Yarn Twist: <Insert twist in TPI (TPCM)>.
- H. Yarn Count: <Insert yarn count>.
- I. Density: <Insert oz./cu. yd. (g/cu. cm)>.
- J. Pile Thickness: <Insert inches (mm)> for finished carpet **[per ASTM D 6859]**.
- K. Stitches: <Insert stitches per inch (mm)>.
- L. Gage: <Insert gage in ends per inch (mm)>.
- M. Face Weight: <Insert oz./sq. yd. (g/sq. m)>.
- N. Total Weight: <Insert oz./sq. yd. (g/sq. m)> for finished carpet.
- O. Primary Backing: **[Manufacturer's standard material]** **[Woven polypropylene]** **[Nonwoven, polypropylene or polyester]** <Insert specific primary backing material>.
- P. Secondary Backing: **[Manufacturer's standard material]** **[Woven polypropylene]** **[Nonwoven, polypropylene or polyester]** **[Woven jute]** **[Fiberglass]** <Insert specific secondary backing material>.
- Q. Backcoating: **[Manufacturer's standard material]** **[SBR latex]** **[PVC]** **[Thermoplastic copolymer]** <Insert backcoating; consult manufacturers>.
- R. Backing System: <Insert proprietary name>.
- S. Width: **[12 feet (3.7 m)]** **[6 feet (1.8 m)]** **[13.5 feet (4.1 m)]** **[15 feet (4.6 m)]** <Insert dimension>.
- T. Applied Soil-Resistance Treatment: **[Manufacturer's standard material]** <Insert treatment>.
- U. Antimicrobial Treatment: **[Manufacturer's standard material]** <Insert treatment>.
- V. Performance Characteristics: As follows:
1. Appearance Retention Rating: **[Moderate traffic, 2.5]** **[Heavy traffic, 3.0]** **[Severe traffic, 3.5]** <Insert number> minimum per ASTM D 7330.

2. Critical Radiant Flux Classification: Not less than **[0.45 W/sq. cm]** **[0.22 W/sq. cm]**.
3. Dry Breaking Strength: Not less than **100 lbf** (445 N) per ASTM D 2646.
4. Tuft Bind: Not less than **[3 lbf (13 N)] [5 lbf (22 N)] [6.2 lbf (28 N)] [8 lbf (36 N)] [10 lbf (45 N)]** **<Insert value>** per ASTM D 1335.
5. Delamination: Not less than **[2.5 lbf/in. (12 N/mm)] [3.5 lbf/in. (15 N/mm)] [4 lbf/in. (18 N/mm)]** **<Insert value>** per ASTM D 3936.
6. Resistance to Insects: Comply with AATCC 24.
7. Noise Reduction Coefficient (NRC): **<Insert NRC>** per ASTM C 423.
8. Colorfastness to Crocking: Not less than 4, wet and dry, per AATCC 165.
9. Colorfastness to Light: Not less than 4 after **[40] [60]** **<Insert number>** AFU (AATCC fading units) per AATCC 16, Option E.
10. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria; not less than 1-mm halo of inhibition for gram-negative bacteria; no fungal growth; per AATCC 174.
11. Electrostatic Propensity: Less than **[3.5] [2]** **<Insert number>** kV per AATCC 134.
12. Emissions: Provide carpet that complies with testing and product requirements of CRI's "Green Label Plus" program.
13. Emissions: Provide carpet that complies with the product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 WOVEN CARPET **<Insert designation>**

- A. Products: Subject to compliance with requirements, provide one of the following:
 1. **<Insert manufacturer's name; product name or designation>**.
 2. or approved equal.
- B. Color: **[Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range]** **<Insert color>**.
- C. Pattern: **[Match DEN Project Manager's samples]** **<Insert pattern>**.
- D. Fiber Content: **[100 percent wool] [80 percent wool; 20 percent nylon 6, 6] [80 percent wool; 20 percent nylon 6]** **<Insert fiber and content by percentage>**.
 1. Document that **[5 to 20] [85 to 100]** **<Insert number>** percent of the material feedstock for carpet is composed of biobased or recycled materials according to ANSI/NSF 140.
- E. Face Construction: **[Axminster] [Wilton] [Velvet]** **<Insert construction>**.
- F. Pile Characteristic: **[Level-loop] [Cut] [Cut-and-loop]** pile.
- G. Yarn Twist: **<Insert twist in TPI (TPCM)>**.

- H. Yarn Count: <Insert yarn count>.
- I. Density: <Insert oz./cu. yd. (g/cu. cm)>.
- J. Pile Thickness: <Insert inches (mm)> for finished carpet[per ASTM D 6859].
- K. Rows: <Insert number of lengthwise tufts per inch (mm)>.
- L. Pitch: <Insert number of rows in 27 inches (686 mm)>.
- M. Face Weight: <Insert oz./sq. yd. (g/sq. m)>.
- N. Total Weight: <Insert oz./sq. yd. (g/sq. m)> for finished carpet.
- O. Backing: [Manufacturer's standard.] [As follows:]
1. Chain Warp: <Insert material>.
 2. Stuffer Warp: <Insert material>.
 3. Shot or Fill Weft: <Insert material>.
 4. Backcoating: <Insert backcoating>.
- P. Applied Soil-Resistance Treatment: [Manufacturer's standard material] <Insert treatment>.
- Q. Antimicrobial Treatment: [Manufacturer's standard material] <Insert treatment>.
- R. Performance Characteristics: As follows:
1. Appearance Retention Rating: [Moderate traffic, 2.5] [Heavy traffic, 3.0] [Severe traffic, 3.5] <Insert number> minimum per ASTM D 7330.
 2. Critical Radiant Flux Classification: Not less than [0.45 W/sq. cm] [0.22 W/sq. cm].
 3. Dry Breaking Strength: Not less than 100 lbf (445 N) per ASTM D 2646.
 4. Resistance to Insects: Comply with AATCC 24.
 5. Noise Reduction Coefficient (NRC): <Insert NRC> per ASTM C 423.
 6. Colorfastness to Crocking: Not less than 4, wet and dry, per AATCC 165.
 7. Colorfastness to Light: Not less than 4 after [40] [60] <Insert number> AFU (AATCC fading units) per AATCC 16, Option E.
 8. Electrostatic Propensity: Less than [3.5] [2] <Insert number> kV per AATCC 134.
 9. Emissions: Provide carpet that complies with testing and product requirements of CRI's "Green Label Plus" program.
 10. Emissions: Provide carpet that complies with the product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 CARPET CUSHION <Insert designation>

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. <Insert manufacturers' names>.
2. or approved equal.

B. Traffic Classification: CCC [**Class I, moderate**] [**Class II, heavy**] [**Class III, extra-heavy**] traffic.

C. Fiber Cushion: [**Rubberized hair, mothproofed and sterilized**] [**Rubberized jute, mothproofed and sterilized**] [**Synthetic**] [**Resinated, recycled textile**].

1. Weight: <Insert oz./sq. yd. (g/sq. m)>.
2. Thickness: <Insert inches (mm)> plus 5 percent maximum.
3. Density: <Insert lb/cu. ft. (kg/cu. m)>.

D. Rubber Cushion: [**Flat**] [**Rippled waffle**] [**Textured flat**] [**Reinforced**].

1. Weight: <Insert oz./sq. yd. (g/sq. m)>.
2. Thickness: <Insert inches (mm)> plus 5 percent maximum.
3. Compression Resistance: <Insert lb/sq. in. (kg/sq. mm)> at [**25**] [**65**] percent per ASTM D 3676.
4. Density: <Insert lb/cu. ft. (kg/cu. m)>.

E. Polyurethane-Foam Cushion: [**Grafted prime**] [**Densified**] [**Bonded**] [**Mechanically frothed**].

1. Compression Force Deflection at 65 Percent: <Insert lb/sq. in. (kg/sq. mm) of **polymer density**> per ASTM D 3574.
2. Thickness: <Insert inches (mm)>.
3. Density: <Insert lb/cu. ft. (kg/cu. m)>.

F. Performance Characteristics: As follows:

1. Critical Radiant Flux Classification: Not less than [**0.45 W/sq. cm**] [**0.22 W/sq. cm**].
2. Noise Reduction Coefficient (NRC): <Insert **NRC**> per ASTM C 423.
3. Emissions: Provide carpet cushion that complies with testing and product requirements of CRI's "Green Label" program.
4. Emissions: Provide carpet cushion that complies with the product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 INSTALLATION ACCESSORIES

A. Concrete-Slab Primer: Nonstaining type as recommended by [**Carpet manufacturer**] [**Carpet cushion manufacturer**].

- B. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet[**cushion**] manufacturer.
- C. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by [**carpet manufacturer**] [**carpet and carpet cushion manufacturers**].
 - 1. Use adhesives with VOC content not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Use adhesives that comply with the product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Tackless Carpet Stripping: Water-resistant plywood, in strips as required to match cushion thickness and that comply with CRI 104, Section 12.2.
- E. Seam Adhesive: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.
- F. Metal Edge/Transition Strips: Extruded aluminum with [**mill**] <**Insert finish**> finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.
- G. Extruded or molded vinyl or rubber, colors selected by DEN Project Manager from standard colors available within the industry.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Examine carpet for type, color, pattern, and potential defects.
- B. Verify that subfloors and conditions are satisfactory for carpet installation and comply with requirements specified in this Section and those of the [**Carpet manufacturer**] [**Carpet cushion manufacturer**].
- C. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and

- dryness characteristics by performing bond and moisture tests recommended by carpet[**cushion**] manufacturer.
2. Subfloor finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" for slabs receiving carpet.
 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- D. For wood subfloors, verify the following:
1. Underlayment over subfloor complies with requirements specified in Section 061000 "Rough Carpentry."
 2. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with carpet manufacturer's installation recommendations to prepare substrates indicated to receive carpet installation.
- B. Examine surfaces to receive carpeting for holes, debris, or other defects that will adversely affect the execution and quality of Work. Do not proceed until conditions are satisfactory.
- C. Allow concrete surfaces to cure a minimum of 30 days.
- D. Do not install carpeting until masonry [**and drywall**] [**and plastering**] [**is**] [**are**] complete.
- E. Install carpeting prior to installation of demountable or movable partitions, fixtures, or telephone and electrical pedestal floor outlets.
- F. Install carpet within allowable temperature range stated by manufacturer.
- G. Level subfloor within 1/4 inch in 10 feet (6 mm in 3 m), noncumulative, in all directions. Sand or grind protrusions, bumps, and ridges. Patch and repair cracks and rough areas. Fill depressions.
- H. Use leveling and patching compounds to fill cracks, holes, and depressions in subfloor as recommended by the following:
 1. [**Carpet manufacturer.**] [**Carpet cushion manufacturer.**]
- I. Remove subfloor coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone.
- J. Broom or vacuum clean subfloors to be covered with carpet. Following cleaning, examine subfloors for moisture, alkaline salts, carbonation, or dust.
- K. Concrete-Subfloor Preparation: Apply concrete-slab primer, according to

manufacturer's directions, where recommended by [**Carpet manufacturer**] [**Carpet cushion manufacturer**].

- L. Resilient-Flooring Substrate Preparation: Replace missing pieces of existing resilient flooring or patch to level. Cut out peaked seams and fill with latex underlayment as recommended by manufacturer. Repair depressions with material recommended by [**Carpet manufacturer**] [**Carpet cushion manufacturer**].
- M. General: Comply with CRI 104, Section 7.3, "Site Conditions; Floor Preparation," and with carpet manufacturer's written installation instructions for preparing substrates.
- N. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions **1/8 inch** (3 mm) wide or wider, and protrusions more than **1/32 inch** (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.
- O. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet [**cushion**] manufacturer.
- P. Broom and vacuum clean substrates to be covered immediately before installing carpet.

3.3 INSTALLATION

- A. Comply with CRI 104 and [**carpet manufacturer's**] [**carpet and carpet cushion manufacturers**] written installation instructions for the following:
 - 1. Direct-Glue-Down Installation: Comply with CRI 104, Section 9, "Direct Glue-Down Installation."
 - 2. Double-Glue-Down Installation: Comply with CRI 104, Section 10, "Double-Glue-Down Installation."
 - 3. Carpet with Attached-Cushion Installation: Comply with CRI 104, Section 11, "Attached-Cushion Installations."
 - 4. Preapplied Adhesive Installation: Comply with CRI 104, Section 11.4, "Pre-Applied Adhesive Systems (Peel and Stick)."
 - 5. Hook-and-Loop Installation: Comply with CRI 104, Section 11.5, "Hook and Loop Technology."
 - 6. Stretch-in Installation: Comply with CRI 104, Section 12, "Stretch-in Installations."
 - 7. Stair Installation: Comply with CRI 104, Section 13, "Carpet on Stairs" for [**stretch-in**] [**glue-down**] installation.
- B. Comply with carpet manufacturer's written recommendations and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
- C. Do not bridge building expansion joints with carpet.

- D. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
- E. Where demountable partitions or other items are indicated for installation on top of finished carpet floor, install carpet before installation of these items.
- F. Extend carpet into toe spaces, door reveals, closet, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders to comply with CRI 104, Section 15, "Patterned Carpet Installations" and with carpet manufacturer's written recommendations.
- I. Comply with carpet cushion manufacturer's written recommendations. [**Install carpet cushion seams at 90-degree angle with carpet seams.**]

3.4 CLEANING AND PROTECTING

- A. Perform the following operations immediately after installing carpet:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
 - 2. Remove yarns that protrude from carpet surface.
 - 3. Vacuum carpet using commercial machine with face-beater element.
 - 4. Vacuum carpet, and clean if necessary, just prior to acceptance by Owner.
- B. Protect installed carpet to comply with CRI 104, Section 16, "Protecting Indoor Installations."
- C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer [**and carpet cushion manufacturer**] [**and carpet adhesive manufacturer**] [**and carpet cushion and adhesive manufacturers**].

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 096816

SECTION 096900 - ACCESS FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Access-flooring panels.
 - 2. Understructure.
 - 3. Floor panel coverings.
- B. Related Requirements:
 - 1. Section 233600 "Air Terminal Units" for variable-air-volume diffusers.
 - 2. Section 260526 "Grounding and Bonding for Electrical Systems" for connection to ground of access-flooring understructure.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ALLOWANCES

- A. Cutouts in floor panels are part of **<Insert name of allowance>**.
- B. Service outlets are part of **<Insert name of allowance>**.

1.4 UNIT PRICES

- A. Work of this Section is affected by **[cutouts in floor panels] [and] [service outlets]**.

1.5 COORDINATION

- A. Coordinate location of mechanical and electrical work in underfloor cavity to prevent interference with access-flooring pedestals.
- B. Mark pedestal locations on subfloor using a grid to enable mechanical and electrical work to proceed without interfering with access-flooring pedestals.

1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.
1. Review connection with mechanical and electrical systems.
 2. Review requirements related to sealing the plenum.
 3. Review procedures for keeping underfloor space clean.

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
1. Product Data for Credit IEQ 4.1: For pedestal-installation adhesives, documentation including printed statement of VOC content.
 2. Product Data for Credit IEQ 4.3: For pedestal-installation adhesives, documentation including printed statement of VOC content.
 3. Product Data for Credit IEQ 4.3: For floor panel coverings, documentation from an independent testing agency indicating compliance with the FloorScore Standard.
 4. Product Data for Credit IEQ 4.4: For particleboard used in steel-encapsulated, wood-core panels, documentation indicating that product contains no urea formaldehyde.
 5. Laboratory Test Reports for Credit IEQ 4: For **[access-flooring system with integral finishes] [pedestal-installation adhesives] [and] [particleboard used in steel-encapsulated, wood-core panels]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Include layout of access-flooring system and relationship to adjoining Work based on field-verified dimensions.
1. Details and sections with descriptive notes indicating materials, finishes, fasteners, typical and special edge conditions, accessories, and understructures.
- D. Samples:
1. Floor Covering: Full-size units for each color and texture specified.
 2. Exposed Metal Accessories: Approximately **10 inches** (250 mm) in length.
 3. One complete full-size floor panel, pedestal, and understructure unit for each type of access-flooring system required.
- E. Samples for Initial Selection: For each type of product and exposed finish.

- F. Samples for Verification: For the following products:
1. Floor Covering: Full-size units.
 2. Exposed Metal Accessories: Approximately **10 inches** (250 mm) in length.
 3. One complete full-size floor panel, pedestal, and understructure unit for each type of access-flooring system required.

1.8 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of access-flooring system.
- C. Product Test Reports: For each type of flooring material and exposed finish, for tests performed by a qualified testing agency.
- D. Seismic Design Calculations: For seismic design of access-flooring systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Preconstruction Test Reports: For preconstruction adhesive field test.

1.9 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.10 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Flooring Panels: **<Insert number>**.
 2. Pedestals: **<Insert number>**.
 3. Stringers: **<Insert number>**.

1.11 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Mockups: Build mockups to verify selections made under Sample submittals to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockup of typical access-flooring assembly as shown on Drawings. Size to be an area no fewer than **[five]** <Insert number> floor panels in length by **[five]** <Insert number> floor panels in width.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.12 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: **[Owner will engage]** a qualified testing agency to perform preconstruction testing on field mockups.

1. <Insert sizes and configurations of assemblies>.
2. Use personnel, materials, and methods of construction that will be used at Project site.
3. Notify DEN Project Manager **[seven]** <Insert number> days in advance of the dates and times when laboratory mockups will be tested.

- B. Preconstruction Adhesive Field Test: Before installing pedestals, field test their adhesion to subfloor surfaces by doing the following:

1. In areas representative of each subfloor surface, set typical pedestal assemblies in same adhesive and use methods required for the completed Work.
2. Allow test installation to cure for manufacturer's recommended cure time, with a pressure of **25 lbf** (111 N) applied vertically to pedestals during this period.
3. After curing, apply lateral load against a straight steel bar inserted **2 inches** (51 mm) into pedestal stems. Measure the force needed to cause adhesive failure of pedestal base.
4. Remove and discard failed pedestals, and clean pedestals of adhered residue.
5. Proceed with installation only after tests show compliance with performance requirement specified for pedestals' capability to resist overturning moment.

1.13 FIELD CONDITIONS

- A. Environmental Limitations: Do not install access flooring until spaces are enclosed, **[subfloor has been sealed,]** ambient temperature is between **50 and 90 deg F** (10 and 32 deg C), and relative humidity is not less than 20 and not more than 70 percent.

1.14 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Access flooring shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7]** **<Insert requirement>**.
- B. Structural Performance: Provide access-flooring systems capable of complying with the following performance requirements according to testing procedures in Cisca's "Recommended Test Procedures for Access Floors":
1. Concentrated Loads: **[900 lbf (4003 N)] [1000 lbf (4448 N)] [1250 lbf (5560 N)] [1500 lbf (6672 N)] [2000 lbf (8896 N)] <Insert value>** with the following deflection and permanent set:
 - a. Top-Surface Deflection: **[0.10 inch (2.54 mm)] <Insert dimension>**.
 - b. Permanent Set: **[0.010 inch (0.25 mm)] <Insert dimension>**.
 2. Ultimate Loads: **[1800 lbf (8006 N)] [2000 lbf (8896 N)] [2500 lbf (11 121 N)] [3000 lbf (13 345 N)] [4000 lbf (17 793 N)] <Insert value>**.
 3. Rolling Loads: With local or overall deformation not to exceed **0.040 inch (1.02 mm)**.
 - a. Cisca Wheel 1: 10 passes at **[400 lbf (1779 N)] [500 lbf (2224 N)] [600 lbf (2669 N)] [800 lbf (3559 N)] [1000 lbf (4448 N)] [1200 lbf (5338 N)] [1250 lbf (5560 N)] [2000 lbf (8896 N)] <Insert value>**.
 - b. Cisca Wheel 2: 10,000 passes at **[400 lbf (1779 N)] [500 lbf (2224 N)] [600 lbf (2669 N)] [800 lbf (3559 N)] [1000 lbf (4448 N)] [1250 lbf (5560 N)] [1750 lbf (7784 N)] [2000 lbf (8896 N)] <Insert value>**.
 4. Stringer Load Test: **[75 lbf (334 N)] [225 lbf (1001 N)] [350 lbf (1557 N)] [450 lbf (2002 N)] <Insert value>** at center of span with a permanent set not to exceed **0.010 inch (0.25 mm)**.
 5. Pedestal Axial Load Test: **[5000 lbf (22 240 N)] [6000 lbf (26 690 N)] <Insert value>**.
 6. Pedestal Overturning Moment Test: **[1000 lbf x inches (113 N x meters)] <Insert values>**.
 7. Uniform Load Test: **[200 lbf/sq. ft. (9.6 kPa)] [250 lbf/sq. ft. (12.0 kPa)] [300 lbf/sq. ft. (14.4 kPa)] [400 lbf/sq. ft. (19.2 kPa)] [500 lbf/sq. ft. (23.9 kPa)] <Insert value>** with a maximum top-surface deflection not to exceed **0.040 inch (1.02 mm)** and a permanent set not to exceed **0.010 inch (0.25 mm)**.
 8. Drop Impact Load Test: **[75 lb (34.0 kg)] [100 lb (45.5 kg)] [125 lb (56.7 kg)] [150 lb (68.0 kg)] [175 lb (79.4 kg)] <Insert value>**.
- C. Fire Performance:
1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

- a. Flame-Spread Index: **[25]** <Insert value> or less.
 - b. Smoke-Developed Index: **[50]** **[450]** <Insert value> or less.
2. Combustion Characteristics: ASTM E 136.
- D. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 MANUFACTURERS

- A. Source Limitations: Obtain access-flooring system from single source from single manufacturer.

2.3 FLOOR PANELS

- A. Floor Panels, General: Provide modular panels interchangeable with other field panels without disturbing adjacent panels or understructure.

1. Size: Nominal **[24 by 24 inches]** (610 by 610 mm) <Insert dimensions>.
2. Attachment to Understructure: **[Bolted]** **[By gravity]**.
3. One-to-One Carpet Tile: Fabricate panels to accept one-to-one carpet tile.

- B. Cementitious-Core Steel Panels: Fabricated from cold-rolled steel sheet, with the die-cut flat top sheet and die-formed and stiffened bottom pan welded together, and with metal surfaces protected against corrosion by manufacturer's standard factory-applied finish. Fully grout internal spaces of completed units with manufacturer's standard cementitious fill.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ASM Modular Systems, Inc.
- b. Bergvik North America, Inc.
- c. Camino Modular Systems, Inc.
- d. Computer Environments, Inc.
- e. Haworth, Inc.
- f. Tate Access Floors, Inc.
- g. <Insert manufacturer's name>.
- h. or approved equal.

- C. Wood-Core Steel Panels: Fabricated with **1-inch-** (25-mm-) thick particleboard core[, **made without urea formaldehyde**], **that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers,"**] laminated to top and bottom steel face sheets, with metal surfaces protected against corrosion by manufacturer's standard factory-applied finish, and with a flame-spread index of 25 or less according

to ASTM E 84. Provide core edges enclosed with upturned, die-formed, bottom-sheet edge or with perimeter steel channel welded to top sheet and welded or bonded to bottom sheet.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASM Modular Systems, Inc.
 - b. Bergvik North America, Inc.
 - c. Camino Modular Systems, Inc.
 - d. Computer Environments, Inc.
 - e. Tate Access Floors, Inc.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.

- D. Unfilled Steel Panels: Fabricated from cold-rolled steel sheet, with the die-cut flat top sheet and die-formed and stiffened bottom pan welded together, and with metal surfaces protected against corrosion by manufacturer's standard factory-applied finish.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASM Modular Systems, Inc.
 - b. Camino Modular Systems, Inc.
 - c. Computer Environments, Inc.
 - d. Haworth, Inc.
 - e. Tate Access Floors, Inc.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.

 2. Solid Panels: Flat, solid top surface.
 3. Perforated Panels: Perforated top surface with **[holes] [slots]** of number, spacing, and size standard with manufacturer to produce a nominal open area of **[23] [24] [25] <Insert number>** percent.**[Provide mechanical dampers with each panel unit.]**
 - a. Quantity: **[As shown on Drawings] <Insert number>**.
 - b. Finish: **[Manufacturer's standard] [To match solid panels] <Insert finish>**.

 4. Grates: Grating ribs arranged in manufacturer's standard pattern to produce a nominal open area of **[45] [50] [56] <Insert number>** percent.**[Provide mechanical dampers with each panel unit.]**
 - a. Quantity: **[As shown on Drawings] <Insert number>**.
 - b. Finish: **[Manufacturer's standard] [To match solid panels] <Insert finish>**.

- E. Exposed-Concrete-Surface Panels: Fabricated with bottom pan that is die formed from metallic-coated steel sheet and filled with lightweight concrete that is reinforced and bonded to pan by shear ties.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Haworth, Inc.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.
- F. Aluminum Panels: Fabricated from manufacturer's standard aluminum alloy with equivalent strength and corrosion resistance of Alloy UNS No. A03830 or UNS No. A03840 according to ASTM B 85.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASM Modular Systems, Inc.
 - b. Computer Environments, Inc.
 - c. Tate Access Floors, Inc.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
 2. Solid Panels: Flat, solid surface on top and symmetrical crossing ribs on bottom; edge machined after casting to specified tolerances.
 3. Perforated Panels: Perforated top surface with **[holes] [slots]** of number, spacing, and size standard with manufacturer to produce a nominal open area of **[16.5] <Insert number>** percent.[**Provide mechanical dampers with each panel unit.**]
 - a. Quantity: **[As shown on Drawings] <Insert number>**.
 - b. Finish: **[Manufacturer's standard] [To match solid panels] <Insert finish>**.
 4. Grates: Grating ribs arranged in manufacturer's standard pattern to produce a nominal open area of **[55] <Insert number>** percent.[**Provide mechanical dampers with each panel unit.**]
 - a. Quantity: **[As shown on Drawings] <Insert number>**.
 - b. Finish: **[Manufacturer's standard] [To match solid panels] <Insert finish>**.
 5. Epoxy Finish: **[Conductive]** epoxy powder coating with a minimum average thickness of **2.5 mils** (0.064 mm) and in color selected from manufacturer's full range.
 6. Plated Finish: Nickel-chrome electrodeposited plating, **0.000005-inch** (0.000127-mm) chrome over **0.0008-inch** (0.02-mm) nickel, without copper or brass strike, to produce complete coverage over significant surfaces with a matte metallic appearance.

2.4 UNDERSTRUCTURE

- A. Pedestals: Assembly consisting of base, column with provisions for height adjustment, and head (cap); made of **[steel]** **[aluminum]**.
1. Provide pedestals designed for use in seismic applications.
 2. Base: Square or circular base with not less than **[16 sq. in. (103 sq. cm)]** **<Insert dimension>** of bearing area.
 3. Column: Of height required to bring finished floor to elevations indicated. Weld to base plate.
 4. Provide vibration-proof leveling mechanism for making and holding fine adjustments in height over a range of not less than **[2 inches (51 mm)]** **<Insert dimension>** and for locking at a selected height, so deliberate action is required to change height setting and prevent vibratory displacement.
 5. Head: Designed to support the panel system indicated.
 - a. Provide sound-deadening pads or gaskets at contact points between heads and panels.
 - b. Bolted Assemblies: Provide head with four holes aligned with holes in floor panels for bolting of panels to pedestals.
- B. Stringer Systems: Modular **[steel]** **[aluminum]** stringer systems designed to bolt to pedestal heads and form a grid pattern. Protect steel components with manufacturer's standard galvanized or corrosion-resistant paint finish.
1. Continuous Gaskets: At contact surfaces between panel and stringers to deaden sound, seal off the underfloor cavity from above, and maintain panel alignment and position.

2.5 FLOOR PANEL COVERINGS

- A. FloorScore Compliance: Floor panel coverings shall comply with requirements of FloorScore Standard.
- B. High-Pressure Plastic Laminate: Factory applied, NEMA LD 3, High-Wear type, **[Grade HDH]** **[Grade HDM]**; fabricated in one piece to cover each panel face with **[integral trim]** **[applied perimeter plastic]** edging.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Formica Corporation.
 - b. Panolam Industries.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.
 2. Electrical Resistance: Average no less than 1 megohm and no more than 20,000 megohms when installed floor coverings are surface-to-ground tested according to NFPA 99.

3. Colors, Textures, and Patterns: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert colors, textures, and patterns>**.
- C. Conductive High-Pressure Plastic Laminate: Factory applied, NEMA LD 3, High-Wear type, **[Grade HDH] [Grade HDM]**; fabricated in one piece to cover each panel face with **[integral trim] [applied perimeter plastic]** edging.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Panolam Industries.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.
 2. Electrical Resistance: Average no less than 25,000 ohms and no more than 1 megohm when installed floor coverings are surface-to-ground tested according to ASTM F 150 with 100-V applied voltage.
 3. Colors, Textures, and Patterns: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert colors, textures, and patterns>**.
- D. Static-Dissipative Vinyl Tile: Factory applied, ASTM F 1700, Class I (Monolithic Vinyl Tile), Type A (Smooth Surface), fabricated in one piece to cover panel face with **[monolithic] [applied perimeter plastic]** edging.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flexco, Inc.
 - b. VPI Corporation.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.
 2. Electrical Resistance: Average no less than 1 megohm and no more than 1000 megohms when installed floor coverings are surface-to-ground tested according to ASTM F 150 with 100-V applied voltage.
 3. Colors, Textures, and Patterns: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert colors, textures, and patterns>**.
- E. Conductive Vinyl Tile: Factory applied, ASTM F 1700, Class I (Monolithic Vinyl Tile), Type A (Smooth Surface), fabricated in one piece to cover panel face with **[monolithic] [applied perimeter plastic]** edging.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Flexco, Inc.
 - b. VPI Corporation.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.
2. Electrical Resistance: Average no less than 25,000 ohms and no more than 1 megohm when installed floor coverings are surface-to-ground tested according to ASTM F 150 with 100-V applied voltage.
 3. Colors, Textures, and Patterns: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert colors, textures, and patterns>**.

2.6 FABRICATION

A. Fabrication Tolerances:

1. Size: Plus or minus **0.020 inch** (0.50 mm) of required size.
2. Squareness: Plus or minus **0.015 inch** (0.38 mm) between diagonal measurements across top of panel.
3. Flatness: Plus or minus **0.035 inch** (0.89 mm), measured on a diagonal on top of panel.

B. Panel Markings: Clearly and permanently mark floor panels on their underside with panel type and concentrated-load rating.

C. Bolted Panels: Provide panels with holes drilled in corners to align precisely with threaded holes in pedestal heads and to accept countersunk screws with heads flush with top of panel.

1. Captive Fasteners: Provide fasteners held captive to panels.

D. Cutouts: Fabricate cutouts in floor panels for cable penetrations and service outlets. Provide reinforcement or additional support, if needed, to make panels with cutouts comply with structural performance requirements.

1. Number, Size, Shape, and Location: **[As indicated.] [As specified in Section 012100 "Allowances" and Section 012200 "Unit Prices."]**
2. Grommets: Where indicated, fit cutouts with manufacturer's standard grommets; or, if size of cutouts exceeds maximum grommet size available, trim edge of cutouts with manufacturer's standard plastic molding with tapered top flange.**[Furnish removable covers for grommets.]**
3. Provide foam-rubber pads for sealing annular space formed in cutouts by cables.

2.7 ACCESSORIES

A. Adhesives: Manufacturer's standard adhesive for bonding pedestal bases to subfloor.

1. Adhesive shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Post-Installed Anchors: For anchoring pedestal bases to subfloor, provide **[two] [four]** post-installed **[expansion anchors] [threaded concrete screws]** made from carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (5 microns) for Class SC 1 (Mild), with the capability to sustain, without failure, a load equal to **[1.5] <Insert number>** times the loads imposed by pedestal overturning moment on fasteners, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- C. Service Outlets: Standard UL-listed and -labeled assemblies, for recessed mounting flush with top of floor panels; for power, communication, and signal services; and complying with the following requirements:
1. Structural Performance: Cover capable of supporting a **[300-lbf (1334-N)] [800-lbf (3559-N)] [1000-lbf (4448-N)]** concentrated load.
 2. Cover and Box Type: **[Hinged polycarbonate cover with opening for passage of cables when cover is closed and including frame and steel box or formed-steel plate for mounting electrical receptacles] [Grommet with twist-close cover and including steel junction box for electrical receptacle with provision for telephone connectors and signal cables] <Insert type>**.
 3. Location: In center of panel quadrant unless otherwise indicated.
 4. Receptacles and Wiring: Electrical receptacles and wiring for service outlets are specified elsewhere.
 5. Receptacles and Wiring: Equip each service outlet with power receptacles to comply with the following requirements:
 - a. Type of Receptacle: Heavy-duty duplex, two-pole, three-wire grounding, 20 A, 125 V, NEMA WD 6, Configuration 5-20R unless otherwise indicated.
 - b. Number of Receptacles for Outlet: **[One] [Two] [Four] <Insert number>**.
 - c. Wiring Method: Factory wired for hardwiring in field with armored cable, containing three insulated No. 12 AWG solid-copper conductors, terminated with a **[6-inch- (152-mm-)] <Insert dimension>** long pigtail.
 - d. Wiring Method: Power-in connectors, built into outlet housing, of type to fit power-in and power-out connectors of branch-circuit cables supplied with building electrical system.
- D. Occupant Adjustable Diffusers: Manufacturer's standard round diffusers, **[4 inches (102 mm)] [8 inches (203 mm)] <Insert dimension>** in diameter, formed from **[aluminum] [polycarbonate plastic]** to produce a removable one-piece unit complete with diffuser, manually adjustable flow regulator, dirt and dust receptacle, trim ring, and underfloor compression mounting ring; precisely fitted in factory-prepared openings of standard field panels and complying with the following requirements:

1. Air-Distribution Characteristics: [100 cfm (47 L/s)] <Insert value> at [0.096-inch (24-Pa)] <Insert value> static pressure and a maximum noise criterion rating of [15] <Insert number>.
 2. Structural Performance: Capable of supporting a [600-lbf (2669-N)] <Insert value> concentrated load.
 3. Fire-Test-Response Characteristics: Classified 94V-0 according to UL 94.
- E. Floor Grilles: Standard load-bearing grilles formed from [aluminum] [polycarbonate plastic] to produce removable one-piece unit precisely fitted in factory-prepared openings of standard field panels, [with adjustable/removable] [without] dampers and complying with the following requirements:
1. Air-Distribution Characteristics: 468 cfm at 0.10-inch wg (221 L/s at 25-Pa) static pressure.
 2. Structural Performance: Capable of supporting a 1000-lbf (4448-N) concentrated load.
 3. Fire-Test-Response Characteristics: Classified 94V-0 according to UL 94.
- F. Plenum-Wall Brush Grommets: Self-sealing cable brush grommet with [4-by-13-inch (102-by-330-mm) rectangular] [3-inch (76-mm) round] [5-inch (127-mm) round] <Insert dimension(s)> usable area for passage of power and signal cables through plenum walls. Frame of [ABS plastic] [aluminum] with passageway consists of intermediate layer of flexible EPDM rubber and interwoven nylon filaments.[Provide units with plastic cable tray for support of cables and protection of wallboard.]
- G. Cavity Dividers: Provide manufacturer's standard metal dividers located where indicated to divide underfloor cavities.
- H. Closures: Where underfloor cavity is not enclosed by abutting walls or other construction, provide metal-closure plates with [manufacturer's standard finish] <Insert finish>.
- I. Ramps: Manufacturer's standard ramp construction of width and slope indicated, but not steeper than 1:12, with raised-disc or textured rubber or vinyl-tile floor coverings, and of same materials, performance, and construction requirements as access flooring.
- J. Steps: Provide steps of size and arrangement indicated with floor coverings to match access flooring. Apply nonslip aluminum nosings to treads unless otherwise indicated.
- K. Railings: Standard extruded-aluminum railings at ramps and open-sided perimeter of access flooring where indicated. Include handrail, intermediate rails, posts, brackets, end caps, wall returns, wall and floor flanges, plates, and anchorages where required.
1. Provide railings that comply with structural performance requirements specified in [Section 055213 "Pipe and Tube Railings"] [Section 057300 "Decorative Metal Railings."]
- L. Panel Lifting Device: Panel manufacturer's standard portable lifting device for each type of panel required[for each computer room].

- M. Perimeter Support: Where indicated, provide manufacturer's standard method for supporting panel edge and forming transition between access flooring and adjoining floor coverings at same level as access flooring.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer and manufacturer's representative present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, foreign deposits, and debris that might interfere with attachment of pedestals.
 - 2. Verify that concrete floor sealer and finish have been applied and cured.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Lay out floor panel installation to keep the number of cut panels at floor perimeter to a minimum. Avoid using panels cut to less than **6 inches** (152 mm).
- B. Locate each pedestal, complete any necessary subfloor preparation, and vacuum subfloor to remove dust, dirt, and construction debris before beginning installation.

3.3 INSTALLATION

- A. Install access-flooring system and accessories under supervision of access-flooring manufacturer's authorized representative to produce a rigid, firm installation that complies with performance requirements and is free of instability, rocking, rattles, and squeaks.
- B. Adhesive Attachment of Pedestals: Set pedestals in adhesive, according to access-flooring manufacturer's written instructions, to provide full bearing of pedestal base on subfloor.
- C. Mechanical Attachment of Pedestals: Attach pedestals to subfloor with post-installed mechanical anchors.
- D. Adjust pedestals to permit top of installed panels to be set flat, level, and to proper height.
- E. Stringer Systems: Secure stringers to pedestal heads according to access-flooring manufacturer's written instructions.

- F. Install flooring panels securely in place, properly seated with panel edges flush. Do not force panels into place.
 - G. Scribe perimeter panels to provide a close fit with adjoining construction with no voids greater than **1/8 inch** (3 mm) where panels abut vertical surfaces.
 - 1. To prevent dusting, seal cut edges of steel-encapsulated, wood-core panels with sealer recommended in writing by panel manufacturer.
 - H. Cut and trim access flooring and perform other dirt-or-debris-producing activities at a remote location or as required to prevent contamination of subfloor under already-installed access flooring.
 - I. Grounded Flooring Access Panel Systems: Ground flooring system as recommended by manufacturer and as needed to comply with performance requirements for electrical resistance of floor coverings.
 - 1. Panel-to-Understructure Resistance: Not more than 10 ohms as measured without floor coverings.
 - J. Underfloor Dividers: Scribe and install underfloor-cavity dividers to closely fit against subfloor surfaces, and seal with mastic.
 - K. Closures: Scribe closures to closely fit against subfloor and adjacent finished-floor surfaces. Set in mastic and seal to maintain plenum effect within underfloor cavity.
 - L. Clean dust, dirt, and construction debris caused by floor installation, and vacuum subfloor area as installation of floor panels proceeds.
 - M. Seal underfloor air cavities at construction seams, penetrations, and perimeter to control air leakage, according to manufacturer's written instructions.
 - N. Install access flooring without change in elevation between adjacent panels and within the following tolerances:
 - 1. Plus or minus [**1/16 inch** (1.5 mm)] [**1/8 inch** (3 mm)] **<Insert dimension>** in any **10-foot** (3-m) distance.
 - 2. Plus or minus [**1/8 inch** (3 mm)] [**1/4 inch** (6.5 mm)] **<Insert dimension>** from a level plane over entire access-flooring area.
- 3.4 PROTECTION
- A. Prohibit traffic on access flooring for 24 hours and removal of floor panels for [**72**] **<Insert number>** hours after installation to allow pedestal adhesive to set.
 - B. After completing installation, vacuum access flooring and cover with continuous sheets of reinforced paper or plastic. Maintain protective covering until time of Substantial Completion.

- C. Replace access-flooring panels that are stained, scratched, or otherwise damaged or that do not comply with specified requirements.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 096900

SECTION 097200 - WALL COVERINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Vinyl wall covering.
2. Woven glass-fiber wall covering.
3. Textile wall covering.
4. Heavy-duty synthetic textile wall covering.
5. Wood-veneer wall covering.
6. Wallpaper.

- B. Owner-Furnished Materials: **<Insert wall-covering materials>**.

- C. Related Sections:

1. **[Section 099113 "Interior Painting"]** Section **<Insert Section number>** "**<Insert Section title>**" for **[priming wall surfaces] [primers, coatings, and paint for woven glass-fiber wall coverings]**.
2. Section 099300 "Staining and Transparent Finishing" for field-applied finishes for wood-veneer wall coverings.

- D. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include data on physical characteristics, durability, fade resistance, and flame-resistance characteristics.

1. Include data substantiating that materials comply with requirements.

- B. LEED Submittals:

1. Certificates for **[Credit MR 6] [Credit MR 7]**: Chain-of-custody certificates indicating that wood-veneer wall coverings comply with forest certification requirements. Include documentation that manufacturer is certified for chain of

2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
 3. Product Data for Credit IEQ 4.2: For paints and coatings, documentation including printed statement of VOC content.
 4. Laboratory Test Reports for Credit IEQ 4: For **[wall covering systems] [adhesives] [and] [paints and coatings]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Show location and extent of each wall-covering type. Indicate **[pattern placement,] [veneer matching,]** seams and termination points.
- D. Samples for Initial Selection: For each type of wall covering indicated.
- E. Samples for Verification: Full width by **[36-inch- (914-mm-)] <Insert dimension>** long section of wall covering.
1. Sample from same print run or dye lot to be used for the Work, with specified **[treatments] [paint]** applied. **[Show complete pattern repeat.]** Mark top and face of fabric.
 2. Sample from same flitch to be used for the Work, with specified finish applied.
- F. Product Schedule: For wall coverings. **[Use same designations indicated on Drawings.]**

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for wall covering.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For wall coverings to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Wall-Covering Materials: For each type, full-size units equal to **[5]** **<Insert number>** percent of amount installed.

1.7 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Surface-Burning Characteristics: As follows, per ASTM E 84:
 - a. Flame-Spread Index: **[25]** **<Insert value>** or less.
 - b. Smoke-Developed Index: **[50]** **[450]** **<Insert value>** or less.
 2. Fire-Growth Contribution: Textile wall coverings complying with acceptance criteria of UBC Standard 8-2.
 3. Fire-Growth Contribution: Textile wall coverings tested according to **[NFPA 265]** **[NFPA 286]** and complying with test protocol and criteria in the 2003 IBC.
- B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 1. Build mockups for each type of wall covering on each substrate required. Comply with requirements in ASTM F 1141.
 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion and approved by DEN Project Manager.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 1. Wood-Veneer Wall Coverings: Condition spaces for not less than 48 hours before installation.
- B. Lighting: Do not install wall covering until **[a permanent level of lighting]** **<Insert requirement>** is provided on the surfaces to receive wall covering.
- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419

"Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Low-Emitting Materials: Wall covering system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 WALL COVERINGS

- A. General: Provide rolls of each type of wall covering from same print run or dye lot.

2.3 VINYL WALL COVERING <Insert drawing designation>

- A. Vinyl Wall-Covering Standards: Provide[**mildew-resistant**] products complying with the following:
1. **[FS CCC-W-408D and]CFFA-W-101-D** for **[Type I, Light] [Type II, Medium] [Type III, Heavy]**-Duty products.
 2. ASTM F 793 for **[peelable] [strippable]** wall coverings that qualify as **[Category I, Decorative Only] [Category II, Decorative with Medium Serviceability] [Category III, Decorative with High Serviceability] [Category IV, Type I, Commercial Serviceability] [Category V, Type II, Commercial Serviceability] [Category VI, Type III, Commercial Serviceability]** products.
 3. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert manufacturer's name; product name or designation>**.
 - b. or approved equal.
- B. Total Weight Excluding Coatings: **<Insert weight>**.
- C. Width: **[27 inches (686 mm)] [54 inches (1372 mm)] <Insert width>**.
- D. Backing: **[Scrim] [Osna burg] [Drill] [Nonwoven]** fabric.
1. Fiber Content: **[Cotton] [Polyester] [Polycotton] [Polyester cellulose] <Insert fiber content>**.
- E. Repeat: **[Random] <Insert horizontal and vertical dimensions of repeat>**.
- F. Stain-Resistant Coating: **<Insert coating manufacturer's name; product name or designation>**.

- G. Colors, Textures, and Patterns: **[Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range].**

2.4 WOVEN GLASS-FIBER WALL COVERING <Insert drawing designation>

A. General:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. <Insert manufacturer's name; product name or designation>.
 - b. or approved equal.

B. Total Weight: <Insert weight>.

1. Width: [39 inches (991 m)] <Insert width>.

- C. Colors, Textures, and Patterns: **[Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range].**

2.5 TEXTILE WALL COVERING <Insert drawing designation>

- A. Wall-Covering Standard: Provide **[mildew-resistant] [peelable] [strippable]** wall coverings that comply with ASTM F 793 for **[Category IV, Type I, Commercial Serviceability] [Category V, Type II, Commercial Serviceability] [Category VI, Type III, Commercial Serviceability]** products.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. <Insert manufacturer's name; product name or designation>.
 - b. or approved equal.

B. Test Responses:

1. Colorfastness to Wet and Dry Crocking: Passes AATCC 8, Grade 3, minimum.
2. Colorfastness to Light: Passes AATCC 16, Option 1 or 3, Grade 4, minimum, at 40 hours.

C. Total Weight Excluding Coatings: <Insert weight>.

D. Width: <Insert width>.

E. Repeat: **[Random] <Insert horizontal and vertical dimensions of repeat>.**

F. Applied Backing Material: **[Acrylic] [Paper].**

- G. Stain-Resistant Coating: <Insert coating manufacturer's name; product name or designation>.

- H. Colors, Textures, and Patterns: [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**].

2.6 HEAVY-DUTY SYNTHETIC TEXTILE WALL COVERING <Insert drawing designation>

- A. Wall-Covering Standard: Provide[**mildew-resistant**] wall coverings that comply with ASTM F 793 for [**Category IV, Type I, Commercial Serviceability**] [**Category V, Type II, Commercial Serviceability**] [**Category VI, Type III, Commercial Serviceability**] products.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. <Insert manufacturer's name; product name or designation>.
 - b. or approved equal.

- B. Test Responses:

1. Colorfastness to Wet and Dry Crocking: Passes AATCC 8, Class 3, minimum.
2. Colorfastness to Light: Passes AATCC 16A or AATCC 16E, Class 4, minimum, at 40 hours.

- C. Total Weight: <Insert weight>.

- D. Width: [**54 inches** (1372 mm)] [**60 inches** (1524 mm)] <Insert width>.

- E. Colors, Textures, and Patterns: [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**].

2.7 WOOD-VENEER WALL COVERING <Insert drawing designation>

- A. General:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. <Insert manufacturer's name; product name or designation>.
 - b. or approved equal.

- B. Forest Certification: Fabricate products with wood veneer produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

- C. Sheet Size: [**24 by 96 inches** (610 by 2440 mm)] [**48 by 96 inches** (1220 by 2440 mm)] [**48 by 120 inches** (1220 by 3050 mm)] <Insert dimensions>.

- D. Veneer Construction: [**Single ply veneer**] [**Two veneer plies assembled perpendicular to one another**] <Insert construction>.

- E. Wood Species: [**Red oak**] [**Maple**] [**Cherry**] <Insert species>.

- F. Cut and Figure: **<Insert cut and figure>**.
- G. Veneer Match: **[Book] [Slip] <Insert matching>**.
- H. Sheet Match: **[Running] [Balance] [Center] [Sequence, as indicated] [Blueprint, as indicated]**.
- I. Applied Backing Material: **[Fabric] <Insert material>**.
- J. Finish: **[Factory] [Field]** applied using wall-covering manufacturer's standard **[stain and polyurethane] <Insert type>** system.
 - 1. Colors: **[Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range]**.

2.8 WALLPAPER **<Insert drawing designation>**

- A. Wall-Covering Standard: Provide **[mildew-resistant] [peelable] [strippable]** wallpaper that complies with ASTM F 793 for **[Category II, Decorative with Medium Serviceability] [Category III, Decorative with High Serviceability]** products.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert manufacturer's name; product name or designation>**.
 - b. or approved equal.
- B. Total Weight: **<Insert weight>**.
- C. Width: **[20-1/2 inches (520.7 mm)] [28 inches (711.2 mm)] <Insert width>**.
- D. Repeat: **[Random] <Insert horizontal and vertical dimensions of repeat>**.
- E. Colors, Textures, and Patterns: **[Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range]**.

2.9 ACCESSORIES

- A. Adhesive: Mildew-resistant, nonstaining[, **strippable**] adhesive, for use with specific wall covering and substrate application; as recommended in writing by wall-covering manufacturer.
 - 1. Adhesive shall have VOC content of **[50] <Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Primer/Sealer: Mildew resistant, complying with requirements in **[Section 099123]**

"Interior Painting"] Section <Insert Section number> "<Insert Section title>" and recommended in writing by wall-covering manufacturer for intended substrate.

- C. Wall Liner: Nonwoven, synthetic underlayment and adhesive as recommended by wall-covering manufacturer.
- D. Seam Tape: As recommended in writing by wall-covering manufacturer.
- E. Metal Primer: Interior ferrous metal primer complying with [**Section 099123 "Interior Painting"]** Section <Insert Section number> "<Insert Section title>."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.
- C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
 - 1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
 - 2. Plaster: Allow new plaster to cure. Neutralize areas of high alkalinity. Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
 - 3. Metals: If not factory primed, clean and apply metal as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
 - 4. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
 - 5. Painted Surfaces: Treat areas susceptible to pigment bleeding.
- D. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finish with fine sandpaper.
- E. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

- F. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.
- G. Install wall liner, with no gaps or overlaps, where required by wall-covering manufacturer. Form smooth wrinkle-free surface for finished installation. Do not begin wall-covering installation until wall liner has dried.

3.3 INSTALLATION

- A. General: Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated except where more stringent requirements apply.
- B. Cut wall-covering strips in roll number sequence. Change roll numbers at partition breaks and corners.
- C. Install strips in same order as cut from roll.
- D. Install reversing every other strip.
- E. Install wall covering with no gaps or overlaps, no lifted or curling edges, and no visible shrinkage.
- F. Match pattern **72 inches** (1830 mm) above the finish floor.
- G. Install seams vertical and plumb at least **6 inches** (150 mm) from outside corners and [**3 inches** (75 mm)] [**6 inches** (150 mm)] from inside corners unless a change of pattern or color exists at corner. No horizontal seams are permitted.
- H. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.
- I. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without any overlay or spacing between strips.

3.4 FIELD FINISHING OF WOOD-VENEER WALL COVERINGS

- A. Apply [**wall-covering manufacturer's standard stain and polyurethane**] <Insert **type**> system according to coating manufacturer's written instructions to produce finish that is consistent in color and gloss and matches approved Samples.
- B. Apply no fewer than [**two**] [**three**] finish coats.

3.5 CLEANING

- A. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommended in writing by wall-covering manufacturer.

- C. Replace strips that cannot be cleaned.
- D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 097200

SECTION 097513 - STONE PANELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes anchored stone paneling for the following interior applications:
 - 1. Wall paneling.
 - 2. Column facing.
 - 3. Units with carving or inscriptions.
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete" for installing concrete inserts for anchoring stone paneling.
 - 2. Section 042000 "Unit Masonry" for installing masonry inserts for anchoring stone paneling.
 - 3. Section 079200 "Joint Sealants" for sealing expansion joints in stone paneling.
 - 4. Section 093033 "Stone Tiling" for stone wall tile.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.

1.4 ACTION SUBMITTALS

- A. Product Data: For each[**variety of stone,**] stone accessory, and manufactured product.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:

1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
 2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured[**and regionally extracted and manufactured**] materials. Include statement indicating cost for each regionally manufactured material.
 - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
 - b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
 3. Product Data for Credit IEQ 4.1: For sealants, documentation including printed statement of VOC content.
- C. Laboratory Test Reports for Credit IEQ 4.1: For sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Shop Drawings: Show fabrication and installation details for stone paneling system, including dimensions and profiles of stone units.
1. Show locations and details of joints both within stone paneling system and between stone paneling system and other finish materials.
 2. Show locations and details of anchors, including locations of supporting construction.
 3. Show direction of veining, grain, or other directional pattern.
 4. Include large-scale shaded drawings of [**decorative surfaces**] [**and**] [**inscriptions**].
- E. Samples for Initial Selection: For joint materials involving color selection.
- F. Samples for Verification:
1. For each stone type indicated, in sets of Samples not less than **12 inches** (300 mm) square. Include [**two**] [**three**] [**four**] [**five**] <Insert number> or more Samples in each set and show the full range of variations in appearance characteristics in completed Work.
 2. For each color of [**grout**] [**pointing mortar**] [**and**] [**sealant**] required.
 3. For [**carving**] [**and**] [**inscriptions**].
- G. Delegated-Design Submittal: For stone paneling assembly.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[Installer]** **[fabricator]** **[professional engineer]**.
- B. Material Test Reports:
 - 1. Stone Test Reports: For **[each]** stone variety proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, other than abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous **[three]** **[five]**<Insert number> years.
 - 2. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer indicating that sealants will not stain or damage stone. Include interpretation of test results and recommendations for primers and substrate preparation needed for adhesion.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For stone paneling to include in maintenance manuals. Include product data for stone-care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate stone paneling similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of stone paneling.
- C. Installer Qualifications: A firm or individual experienced in installing stone paneling similar in material, design, and extent to that indicated for this Project, whose work has a record of successful in-service performance.
- D. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Build mockups for the following kinds of stone paneling:
 - a. Typical stone wall paneling, not less than **72 inches** (1800 mm) long by **96 inches** (2400 mm) high.
 - b. Typical stone wainscot paneling, not less than **72 inches** (1800 mm) long by full wainscot height.
 - c. Typical column facing, one complete column.
 - d. Grouting or pointing of joints.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Sealant Adhesion and Compatibility Testing: Submit to joint-sealant manufacturers, for compatibility and adhesion testing according to sealant manufacturer's standard testing methods and Section 079200 "Joint Sealants," Samples of materials that will contact or affect joint sealants.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.
 1. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
 2. Store stone on wood A-frames or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.
- B. Mark stone units, on surface that will be concealed after installation, with designations used on Shop Drawings to identify individual stone units. Orient markings on vertical panels so that they are right side up when units are installed.
- C. Deliver sealants to Project site in original unopened containers labeled with manufacturer's name, product name and designation, color, expiration period, pot life, curing time, and mixing instructions for multicomponent materials.
- D. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

1.10 FIELD CONDITIONS

- A. Maintain air and material temperatures to comply with requirements of installation material manufacturers, but not less than 50 deg F (10 deg C) during installation and for seven days after completion.
- B. Field Measurements: Verify dimensions of construction to receive stone paneling by field measurements before fabrication and indicate measurements on Shop Drawings.

1.11 COORDINATION

- A. Coordinate installation of inserts that are to be embedded in concrete or masonry and similar items to be used by stone paneling Installer for anchoring and supporting stone paneling. Furnish setting drawings, templates, and directions for installing such items and deliver to Project site in time for installation.
- B. Time delivery and installation of stone paneling to avoid extended on-site storage and to coordinate with work adjacent to stone paneling.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Stone: Obtain[**each variety of**] stone, [**regardless of finish,**] from a single quarry[, **whether specified in this Section or in another Section of the Specifications,**] with resources to provide materials of consistent quality in appearance and physical properties.
 - 1. For stone types that include same list of varieties and sources, provide same variety from same source for each.
 - 2. Make quarried blocks available for examination by DEN Project Manager.
 - 3. Make stone slabs available for examination by DEN Project Manager.
 - a. DEN Project Manager will select aesthetically acceptable slabs[**and will indicate aesthetically unacceptable portions of slabs**].
 - b. Segregate slabs selected for use on Project and mark backs indicating approval.
 - c. Mark and photograph aesthetically unacceptable portions of slabs as directed by DEN Project Manager.
- B. Varieties and Sources: Subject to compliance with requirements, provide stone of varieties and from sources complying with Section 044200 "Exterior Stone Cladding."

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stone paneling system.
- B. General: Design stone anchors and anchoring systems according to ASTM C 1242.

C. Seismic Performance: Stone paneling system shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7]** **<Insert requirement>**.

1. Component Importance Factor: **[1.5]** **[1.0]**.

2.3 GRANITE **<Insert drawing designation>**

A. Material Standard: Comply with ASTM C 615.

B. Regional Materials: Granite shall be fabricated within **500 miles** (800 km) of Project site from stone that has been extracted within **500 miles** (800 km) of Project site.

C. Regional Materials: Granite shall be fabricated within **500 miles** (800 km) of Project site.

D. Description: Uniform, **[fine]** **[medium]**-grained, **[white]** **[pink]** **[gray]** **[black]** **<Insert color>** stone **[without veining]**.

E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:

1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>**.
2. or approved equal.

F. Cut: **[Vein]** **[Fleuri]**.

1. Orientation of Veining: **[Horizontal]** **[Vertical]** **[As indicated]**.

G. Cut stone from one block or contiguous, matched blocks in which natural markings occur.

H. Finish: **[Polished]** **[Honed]** **[Thermal]** **[As indicated]** **[Match DEN Project Manager's sample]** **<Insert finish>**.

I. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.4 LIMESTONE **<Insert drawing designation>**

A. Material Standard: Comply with ASTM C 568.

1. Classification: **[I Low]** **[II Medium]** **[III High]** Density.

B. Regional Materials: Limestone shall be fabricated within **500 miles** (800 km) of Project site from stone that has been extracted within **500 miles** (800 km) of Project site.

C. Regional Materials: Limestone shall be fabricated within **500 miles** (800 km) of Project site.

- D. Description: [**Dolomitic**] [**Oolitic**] [**Shell**] limestone.
- E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.**
 2. or approved equal.
- F. Varieties and Sources: Indiana oolitic limestone quarried in Lawrence, Monroe, or Owen Counties, Indiana.
1. Indiana Oolitic Limestone Grade and Color: [**Select, buff**] [**Select, gray**] [**Standard, buff**] [**Standard, gray**] [**Rustic, buff**] [**Rustic, gray**] [**Variegated**], according to grade and color classification established by ILI.
- G. Cut: [**Vein**] [**Fleuri**].
1. Orientation of Veining: [**Horizontal**] [**Vertical**] [**As indicated**].
- H. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- I. Finish: [**Smooth**] [**Sand rubbed**] [**Machine tooled, four bats per 1 inch (25 mm)**] [**Machine tooled, six bats per 1 inch (25 mm)**] [**Machine tooled, eight bats per 1 inch (25 mm)**] [**As indicated**] [**Match DEN Project Manager's sample**] **<Insert finish>** [, **matching standard ILI finish**].
- J. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.5 MARBLE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 503[, **Classification I Calcite**] [, **Classification II Dolomite**] [, **Group A**] [, **Group B**] [, **Group C**] [, **Group D**].
- B. Regional Materials: Marble shall be fabricated within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.
- C. Regional Materials: Marble shall be fabricated within **500 miles (800 km)** of Project site.
- D. Description: Uniform, fine- to medium-grained, [**white**] **<Insert color>** stone with only slight veining.
- E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.**
 2. or approved equal.

- F. Cut: **[Vein] [Fleuri]**.
 - 1. Orientation of Veining: **[Horizontal] [Vertical] [As indicated]**.
- G. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- H. Finish: **[Polished] [Honed] [As indicated] [Match DEN Project Manager's sample] <Insert finish>**.
- I. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.6 QUARTZ-BASED STONE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 616, **[Classification I Sandstone] [Classification II Quartzitic Sandstone] [Classification III Quartzite] [, except for minimum free silica content]**.
- B. Regional Materials: Quartz-based stone shall be fabricated within **500 miles** (800 km) of Project site from stone that has been extracted within **500 miles** (800 km) of Project site.
- C. Regional Materials: Quartz-based stone shall be fabricated within **500 miles** (800 km) of Project site.
- D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 - 1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>**.
 - 2. or approved equal.
- E. Finish: **[Sand rubbed] [Natural cleft] [Thermal] [As indicated] [Match DEN Project Manager's sample] <Insert finish>**.
- F. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.7 SERPENTINE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 1526, **[Classification I Exterior] [Classification II Interior]**.
- B. Regional Materials: Serpentine shall be fabricated within **500 miles** (800 km) of Project site from stone that has been extracted within **500 miles** (800 km) of Project site.
- C. Regional Materials: Serpentine shall be fabricated within **500 miles** (800 km) of Project site.

- D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 - 1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.**
 - 2. or approved equal.
- E. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- F. Finish: [**Polished**] [**Honed**] [**As indicated**] [**Match DEN Project Manager's sample**] **<Insert finish>.**
- G. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.8 SLATE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 629, [**Classification I Exterior**] [**Classification II Interior**].
- B. Regional Materials: Slate shall be fabricated within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.
- C. Regional Materials: Slate shall be fabricated within **500 miles (800 km)** of Project site.
- D. Description: [**Black**] [**Blue-black**] [**Gray**] [**Blue-gray**] [**Green**] [**Purple**] [**Mottled purple and green**] [**Red**] slate with a fine, even grain[**and unfading color,**] from clear, sound stock.
- E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 - 1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.**
 - 2. or approved equal.
- F. Finish: [**Honed**] [**Sand rubbed**] [**Natural cleft**] [**As indicated**] [**Match DEN Project Manager's sample**] **<Insert finish>.**
- G. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.9 TRAVERTINE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 1527, [**Classification I Exterior**] [**Classification II Interior**].

- B. Regional Materials: Travertine shall be fabricated within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.
 - C. Regional Materials: Travertine shall be fabricated within **500 miles (800 km)** of Project site.
 - D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 - 1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.**
 - 2. or approved equal.
 - E. Cut: [**Vein**] [**Fleuri**].
 - 1. Orientation of Veining: [**Horizontal**] [**Vertical**] [**As indicated**].
 - F. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
 - G. Filling: Fill pores on faces of stone with cementitious filler of color [**selected by DEN Project Manager**] [**matching DEN Project Manager's sample**].
 - H. Finish: [**Polished**] [**Honed**] [**As indicated**] [**Match DEN Project Manager's sample**] **<Insert finish>.**
 - I. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.
- 2.10 OTHER STONE <Insert drawing designation>
- A. Material Standards:
 - 1. Maximum Absorption per ASTM C 97/C 97M: **<Insert required value>.**
 - 2. Minimum Compressive Strength per ASTM C 170/C 170M: **<Insert required value>.**
 - 3. Minimum Flexural Strength per ASTM C 880/C 880M: **<Insert required value>.**
 - B. Regional Materials: Stone shall be fabricated within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.
 - C. Regional Materials: Stone shall be fabricated within **500 miles (800 km)** of Project site.
 - D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 - 1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.**
 - 2. or approved equal.

- E. Finish: [**Polished**] [**Honed**] [**Sand rubbed**] [**Natural cleft**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish>.
- F. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.11 SETTING MATERIALS

- A. Molding Plaster: ASTM C 59/C 59M.
- B. Portland Cement: ASTM C 150, Type I or Type II.
 - 1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C 114.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Aggregate: ASTM C 144.
- E. Water: Potable.

2.12 GROUT

- A. Grout Colors: [**Match stone**] [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**].
- B. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate to produce required color.
- C. Standard Cement Grout: ANSI A118.6, packaged.
 - 1. Grout Type: [**Sanded**] [**Unsanded**].
- D. Polymer-Modified Tile Grout: ANSI A118.7, packaged.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bostik, Inc.
 - b. C-Cure.
 - c. Custom Building Products.
 - d. DAP Inc.
 - e. Jamo Inc.
 - f. Laticrete International, Inc.
 - g. MAPEI Corporation.
 - h. Mer-Krete Systems; ParexLahabra, Inc.
 - i. Prospec; Bonsal American; a division of Oldcastle Architectural Products Group.

- j. [Southern Grouts & Mortars, Inc.](#)
 - k. [Summitville Tiles, Inc.](#)
 - l. [TEC, Specialty Construction Brands, Inc.; an H. B. Fuller company.](#)
 - m. **<Insert manufacturer's name>**.
 - n. or approved equal.
2. Polymer Type: **[Acrylic resin] [or] [ethylene vinyl acetate]**, in dry, redispersible form, packaged with other dry ingredients.
3. Polymer Type: **[Acrylic resin] [or] [styrene-butadiene rubber]** in liquid-latex form for addition to packaged dry-grout mix.
4. Grout Type: **[Sanded] [Unsanded]**.
- E. Water-Cleanable Epoxy Grout: ANSI A118.3, packaged, chemical-resistant, water-cleanable, tile-setting and -grouting epoxy.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
- a. [Boiardi Products; a QEP company.](#)
 - b. [Bostik, Inc.](#)
 - c. [C-Cure.](#)
 - d. [Custom Building Products.](#)
 - e. [Jamo Inc.](#)
 - f. [Laticrete International, Inc.](#)
 - g. [MAPEI Corporation.](#)
 - h. [Mer-Krete Systems; ParexLahabra, Inc.](#)
 - i. [Prospec; Bonsal American; a division of Oldcastle Architectural Products Group.](#)
 - j. [Summitville Tiles, Inc.](#)
 - k. [TEC, Specialty Construction Brands, Inc.; an H. B. Fuller company.](#)
 - l. **<Insert manufacturer's name>**.
 - m. or approved equal.

2.13 POINTING MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II. Provide natural color or white cement as required to produce mortar color indicated.
1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Pigments shall have a record of satisfactory performance in mortar.
1. **Products:** Subject to compliance with requirements, provide one of the following:

- a. Davis Colors; True Tone Mortar Colors.
 - b. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
 - c. Solomon Colors; SGS Mortar Colors.
 - d. **<Insert manufacturer's name; product name or designation>.**
 - e. or approved equal.
- D. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime.
- E. Colored Portland Cement-Lime Mix: Packaged blend of Portland cement, hydrated lime, and mortar pigments. Use a mix of formulation required to produce color indicated or, if not indicated, as selected from manufacturer's standard formulations. Pigments shall not exceed 10 percent of Portland cement by weight.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
 - b. Lafarge North America Inc.; Eaglebond.
 - c. Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.
 - d. **<Insert manufacturer's name; product name or designation>.**
 - e. or approved equal.
- F. Aggregate: ASTM C 144, except with 100 percent passing **No. 16 (1.18-mm)** sieve.
1. White Aggregates: Natural white sand or ground white stone.
 2. Colored Aggregates: Natural-colored sand or ground marble, granite, or other durable stone; of color necessary to produce required mortar color.
- G. Water: Potable.

2.14 SEALANTS

- A. Joint Sealants: Manufacturer's standard sealants of characteristics indicated below that comply with applicable requirements in Section 079200 "Joint Sealants" and will not stain the stone they are applied to.
1. Use mildew-resistant joint sealant at plumbing fixtures and for control and expansion joints in toilet rooms[**and other wet locations**].
 2. Mildew-Resistant Joint Sealant: [**Mildew resistant, single component, nonsag, neutral curing, silicone**] [**Single component, nonsag, mildew resistant, acid curing, silicone**] **<Insert joint sealant>.**
 3. Joint Sealant: [**Latex**] [**Acrylic based**] [**Butyl rubber based**] [**Single component, nonsag, neutral curing, silicone; Class 25**] **<Insert joint sealant>.**
 4. VOC Content: [**250**] **<Insert value>** g/L.
 5. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

6. Colors: Provide colors of exposed sealants to match other joints in stone adjoining sealed joints unless otherwise indicated.

B. Sealant for Filling Kerfs: [**Same sealant used for joints in dimension stone**] [**Single-component, nonsag, urethane sealant; Class 25, Use T (traffic), and Use M (masonry) that complies with applicable requirements in Section 079200 "Joint Sealants" and that does not stain stone**] [**Single-component, nonsag, neutral-curing, medium- to high-modulus silicone sealant; Class 25, Use NT (nontraffic), and Use M (masonry) that complies with applicable requirements in Section 079200 "Joint Sealants" and that does not stain stone**].

1. Products: Subject to compliance with requirements, provide one of the following:

- a. BASF Building Systems; Sonolastic NP.
- b. BASF Building Systems; Sonolastic Ultra.
- c. Sika Corporation; Sikaflex - 1a.
- d. Tremco Incorporated; Vulkem 116.
- e. BASF Building Systems; Omniseal 50.
- f. Dow Corning Corporation; Spectrem 2.
- g. **<Insert manufacturer's name; product name or designation>**.
- h. or approved equal.

2. VOC Content: **[250]** **<Insert value>** g/L.

3. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.15 STONE ANCHORS AND ATTACHMENTS

A. Fabricate anchors from stainless steel, ASTM A 240/A 240M or ASTM A 666, Type 304.

1. Fasteners for Stainless-Steel Anchors: Annealed stainless-steel bolts, nuts, and washers; **ASTM F 593** (ASTM F 738M) for bolts and **ASTM F 594** (ASTM F 836M) for nuts, Alloy Group **1** (A1).

B. Fabricate dowels from stainless steel, ASTM A 276, Type 304.

C. Fabricate anchors from extruded aluminum, **ASTM B 221** (ASTM B 221M), Alloy 6063-T6.

1. Fasteners for Extruded-Aluminum Anchors: Annealed stainless-steel bolts, nuts, and washers; **ASTM F 593** (ASTM F 738M) for bolts and **ASTM F 594** (ASTM F 836M) for nuts, Alloy Group **1** (A1).

D. Anchor Support Grids: Roll-formed steel channels, of size and shape required for application indicated, formed from galvanized-steel sheet not less than **0.108 inch** (2.8 mm) thick and complying with ASTM A 653/A 653M, **G90** (Z275).

1. Fittings and Fasteners: System manufacturer's standard components of design, size, and material required to securely attach grids to building structure and stone anchors to grids. Fabricate components in contact with stone from same material specified for anchors.
- E. Wire Tiebacks: **[No. 9 AWG copper or copper-alloy] [or] [0.120-inch- (3.0-mm-) diameter, stainless-steel]** wire.
- F. Dovetail Slots: Furnish dovetail slots with filler strips of slot size required to receive anchors provided, fabricated from **0.034-inch- (0.86-mm-)** thick, galvanized-steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)**.
- G. Direct-Mount Anchoring Systems: Stainless-steel[**or aluminum**] stone anchors designed to be applied directly to wall surfaces[**or to metal grids**]. System is secured to wall framing, furring, or sheet-metal reinforcing strips built into wall with[**stainless-steel**] self-drilling screws. Anchors fit into kerfs or holes in edges of stone panels[**and do not need setting spots**].
 1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. Halfen Anchoring Systems; Meadow Burke.
 - b. Heckmann Building Products Inc.
 - c. Hohmann & Barnard, Inc.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.

2.16 STONE ACCESSORIES

- A. Temporary Setting Shims: Rigid plastic shims, nonstaining to stone, sized to suit joint thickness.
- B. Setting Shims for Direct-Mount Anchoring Systems: Strips of resilient plastic or neoprene, nonstaining to stone, of thickness needed to prevent point loading of stone on anchors and of depths to suit anchors without intruding into required depths of pointing materials.
- C. Cleaner: Stone cleaner specifically formulated for stone types, finishes, and applications indicated, as recommended by stone producer. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.
- D. Stone Sealer: Colorless, stain-resistant sealer that does not affect color or physical properties of stone surfaces, as recommended by stone producer for application indicated.
 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. Bostik, Inc.
 - b. Custom Building Products.
 - c. Hillyard, Inc.

- d. [HMK Stone Care; ACI International.](#)
- e. [Miracle Sealants Company.](#)
- f. [Stone Care International.](#)
- g. [Summitville Tiles, Inc.](#)
- h. **<Insert manufacturer's name>.**
- i. or approved equal.

2.17 STONE FABRICATION, GENERAL

- A. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that could impair structural integrity or function.
 - 1. Repairs that are characteristic of the varieties specified are acceptable provided they do not impair structural integrity or function and are not aesthetically unpleasing, as judged by DEN Project Manager.
- B. Fabricate stone paneling in sizes and shapes required to comply with requirements indicated.
 - 1. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."
 - 2. For marble, comply with recommendations in MIA's "Dimension Stone - Design Manual VII."
 - 3. For limestone, comply with recommendations in ILI's "Indiana Limestone Handbook."
- C. Cut stone to produce pieces of thickness, size, and shape indicated and to comply with fabrication and construction tolerances recommended by applicable stone association.
 - 1. Where items are installed with adhesive or where stone edges are visible in the finished work, make items uniform in thickness and of identical thickness for each type of item; gage back of stone if necessary.
 - 2. Clean sawed backs of stones to remove rust stains and iron particles.
 - 3. Dress joints straight and at right angle to face unless otherwise indicated.
 - 4. Cut and drill sinkages and holes in stone for anchors, supports, and lifting devices as indicated or needed to set stone securely in place; shape beds to fit supports.
 - 5. Provide openings, reveals, and similar features as needed to accommodate adjacent work.
- D. Finish exposed faces and edges of stone to comply with requirements indicated for finish of each stone type required and to match approved Samples and mockups.
- E. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.
 - 1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match

range of colors and other appearance characteristics represented in approved Samples[**and mockups**].

2.18 STONE WALL PANELING

- A. Arrange panels in shop or other suitable space in proposed orientation and sequence for examination by DEN Project Manager. Mark units with temporary sequence numbers to indicate position in proposed layout.
1. Lay out one elevation at a time if approved by DEN Project Manager.
 2. Notify DEN Project Manager seven (7) days in advance of date and time when layout will be available for viewing.
 3. Provide lighting of similar type and level as that of final installation for viewing layout unless otherwise approved by DEN Project Manager.
 4. Rearrange panels as directed by DEN Project Manager until layout is approved.
 5. Do not trim nonmodular-size units to less than modular size until after DEN Project Manager's approval of layout, unless otherwise approved by DEN Project Manager.
 6. Mark backs of units and Shop Drawings with sequence numbers based on approved layout. Mark backs of units to indicate orientation of units in completed Work.
- B. Nominal Thickness: [3/4 inch (20 mm)] [7/8 inch (22 mm)] [1 inch (25 mm)] [1-1/4 inches (32 mm)] [2 inches (50 mm)] unless otherwise indicated.
- C. Control depth of stone to maintain minimum clearances of [3/4 inch (20 mm)] [1 inch (25 mm)] between backs of panels and structural members, fireproofing if any, backup walls, and other work behind stone. Do not back check stone less than 1 inch (25 mm) thick.
- D. Cut stone to produce uniform joints [1/16 inch (1.5 mm)] [1/8 inch (3 mm)] [1/4 inch (6 mm)] [3/8 inch (10 mm)] <Insert dimension> wide and in locations indicated.
- E. Quirk-miter corners unless otherwise indicated. Fabricate for anchorage in top and bottom bed joints of corner units.
- F. Carve and cut [**inscriptions**] [**and**] [**decorative surfaces**]. Use skilled stone carvers experienced in the successful performance of work similar to that indicated.
- G. Abrasively etch [**inscriptions**] [**and**] [**decorative surfaces**].
- H. Laser etch [**inscriptions**] [**and**] [**decorative surfaces**].
- I. Pattern Arrangement: Fabricate and arrange panels with veining and other natural markings to comply with the following requirements:
1. Arrange panels with veining horizontal.
 2. Arrange panels with veining vertical.
 3. Arrange panels with veining as indicated on Drawings.
 4. Arrange panels in blend pattern.

5. Book match units, single-course height.
6. Book match units, both vertically and horizontally.
7. Book match units in each course. No matching is required between successive courses.
8. Slip match units, single-course height.
9. Slip match units, both vertically and horizontally.
10. Slip match units in each course. No matching is required between successive courses.

2.19 STONE COLUMN FACING

- A. Nominal Thickness: [3/4 inch (20 mm)] [7/8 inch (22 mm)] [1 inch (25 mm)] [1-1/4 inches (32 mm)] [2 inches (50 mm)] unless otherwise indicated.
- B. Joints: [1/16-inch- (1.5-mm-) wide grouted] [1/8-inch- (3-mm-) wide grouted] [1/8-inch- (3-mm-) wide, sealant-filled] [1/4-inch- (6-mm-) wide, mortar-pointed] [1/4-inch- (6-mm-) wide, sealant-filled] [3/8-inch- (10-mm-) wide, mortar-pointed] [3/8-inch- (10-mm-) wide, sealant-filled] <Insert dimension and description> joints.
- C. Quirk-miter corners unless otherwise indicated. Install anchorage in top and bottom bed joints of corner units.
- D. Pattern Arrangement: Fabricate and arrange panels with veining and other natural markings to comply with the following requirements:
 1. Arrange panels with veining horizontal.
 2. Arrange panels with veining vertical.
 3. Arrange panels with veining as indicated on Drawings.

2.20 MIXES

- A. Spotting Plaster: Stiff mix of molding plaster and water.
- B. Mortar, General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortar of uniform quality and with optimum performance characteristics.
 1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated. Do not use calcium chloride.
 2. Combine and thoroughly mix cementitious materials, water, and aggregates in a mechanical batch mixer unless otherwise indicated. Discard mortar when it has reached initial set.
- C. Setting Mortar: Comply with ASTM C 270, Proportion Specification.
 1. Type: [N] [O].

2. Mix Proportions: 1 part Portland cement and 2-1/2 to 4 parts lime with aggregate ratio of 2-1/4 to 3 times the volume of cement and lime.
- D. Pointing Mortar: Comply with ASTM C 270, Proportion Specification, for mortar types indicated. Provide pointing mortar mixed to match DEN Project Manager's sample and complying with the following:
1. Pigmented Pointing Mortar: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1:10, by weight.
 2. Packaged Portland Cement-Lime Mix Mortar: Use Portland cement-lime mix of selected color.
 3. Colored-Aggregate Pointing Mortar: Produce color required by combining colored aggregates with Portland cement of selected color.
 4. Type: **[N]** **[O]**.
 5. Mix Proportions: 1 part Portland cement and 2-1/2 to 4 parts lime with aggregate ratio of 2-1/4 to 3 times the volume of cement and lime.
- E. Grout: Comply with mixing requirements of referenced ANSI standards and with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive stone paneling and conditions under which stone paneling will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone paneling.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of stone paneling.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SETTING STONE, GENERAL

- A. Before setting stone, clean surfaces that are dirty or stained by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.
- B. Do necessary field cutting as stone is set. Use power saws with diamond blades to cut stone. Cut lines straight and true, with edges eased slightly to prevent snipping.
- C. Contiguous Work: Provide reveals and openings as required to accommodate contiguous work.

- D. Set stone to comply with requirements indicated. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure stone in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.
- E. Erect stone units level, plumb, and true with uniform joint widths. Use temporary shims to maintain joint width.
- F. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.
 - 1. Sealing of expansion and other joints is specified in Section 079200 "Joint Sealants."
 - 2. Keep expansion joints free of plaster, mortar, grout, and other rigid materials.

3.3 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces, do not exceed **1/8 inch in 96 inches** (3 mm in 2400 mm), **1/4 inch** (6 mm) maximum.
- B. Variation from Level: For lintels, sills, chair rails, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed **1/8 inch in 10 feet** (3 mm in 3 m), **1/4 inch in 20 feet** (6 mm in 6 m), **3/8 inch** (10 mm) maximum.
- C. Variation of Linear Building Line: For position shown in plan and related portion of walls and partitions, do not exceed **1/8 inch in 10 feet** (3 mm in 3 m), **1/4 inch in 20 feet** (6 mm in 6 m), **3/8 inch** (10 mm) maximum.
- D. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated, do not exceed plus or minus **1/8 inch** (3 mm).
- E. Variation in Joint Width: Do not vary from average joint width more than plus or minus **1/16 inch** (1.5 mm) or one-fourth of nominal joint width, whichever is less.
- F. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed **1/32-inch** (0.8-mm) difference between planes of adjacent units.

3.4 INSTALLATION OF STONE PANELING

- A. Set units firmly against setting spots. Locate setting spots at anchors and spaced not more than **18 inches** (450 mm) apart across back of unit, but provide no fewer than one setting spot per **2 sq. ft.** (0.18 sq. m) unless otherwise indicated.
 - 1. **Moisture Exposure:** Use Portland cement mortar for setting spots where stone is applied to inside face of exterior walls and **[where indicated] <Insert wet locations>**.

- B. Set units on direct-mount anchoring system with anchors securely attached to stone and to backup surfaces. Comply with anchoring recommendations in ASTM C 1242.
 - 1. Provide compressible filler in ends of dowel holes and bottoms of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes and kerfs with sealant for filling kerfs.
 - 2. Set stone supported on clips or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths and to prevent point loading of stone on anchors. Hold shims back from face of stone a distance at least equal to width of joint.
- C. Minimum Anchors: Provide anchors at a maximum of **24 inches (600 mm)** o.c. around perimeter of stone panels with a minimum of four anchors per panel.
- D. Minimum Anchors: Provide a minimum of four anchors per panel up to **12 sq. ft. (1.1 sq. m)** in face area, plus a minimum of two additional anchors for each additional **8 sq. ft. (0.7 sq. m)**.
- E. **[Grout] [Point]** joints after setting stone.
- F. Fill **[indicated]** joints with sealant after setting **[and grouting] [and pointing]** stone.

3.5 GROUTING JOINTS

- A. Grout stone to comply with ANSI A108.10.
 - 1. Use sanded grout mixture for joints wider than **1/8 inch (3 mm)**.
 - 2. Use unsanded grout mixture for joints **1/8 inch (3 mm)** and narrower.
- B. Remove temporary shims before grouting.
- C. Tool joints uniformly and smoothly with plastic tool.

3.6 POINTING JOINTS WITH MORTAR

- A. Prepare stone-joint surfaces for pointing with mortar by removing temporary shims, dust, and mortar particles. Where setting spots occur at joints, rake out excess setting mortar or plaster to a depth of not less than **1/2 inch (13 mm)**.
- B. Point stone joints by placing pointing mortar in layers of not more than **3/8 inch (10 mm)**. Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer. Apply mortar first to areas where depths are greater than surrounding areas until a uniform depth is formed.
- C. Tool joints when pointing mortar is thumbprint hard. Use a round jointer having a diameter **1/8 inch (3 mm)** larger than width of joint.

3.7 JOINT-SEALANT INSTALLATION

- A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants." Remove temporary shims before applying sealants.

3.8 ADJUSTING AND CLEANING

- A. In-Progress Cleaning: Clean stone paneling as work progresses. Remove adhesive, grout, mortar, and sealant smears immediately.
- B. Remove and replace stone paneling of the following description:
 - 1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by DEN Project Manager.
 - 2. Defective stone paneling.
 - 3. Defective joints, including misaligned joints.
 - 4. Stone paneling and joints not matching approved Samples and mockups.
 - 5. Stone paneling not complying with other requirements indicated.
- C. Replace in a manner that results in stone paneling that matches approved Samples and mockups, complies with other requirements, and shows no evidence of replacement.
- D. Clean stone paneling no fewer than six days after completion of grouting and pointing, using clean water and soft rags or stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage stone.
- E. Sealer Application: Apply stone sealer to comply with stone producer's and sealer manufacturer's written instructions and recommendations.

3.9 PROTECTION

- A. Protect stone surfaces, edges, and corners from construction damage. Use securely fastened untreated wood, plywood, or heavy cardboard to prevent damage.
- B. Before inspection for Substantial Completion, remove protective coverings and clean surfaces.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 097513

SECTION 097516 - STONE BASE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes stone base.
- B. Related Requirements:
 - 1. Section 079200 "Joint Sealants" for sealing expansion joints in stone base.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each[**variety of stone,**] stone accessory, and manufactured product.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
 - 2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured[**and regionally extracted and manufactured**] materials. Include statement indicating cost for each regionally manufactured material.
 - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
 - b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and

fraction by weight of each regionally manufactured material that is regionally extracted.

3. Product Data for Credit IEQ 4.1: For **[adhesives] [and] [sealants]**, documentation including printed statement of VOC content.
 4. Laboratory Test Reports for Credit IEQ 4.1: For **[adhesives] [and] [sealants]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Show fabrication and installation details for stone base, including dimensions and profiles of stone units.
1. Show locations and details of joints.
 2. Show locations and details of anchors, including locations of supporting construction.
- D. Samples for Initial Selection: For joint materials involving color selection.
- E. Samples for Verification:
1. For each stone type indicated, in sets of Samples not less than **12 inches** (300 mm) square. Include **[two] [three] [four] [five] <Insert number>** or more Samples in each set and show the full range of variations in appearance characteristics in completed Work.
 2. For each color of **[grout] [pointing mortar] [and] [sealant]** required.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[Installer] [fabricator]**.
- B. Material Test Reports:
1. Stone Test Reports: For **[each]** stone variety proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, other than abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous **[three] [five] <Insert number>** years.
 2. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer indicating that sealants will not stain or damage stone. Include interpretation of test results and recommendations for primers and substrate preparation needed for adhesion.

1.5 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate stone similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of stone base.
- C. Installer Qualifications: A firm or individual experienced in installing stone base similar in material, design, and extent to that indicated for this Project, whose work has a record of successful in-service performance.
- D. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Build mockup for stone base, not less than **72 inches** (1800 mm) long.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Sealant Adhesion and Compatibility Testing: Submit to joint-sealant manufacturers, for compatibility and adhesion testing according to sealant manufacturer's standard testing methods and Section 079200 "Joint Sealants," Samples of materials that will contact or affect joint sealants.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.
- B. Mark stone units, on surface that will be concealed after installation, with designations used on Shop Drawings to identify individual stone units.
- C. Deliver sealants to Project site in original unopened containers labeled with manufacturer's name, product name and designation, color, expiration period, pot life, curing time, and mixing instructions for multicomponent materials.
- D. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

1.9 FIELD CONDITIONS

- A. Maintain air and material temperatures to comply with requirements of installation material manufacturers, but not less than **50 deg F** (10 deg C) during installation and for seven days after completion.

- B. Field Measurements: Verify dimensions of construction to receive stone base by field measurements before fabrication and indicate measurements on Shop Drawings.

1.10 COORDINATION

- A. Time delivery and installation of stone base to avoid extended on-site storage and to coordinate with work adjacent to stone base.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Stone: Obtain[**each variety of**] stone, [**regardless of finish,**] from a single quarry[, **whether specified in this Section or in another Section of the Specifications,**] with resources to provide materials of consistent quality in appearance and physical properties.
 - 1. For stone types that include same list of varieties and sources, provide same variety from same source for each.
- B. Varieties and Sources: Subject to compliance with requirements, provide stone of varieties and from sources complying with Section 044200 "Exterior Stone Cladding."

2.2 GRANITE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 615.
- B. Regional Materials: Granite shall be fabricated within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.
- C. Regional Materials: Granite shall be fabricated within **500 miles (800 km)** of Project site.
- D. Description: Uniform, [**fine**] [**medium**]-grained, [**white**] [**pink**] [**gray**] [**black**] <Insert color> stone[**without veining**].
- E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 - 1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.**

2. or approved equal.

F. Cut: **[Vein] [Fleuri]**.

1. Orientation of Veining: **[Horizontal] [Vertical] [As indicated]**.

G. Cut stone from one block or contiguous, matched blocks in which natural markings occur.

H. Finish: **[Polished] [Honed] [Thermal] [As indicated] [Match DEN Project Manager's sample] <Insert finish>**.

I. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.3 LIMESTONE <Insert drawing designation>

A. Material Standard: Comply with ASTM C 568.

1. Classification: **[I Low] [II Medium] [III High]** Density.

B. Regional Materials: Limestone shall be fabricated within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.

C. Regional Materials: Limestone shall be fabricated within **500 miles (800 km)** of Project site.

D. Description: **[Dolomitic] [Oolitic] [Shell]** limestone.

E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:

1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>**.

2. or approved equal.

F. Varieties and Sources: Indiana oolitic limestone quarried in Lawrence, Monroe, or Owen Counties, Indiana.

1. Indiana Oolitic Limestone Grade and Color: **[Select, buff] [Select, gray] [Standard, buff] [Standard, gray] [Rustic, buff] [Rustic, gray] [Variegated]**, according to grade and color classification established by ILI.

G. Cut: **[Vein] [Fleuri]**.

1. Orientation of Veining: **[Horizontal] [Vertical] [As indicated]**.

H. Cut stone from one block or contiguous, matched blocks in which natural markings occur.

- I. Finish: [**Smooth**] [**Sand rubbed**] [**Machine tooled, four bats per 1 inch (25 mm)**] [**Machine tooled, six bats per 1 inch (25 mm)**] [**Machine tooled, eight bats per 1 inch (25 mm)**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish> [, **matching standard ILI finish**].
- J. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.4 MARBLE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 503[, **Classification I Calcite**] [, **Classification II Dolomite**] [, **Group A**] [, **Group B**] [, **Group C**] [, **Group D**].
- B. Regional Materials: Marble shall be fabricated within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.
- C. Regional Materials: Marble shall be fabricated within **500 miles (800 km)** of Project site.
- D. Description: Uniform, fine- to medium-grained, [**white**] <Insert color> stone with only slight veining.
- E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 - 1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
 - 2. or approved equal.
- F. Cut: [**Vein**] [**Fleuri**].
 - 1. Orientation of Veining: [**Horizontal**] [**Vertical**] [**As indicated**].
- G. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- H. Finish: [**Polished**] [**Honed**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish>.
- I. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.5 QUARTZ-BASED STONE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 616, [**Classification I Sandstone**] [**Classification II Quartzitic Sandstone**] [**Classification III Quartzite**] [, **except for minimum free silica content**].

- B. Regional Materials: Quartz-based stone shall be fabricated within **500 miles** (800 km) of Project site from stone that has been extracted within **500 miles** (800 km) of Project site.
- C. Regional Materials: Quartz-based stone shall be fabricated within **500 miles** (800 km) of Project site.
- D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 - 1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.**
 - 2. or approved equal.
- E. Finish: [**Sand rubbed**] [**Natural cleft**] [**Thermal**] [**As indicated**] [**Match DEN Project Manager's sample**] **<Insert finish>.**
- F. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.6 SERPENTINE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 1526, [**Classification I Exterior**] [**Classification II Interior**].
- B. Regional Materials: Serpentine shall be fabricated within **500 miles** (800 km) of Project site from stone that has been extracted within **500 miles** (800 km) of Project site.
- C. Regional Materials: Serpentine shall be fabricated within **500 miles** (800 km) of Project site.
- D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 - 1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.**
 - 2. or approved equal.
- E. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- F. Finish: [**Polished**] [**Honed**] [**As indicated**] [**Match DEN Project Manager's sample**] **<Insert finish>.**
- G. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

- 2.7 SLATE <Insert drawing designation>
- A. Material Standard: Comply with ASTM C 629, [**Classification I Exterior**] [**Classification II Interior**].
 - B. Regional Materials: Slate shall be fabricated within **500 miles** (800 km) of Project site from stone that has been extracted within **500 miles** (800 km) of Project site.
 - C. Regional Materials: Slate shall be fabricated within **500 miles** (800 km) of Project site.
 - D. Description: [**Black**] [**Blue-black**] [**Gray**] [**Blue-gray**] [**Green**] [**Purple**] [**Mottled purple and green**] [**Red**] slate with a fine, even grain[**and unfading color,**] from clear, sound stock.
 - E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 - 1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>**.
 - 2. or approved equal.
 - F. Finish: [**Honed**] [**Sand rubbed**] [**Natural cleft**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish>.
 - G. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.
- 2.8 TRAVERTINE <Insert drawing designation>
- A. Material Standard: Comply with ASTM C 1527, [**Classification I Exterior**] [**Classification II Interior**].
 - B. Regional Materials: Travertine shall be fabricated within **500 miles** (800 km) of Project site from stone that has been extracted within **500 miles** (800 km) of Project site.
 - C. Regional Materials: Travertine shall be fabricated within **500 miles** (800 km) of Project site.
 - D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 - 1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>**.
 - 2. or approved equal.
 - E. Cut: [**Vein**] [**Fleuri**].
 - 1. Orientation of Veining: [**Horizontal**] [**Vertical**] [**As indicated**].

- F. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- G. Filling: Fill pores on faces of stone with cementitious filler of color [**selected by DEN Project Manager**] [**matching DEN Project Manager's sample**].
- H. Finish: [**Polished**] [**Honed**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish>.
- I. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.9 OTHER STONE <Insert drawing designation>

- A. Material Standards:
 - 1. Maximum Absorption per ASTM C 97/C 97M: <Insert required value>.
 - 2. Minimum Compressive Strength per ASTM C 170/C 170M: <Insert required value>.
 - 3. Minimum Flexural Strength per ASTM C 880/C 880M: <Insert required value>.
- B. Regional Materials: Stone shall be fabricated within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.
- C. Regional Materials: Stone shall be fabricated within **500 miles (800 km)** of Project site.
- D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 - 1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
 - 2. or approved equal.
- E. Finish: [**Polished**] [**Honed**] [**Sand rubbed**] [**Natural cleft**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish>.
- F. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.10 SETTING MATERIALS

- A. Molding Plaster: ASTM C 59/C 59M.
- B. Portland Cement: ASTM C 150, Type I or Type II.
 - 1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C 114.
- C. Hydrated Lime: ASTM C 207, Type S.

- D. Aggregate: ASTM C 144.
- E. Water: Potable.
- F. Adhesives, General: Use only adhesives formulated for stone and ceramic tile and recommended by their manufacturer for the application indicated.
- G. Organic Adhesive: ANSI A136.1, Type I[.], with a VOC content of 65 g/L or less.], that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Boiardi Products; a QEP company.](#)
 - b. [Bostik, Inc.](#)
 - c. [C-Cure.](#)
 - d. [Custom Building Products.](#)
 - e. [DAP Inc.](#)
 - f. [Jamo Inc.](#)
 - g. [Laticrete International, Inc.](#)
 - h. [MAPEI Corporation.](#)
 - i. [Mer-Krete Systems; ParexLahabra, Inc.](#)
 - j. [Prospec; Bonsal American; a division of Oldcastle Architectural Products Group.](#)
 - k. [Southern Grouts & Mortars, Inc.](#)
 - l. [TEC, Specialty Construction Brands, Inc.; an H. B. Fuller company.](#)
 - m. **<Insert manufacturer's name>.**
 - n. or approved equal.
- H. Water-Cleanable Epoxy Adhesive: ANSI A118.3[.], with a VOC content of 65 g/L or less.], that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Boiardi Products; a QEP company.](#)
 - b. [Bonstone Materials Corporation.](#)
 - c. [Bostik, Inc.](#)
 - d. [C-Cure.](#)
 - e. [Custom Building Products.](#)
 - f. [Jamo Inc.](#)
 - g. [Laticrete International, Inc.](#)
 - h. [MAPEI Corporation.](#)
 - i. [Mer-Krete Systems; ParexLahabra, Inc.](#)

- j. [Prospec; Bonsal American; a division of Oldcastle Architectural Products Group.](#)
 - k. [Summitville Tiles, Inc.](#)
 - l. [TEC, Specialty Construction Brands, Inc.; an H. B. Fuller company.](#)
 - m. <Insert manufacturer's name>.
 - n. or approved equal.
- I. Stone Adhesive: Two-part, [epoxy-resin] [or] [polyester-resin] stone adhesive with an initial set time of not more than two hours at 70 deg F (21 deg C)[.], **and with a VOC content of 65 g/L or less.**[, that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]
- 1. Color: [Clear] [Match stone].
 - 2. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. Epoxy Adhesive: [Akemi North America](#); Akepox.
 - b. Epoxy Adhesive: [Axson North America, Inc.](#), Wood & Stone Company; Akabond Epoxy.
 - c. Epoxy Adhesive: [Bonstone Materials Corporation](#); Touchstone Last Patch.
 - d. Epoxy Adhesive: [Bonstone Materials Corporation](#); Touchstone Ratio Pac Clear Gel Epoxy.
 - e. Epoxy Adhesive: <Insert manufacturer's name; product name or designation>.
 - f. Polyester Adhesive: [Akemi North America](#); Platinum Clear Polyester Adhesive.
 - g. Polyester Adhesive: [Axson North America, Inc.](#), Wood & Stone Company; Wood & Stone Polyester.
 - h. Polyester Adhesive: [Bonstone Materials Corporation](#); Gripstone L-200KG.
 - i. Polyester Adhesive: <Insert manufacturer's name; product name or designation>.
 - j. or approved equal.

2.11 GROUT

- A. Grout Colors: [Match stone] [As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range].
- B. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate to produce required color.
- C. Standard Cement Grout: ANSI A118.6, packaged.
 - 1. Grout Type: [Sanded] [Unsanded].
- D. Polymer-Modified Tile Grout: ANSI A118.7, packaged.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. Bostik, Inc.
 - b. C-Cure.
 - c. Custom Building Products.
 - d. DAP Inc.
 - e. Jamo Inc.
 - f. Laticrete International, Inc.
 - g. MAPEI Corporation.
 - h. Mer-Krete Systems; ParexLahabra, Inc.
 - i. Prospec; Bonsal American; a division of Oldcastle Architectural Products Group.
 - j. Southern Grouts & Mortars, Inc.
 - k. Summitville Tiles, Inc.
 - l. TEC, Specialty Construction Brands, Inc.; an H. B. Fuller company.
 - m. **<Insert manufacturer's name>**.
 - n. or approved equal.
 2. Polymer Type: **[Acrylic resin] [or] [ethylene vinyl acetate]**, in dry, redispersible form, packaged with other dry ingredients.
 3. Polymer Type: **[Acrylic resin] [or] [styrene-butadiene rubber]** in liquid-latex form for addition to packaged dry-grout mix.
 4. Grout Type: **[Sanded] [Unsanded]**.
- E. Water-Cleanable Epoxy Grout: ANSI A118.3, packaged, chemical-resistant, water-cleanable, tile-setting and -grouting epoxy.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. Boiardi Products; a QEP company.
 - b. Bostik, Inc.
 - c. C-Cure.
 - d. Custom Building Products.
 - e. Jamo Inc.
 - f. Laticrete International, Inc.
 - g. MAPEI Corporation.
 - h. Mer-Krete Systems; ParexLahabra, Inc.
 - i. Prospec; Bonsal American; a division of Oldcastle Architectural Products Group.
 - j. Summitville Tiles, Inc.
 - k. TEC, Specialty Construction Brands, Inc.; an H. B. Fuller company.
 - l. **<Insert manufacturer's name>**.
 - m. or approved equal.

2.12 POINTING MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II. Provide natural color or white cement as required to produce mortar color indicated.
1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Pigments shall have a record of satisfactory performance in mortar.
1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. **Davis Colors;** True Tone Mortar Colors.
 - b. **Lanxess Corporation;** Bayferrox Iron Oxide Pigments.
 - c. **Solomon Colors;** SGS Mortar Colors.
 - d. **<Insert manufacturer's name; product name or designation>.**
 - e. or approved equal.
- D. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime.
- E. Colored Portland Cement-Lime Mix: Packaged blend of Portland cement, hydrated lime, and mortar pigments. Use a mix of formulation required to produce color indicated or, if not indicated, as selected from manufacturer's standard formulations. Pigments shall not exceed 10 percent of Portland cement by weight.
1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. **Holcim (US) Inc.;** Rainbow Mortamix Custom Color Cement/Lime.
 - b. **Lafarge North America Inc.;** Eaglebond.
 - c. **Lehigh Cement Company;** Lehigh Custom Color Portland/Lime Cement.
 - d. **<Insert manufacturer's name; product name or designation>.**
 - e. or approved equal.
- F. Aggregate: ASTM C 144, except with 100 percent passing **No. 16 (1.18-mm)** sieve.
1. White Aggregates: Natural white sand or ground white stone.
 2. Colored Aggregates: Natural-colored sand or ground marble, granite, or other durable stone; of color necessary to produce required mortar color.
- G. Water: Potable.

2.13 SEALANTS

- A. Joint Sealants: Manufacturer's standard sealants of characteristics indicated below that comply with applicable requirements in Section 079200 "Joint Sealants" and will not stain the stone they are applied to.

1. Mildew-Resistant Joint Sealant: [**Mildew resistant, single component, nonsag, neutral curing, silicone**] [**Single component, nonsag, mildew resistant, acid curing, silicone**] <Insert joint sealant>.
2. Joint Sealant: [**Latex**] [**Acrylic based**] [**Butyl rubber based**] [**Single component, nonsag, neutral curing, silicone; Class 25**] <Insert joint sealant>.
3. VOC Content: [**250**] <Insert value> g/L or less.
4. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
5. Colors: Provide colors of exposed sealants to match other joints in stone adjoining sealed joints unless otherwise indicated.

2.14 STONE ANCHORS AND ATTACHMENTS

- A. Wire Tiebacks: [**No. 9 AWG copper or copper-alloy**] [or] [**0.120-inch- (3.0-mm-) diameter, stainless-steel**] wire.

2.15 STONE ACCESSORIES

- A. Temporary Setting Shims: Rigid plastic shims, nonstaining to stone, sized to suit joint thickness.
- B. Cleaner: Stone cleaner specifically formulated for stone types, finishes, and applications indicated, as recommended by stone producer. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.
- C. Stone Sealer: Colorless, stain-resistant sealer that does not affect color or physical properties of stone surfaces, as recommended by stone producer for application indicated.
 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Bostik, Inc.](#)
 - b. [Custom Building Products.](#)
 - c. [Hillyard, Inc.](#)
 - d. [HMK Stone Care; ACI International.](#)
 - e. [Miracle Sealants Company.](#)
 - f. [Stone Care International.](#)
 - g. [Summitville Tiles, Inc.](#)
 - h. <Insert manufacturer's name>.
 - i. or approved equal.

2.16 STONE FABRICATION, GENERAL

- A. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that could impair structural integrity or function.
- Repairs that are characteristic of the varieties specified are acceptable provided they do not impair structural integrity or function and are not aesthetically unpleasing, as judged by DEN Project Manager.
- B. Fabricate stone base in sizes and shapes required to comply with requirements indicated.
- For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."
 - For marble, comply with recommendations in MIA's "Dimension Stone - Design Manual VII."
 - For limestone, comply with recommendations in ILI's "Indiana Limestone Handbook."
- C. Cut stone to produce pieces of thickness, size, and shape indicated and to comply with fabrication and construction tolerances recommended by applicable stone association.
- Where items are installed with adhesive or where stone edges are visible in the finished work, make items uniform in thickness and of identical thickness for each type of item; gage back of stone if necessary.
 - Clean sawed backs of stones to remove rust stains and iron particles.
 - Dress joints straight and at right angle to face unless otherwise indicated.
- D. Fabricate molded work to produce stone shapes with a uniform profile throughout entire unit length and with precisely formed arris slightly eased to prevent snipping, and matched at joints between units.
- Produce moldings with machines having abrasive shaping wheels made to reverse contour of molding shape; do not sculpt moldings.
- E. Finish exposed faces and edges of stone to comply with requirements indicated for finish of each stone type required and to match approved Samples and mockups.
- F. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.
- Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved Samples[**and mockups**].

2.17 STONE BASE

- A. Nominal Thickness: [3/4 inch (20 mm)] [7/8 inch (22 mm)] [1-1/4 inches (32 mm)] unless otherwise indicated.

- B. Top-Edge Detail: [**Straight, slightly eased at corner**] [**3/8-inch (10-mm) bevel**] [**3/4-inch (20-mm) radius**] [**3/8-inch (10-mm) radius**] [**As indicated**].
- C. Ends: [**Butt ends into casings**] [**Butt ends into opening frames**] [**Return ends to depth of adjacent finish with edge detail same as top edge**] unless otherwise indicated.
- D. Joints: [**1/16-inch- (1.5-mm-) wide grouted joints**] [**1/8-inch- (3-mm-) wide grouted joints**] [**1/8-inch- (3-mm-) wide, sealant-filled joints**] [**Bonded joints, 1/32 inch (0.8 mm) or less in width**].
 - 1. Locate joints at midpoints between adjacent paneling joints unless otherwise indicated.

2.18 MIXES

- A. Spotting Plaster: Stiff mix of molding plaster and water.
- B. Mortar, General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortar of uniform quality and with optimum performance characteristics.
 - 1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated. Do not use calcium chloride.
 - 2. Combine and thoroughly mix cementitious materials, water, and aggregates in a mechanical batch mixer unless otherwise indicated. Discard mortar when it has reached initial set.
- C. Setting Mortar: Comply with ASTM C 270, Proportion Specification.
 - 1. Type: [**N**] [**O**].
 - 2. Mix Proportions: 1 part Portland cement and 2-1/2 to 4 parts lime with aggregate ratio of 2-1/4 to 3 times the volume of cement and lime.
- D. Pointing Mortar: Comply with ASTM C 270, Proportion Specification, for mortar types indicated. Provide pointing mortar mixed to match DEN Project Manager's sample and complying with the following:
 - 1. Pigmented Pointing Mortar: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1:10, by weight.
 - 2. Packaged Portland Cement-Lime Mix Mortar: Use Portland cement-lime mix of selected color.
 - 3. Colored-Aggregate Pointing Mortar: Produce color required by combining colored aggregates with Portland cement of selected color.
 - 4. Type: [**N**] [**O**].

5. Mix Proportions: 1 part Portland cement and 2-1/2 to 4 parts lime with aggregate ratio of 2-1/4 to 3 times the volume of cement and lime.
- E. Grout: Comply with mixing requirements of referenced ANSI standards and with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive stone base and conditions under which stone base will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone base.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of stone base.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SETTING STONE, GENERAL

- A. Before setting stone, clean surfaces that are dirty or stained by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.
- B. Do necessary field cutting as stone is set. Use power saws with diamond blades to cut stone. Cut lines straight and true, with edges eased slightly to prevent snipping.
- C. Set stone to comply with requirements indicated. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure stone in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.
- D. Erect stone units level, plumb, and true with uniform joint widths. Use temporary shims to maintain joint width.
- E. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.
 1. Sealing of expansion and other joints is specified in Section 079200 "Joint Sealants."
 2. Keep expansion joints free of plaster, mortar, grout, and other rigid materials.

3.3 CONSTRUCTION TOLERANCES

- A. Variation from Level: For lintels, sills, chair rails, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed **1/8 inch in 10 feet** (3 mm in 3 m), **1/4 inch in 20 feet** (6 mm in 6 m), **3/8 inch** (10 mm) maximum.
- B. Variation in Joint Width: Do not vary from average joint width more than plus or minus **1/16 inch** (1.5 mm) or one-fourth of nominal joint width, whichever is less.
- C. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed **1/32-inch** (0.8-mm) difference between planes of adjacent units.

3.4 INSTALLATION OF STONE BASE

- A. Stone Base: At locations with stone paneling, set units by adhering to stone paneling with water-cleanable epoxy adhesive. Hold adhesive back from exposed edges of joints to allow for grouting.
- B. Stone Base: At locations with stone paneling, set units firmly against setting spots. Locate setting spots at anchors and spaced not more than **18 inches** (450 mm) apart unless otherwise indicated. Provide no fewer than two anchors per piece for stone base up to **48 inches** (1200 mm) in length, plus one additional anchor for each additional **24 inches** (600 mm) of length.
- C. Stone Base: At locations without stone paneling, adhere units to plywood backing with full spread of water-cleanable epoxy adhesive. Hold adhesive back from exposed edges of joints to allow for grouting.
- D. Stone Base: At locations without stone paneling, adhere units to gypsum board with full spread of **[organic] [water-cleanable epoxy]** adhesive. Hold adhesive back from exposed edges of joints to allow for grouting.
- E. Assemble indicated multiple-piece stone base by bonding joints with stone adhesive as units are set. Mask areas adjacent to joints to prevent adhesive smears. Clamp units in place to ensure that surfaces are properly aligned and joints are minimum width.
- F. **[Grout] [Point]** joints after setting stone.
- G. Fill **[indicated]** joints with sealant after setting **[and grouting] [and pointing]** stone.

3.5 GROUTING JOINTS

- A. Grout stone to comply with ANSI A108.10.
 - 1. Use sanded grout mixture for joints wider than **1/8 inch** (3 mm).
 - 2. Use unsanded grout mixture for joints **1/8 inch** (3 mm) and narrower.
- B. Remove temporary shims before grouting.

- C. Tool joints uniformly and smoothly with plastic tool.

3.6 POINTING JOINTS WITH MORTAR

- A. Prepare stone-joint surfaces for pointing with mortar by removing temporary shims, dust, and mortar particles. Where setting spots occur at joints, rake out excess setting mortar or plaster to a depth of not less than **1/2 inch (13 mm)**.
- B. Point stone joints by placing pointing mortar in layers of not more than **3/8 inch (10 mm)**. Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer. Apply mortar first to areas where depths are greater than surrounding areas until a uniform depth is formed.
- C. Tool joints when pointing mortar is thumbprint hard. Use a round jointer having a diameter **1/8 inch (3 mm)** larger than width of joint.

3.7 JOINT-SEALANT INSTALLATION

- A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants." Remove temporary shims before applying sealants.

3.8 ADJUSTING AND CLEANING

- A. In-Progress Cleaning: Clean stone base as work progresses. Remove adhesive, grout, mortar, and sealant smears immediately.
- B. Remove and replace stone base of the following description:
 - 1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by DEN Project Manager.
 - 2. Defective stone base.
 - 3. Defective joints, including misaligned joints.
 - 4. Stone base and joints not matching approved Samples and mockups.
 - 5. Stone base not complying with other requirements indicated.
- C. Replace in a manner that results in stone base that matches approved Samples and mockups, complies with other requirements, and shows no evidence of replacement.
- D. Clean stone base no fewer than six days after completion of grouting and pointing, using clean water and soft rags or stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage stone.
- E. Sealer Application: Apply stone sealer to comply with stone producer's and sealer manufacturer's written instructions and recommendations.

3.9 PROTECTION

- A. Protect stone surfaces, edges, and corners from construction damage. Use securely fastened untreated wood, plywood, or heavy cardboard to prevent damage.
- B. Before inspection for Substantial Completion, remove protective coverings and clean surfaces.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 097516

SECTION 097519 - STONE TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes interior stone trim.
- B. Related Requirements:
 - 1. Section 079200 "Joint Sealants" for sealing expansion joints in interior stone trim.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.

1.4 ACTION SUBMITTALS

- A. Product Data: For each[**variety of stone,**] stone accessory, and manufactured product.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
 - 2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured[**and regionally extracted and manufactured**] materials. Include statement indicating cost for each regionally manufactured material.

- a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
 - b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
3. Product Data for Credit IEQ 4.1: For **[adhesives] [and] [sealants]**, documentation including printed statement of VOC content.
 4. Laboratory Test Reports for Credit IEQ 4.1: For **[adhesives] [and] [sealants]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Show fabrication and installation details for stone trim, including dimensions and profiles of stone units.
1. Show locations and details of joints.
 2. Show locations and details of anchors, including locations of supporting construction.
- D. Samples for Initial Selection: For joint materials involving color selection.
- E. Samples for Verification:
1. For each stone type indicated, in sets of Samples not less than **12 inches** (300 mm) square. Include **[two] [three] [four] [five]** **<Insert number>** or more Samples in each set and show the full range of variations in appearance characteristics in completed Work.
 2. For each color of **[grout] [pointing mortar] [and] [sealant]** required.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For **[Installer] [fabricator]**.
- B. Material Test Reports:
1. Stone Test Reports: For **[each]** stone variety proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, other than abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous **[three] [five]** **<Insert number>** years.
 2. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer indicating that sealants will not stain or damage stone. Include interpretation of test results and recommendations for primers and substrate preparation needed for adhesion.

1.6 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate stone similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of interior stone trim.
- C. Installer Qualifications: A firm or individual experienced in installing interior stone trim similar in material, design, and extent to that indicated for this Project, whose work has a record of successful in-service performance.
- D. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Build mockups for typical interior stone trim as shown on Drawings.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Sealant Adhesion and Compatibility Testing: Submit to joint-sealant manufacturers, for compatibility and adhesion testing according to sealant manufacturer's standard testing methods and Section 079200 "Joint Sealants," Samples of materials that will contact or affect joint sealants.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.
- B. Mark stone units, on surface that will be concealed after installation, with designations used on Shop Drawings to identify individual stone units. Orient markings on vertical units so that they are right side up when units are installed.
- C. Deliver sealants to Project site in original unopened containers labeled with manufacturer's name, product name and designation, color, expiration period, pot life, curing time, and mixing instructions for multicomponent materials.

- D. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

1.10 FIELD CONDITIONS

- A. Maintain air and material temperatures to comply with requirements of installation material manufacturers, but not less than 50 deg F (10 deg C) during installation and for seven days after completion.
- B. Field Measurements: Verify dimensions of construction to receive interior stone trim by field measurements before fabrication and indicate measurements on Shop Drawings.

1.11 COORDINATION

- A. Time delivery and installation of interior stone trim to avoid extended on-site storage and to coordinate with work adjacent to interior stone trim.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Stone: Obtain[**each variety of**] stone, [**regardless of finish,**] from a single quarry[, **whether specified in this Section or in another Section of the Specifications,**] with resources to provide materials of consistent quality in appearance and physical properties.
 - 1. For stone types that include same list of varieties and sources, provide same variety from same source for each.
- B. Varieties and Sources: Subject to compliance with requirements, provide stone of varieties and from sources complying with Section 044200 "Exterior Stone Cladding."

2.2 GRANITE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 615.
- B. Regional Materials: Granite shall be fabricated within 500 miles (800 km) of Project site from stone that has been extracted within 500 miles (800 km) of Project site.

- C. Regional Materials: Granite shall be fabricated within 500 miles (800 km) of Project site.
- D. Description: Uniform, [fine] [medium]-grained, [white] [pink] [gray] [black] <Insert color> stone[without veining].
- E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 - 1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
 - 2. or approved equal.
- F. Cut: [Vein] [Fleuri].
 - 1. Orientation of Veining: [Horizontal] [Vertical] [As indicated].
- G. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- H. Finish: [Polished] [Honed] [Thermal] [As indicated] [Match DEN Project Manager's sample] <Insert finish>.
- I. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.3 LIMESTONE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 568.
 - 1. Classification: [I Low] [II Medium] [III High] Density.
- B. Regional Materials: Limestone shall be fabricated within 500 miles (800 km) of Project site from stone that has been extracted within 500 miles (800 km) of Project site.
- C. Regional Materials: Limestone shall be fabricated within 500 miles (800 km) of Project site.
- D. Description: [Dolomitic] [Oolitic] [Shell] limestone.
- E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 - 1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
 - 2. or approved equal.
- F. Varieties and Sources: Indiana oolitic limestone quarried in Lawrence, Monroe, or Owen Counties, Indiana.

1. Indiana Oolitic Limestone Grade and Color: [**Select, buff**] [**Select, gray**] [**Standard, buff**] [**Standard, gray**] [**Rustic, buff**] [**Rustic, gray**] [**Variegated**], according to grade and color classification established by ILI.
 - G. Cut: [**Vein**] [**Fleuri**].
 1. Orientation of Veining: [**Horizontal**] [**Vertical**] [**As indicated**].
 - H. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
 - I. Finish: [**Smooth**] [**Sand rubbed**] [**Machine tooled, four bats per 1 inch (25 mm)**] [**Machine tooled, six bats per 1 inch (25 mm)**] [**Machine tooled, eight bats per 1 inch (25 mm)**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish> [, **matching standard ILI finish**].
 - J. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.
- 2.4 MARBLE <Insert drawing designation>
- A. Material Standard: Comply with ASTM C 503[, **Classification I Calcite**] [, **Classification II Dolomite**] [, **Group A**] [, **Group B**] [, **Group C**] [, **Group D**].
 - B. Regional Materials: Marble shall be fabricated within 500 miles (800 km) of Project site from stone that has been extracted within 500 miles (800 km) of Project site.
 - C. Regional Materials: Marble shall be fabricated within 500 miles (800 km) of Project site.
 - D. Description: Uniform, fine- to medium-grained, [**white**] <Insert color> stone with only slight veining.
 - E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
 2. or approved equal.
 - F. Cut: [**Vein**] [**Fleuri**].
 1. Orientation of Veining: [**Horizontal**] [**Vertical**] [**As indicated**].
 - G. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
 - H. Finish: [**Polished**] [**Honed**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish>.

- I. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.5 SERPENTINE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 1526, [**Classification I Exterior**] [**Classification II Interior**].
- B. Regional Materials: Serpentine shall be fabricated within 500 miles (800 km) of Project site from stone that has been extracted within 500 miles (800 km) of Project site.
- C. Regional Materials: Serpentine shall be fabricated within 500 miles (800 km) of Project site.
- D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 - 1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
 - 2. or approved equal.
- E. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- F. Finish: [**Polished**] [**Honed**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish>.
- G. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.6 TRAVERTINE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 1527, [**Classification I Exterior**] [**Classification II Interior**].
- B. Regional Materials: Travertine shall be fabricated within 500 miles (800 km) of Project site from stone that has been extracted within 500 miles (800 km) of Project site.
- C. Regional Materials: Travertine shall be fabricated within 500 miles (800 km) of Project site.
- D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 - 1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
 - 2. or approved equal.
- E. Cut: [**Vein**] [**Fleuri**].

1. Orientation of Veining: [**Horizontal**] [**Vertical**] [**As indicated**].
 - F. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
 - G. Filling: Fill pores on faces of stone with cementitious filler of color [**selected by DEN Project Manager**] [**matching DEN Project Manager's sample**].
 - H. Finish: [**Polished**] [**Honed**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish>.
 - I. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.
- 2.7 OTHER STONE <Insert drawing designation>
- A. Material Standards:
 1. Maximum Absorption per ASTM C 97/C 97M: <Insert required value>.
 2. Minimum Compressive Strength per ASTM C 170/C 170M: <Insert required value>.
 3. Minimum Flexural Strength per ASTM C 880/C 880M: <Insert required value>.
 - B. Regional Materials: Stone shall be fabricated within **500 miles** (800 km) of Project site from stone that has been extracted within **500 miles** (800 km) of Project site.
 - C. Regional Materials: Stone shall be fabricated within **500 miles** (800 km) of Project site.
 - D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
 2. or approved equal.
 - E. Finish: [**Polished**] [**Honed**] [**Sand rubbed**] [**Natural cleft**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish>.
 - F. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.
- 2.8 SETTING MATERIALS
- A. Molding Plaster: ASTM C 59/C 59M.
 - B. Portland Cement: ASTM C 150, Type I or Type II.
 1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C 114.

- C. Hydrated Lime: ASTM C 207, Type S.
- D. Aggregate: ASTM C 144.
- E. Water: Potable.
- F. Adhesives, General: Use only adhesives formulated for stone and ceramic tile and recommended by their manufacturer for the application indicated.
- G. Organic Adhesive: ANSI A136.1, Type I[.], **with a VOC content of 65 g/L.], that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]**

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

- a. [Boiardi Products; a QEP company.](#)
- b. [Bostik, Inc.](#)
- c. [C-Cure.](#)
- d. [Custom Building Products.](#)
- e. [DAP Inc.](#)
- f. [Jamo Inc.](#)
- g. [Laticrete International, Inc.](#)
- h. [MAPEI Corporation.](#)
- i. [Mer-Krete Systems; ParexLahabra, Inc.](#)
- j. [Prospec; Bonsal American; a division of Oldcastle Architectural Products Group.](#)
- k. [Southern Grouts & Mortars, Inc.](#)
- l. [TEC, Specialty Construction Brands, Inc.; an H. B. Fuller company.](#)
- m. **<Insert manufacturer's name>.**
- n. or approved equal.

- H. Water-Cleanable Epoxy Adhesive: ANSI A118.3[.], **with a VOC content of 65 g/L or less.], that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]**

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

- a. [Boiardi Products; a QEP company.](#)
- b. [Bonstone Materials Corporation.](#)
- c. [Bostik, Inc.](#)
- d. [C-Cure.](#)
- e. [Custom Building Products.](#)
- f. [Jamo Inc.](#)
- g. [Laticrete International, Inc.](#)
- h. [MAPEI Corporation.](#)

- i. [Mer-Krete Systems; ParexLahabra, Inc.](#)
 - j. [Prospec; Bonsal American; a division of Oldcastle Architectural Products Group.](#)
 - k. [Summitville Tiles, Inc.](#)
 - l. [TEC, Specialty Construction Brands, Inc.; an H. B. Fuller company.](#)
 - m. <Insert manufacturer's name>.
 - n. or approved equal.
- I. Stone Adhesive: Two-part, [**epoxy-resin**] [or] [**polyester-resin**] stone adhesive with an initial set time of not more than two hours at 70 deg F (21 deg C)[.], and with a **VOC content of 65 g/L or less.**], that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]
- 1. Color: [**Clear**] [**Match stone**].
 - 2. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. Epoxy Adhesive: [Akemi North America](#); Akepox.
 - b. Epoxy Adhesive: [Axson North America, Inc.](#), Wood & Stone Company; Akabond Epoxy.
 - c. Epoxy Adhesive: [Bonstone Materials Corporation](#); Touchstone Last Patch.
 - d. Epoxy Adhesive: [Bonstone Materials Corporation](#); Touchstone Ratio Pac Clear Gel Epoxy.
 - e. Epoxy Adhesive: <Insert manufacturer's name; product name or designation>.
 - f. Polyester Adhesive: [Akemi North America](#); Platinum Clear Polyester Adhesive.
 - g. Polyester Adhesive: [Axson North America, Inc.](#), Wood & Stone Company; Wood & Stone Polyester.
 - h. Polyester Adhesive: [Bonstone Materials Corporation](#); Gripstone L-200KG.
 - i. Polyester Adhesive: <Insert manufacturer's name; product name or designation>.
 - j. or approved equal.

2.9 GROUT

- A. Grout Colors: [**Match stone**] [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**].
- B. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate to produce required color.
- C. Standard Cement Grout: ANSI A118.6, packaged.
 - 1. Grout Type: [**Sanded**] [**Unsanded**].
- D. Polymer-Modified Tile Grout: ANSI A118.7, packaged.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. Bostik, Inc.
 - b. C-Cure.
 - c. Custom Building Products.
 - d. DAP Inc.
 - e. Jamo Inc.
 - f. Laticrete International, Inc.
 - g. MAPEI Corporation.
 - h. Mer-Krete Systems; ParexLahabra, Inc.
 - i. Prospec; Bonsal American; a division of Oldcastle Architectural Products Group.
 - j. Southern Grouts & Mortars, Inc.
 - k. Summitville Tiles, Inc.
 - l. TEC, Specialty Construction Brands, Inc.; an H. B. Fuller company.
 - m. **<Insert manufacturer's name>**.
 - n. or approved equal.
 2. Polymer Type: **[Acrylic resin] [or] [ethylene vinyl acetate]**, in dry, redispersible form, packaged with other dry ingredients.
 3. Polymer Type: **[Acrylic resin] [or] [styrene-butadiene rubber]** in liquid-latex form for addition to packaged dry-grout mix.
 4. Grout Type: **[Sanded] [Unsanded]**.
- E. Water-Cleanable Epoxy Grout: ANSI A118.3, packaged, chemical-resistant, water-cleanable, tile-setting and -grouting epoxy.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. Boiardi Products; a QEP company.
 - b. Bostik, Inc.
 - c. C-Cure.
 - d. Custom Building Products.
 - e. Jamo Inc.
 - f. Laticrete International, Inc.
 - g. MAPEI Corporation.
 - h. Mer-Krete Systems; ParexLahabra, Inc.
 - i. Prospec; Bonsal American; a division of Oldcastle Architectural Products Group.
 - j. Summitville Tiles, Inc.
 - k. TEC, Specialty Construction Brands, Inc.; an H. B. Fuller company.
 - l. **<Insert manufacturer's name>**.
 - m. or approved equal.

2.10 POINTING MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II. Provide natural color or white cement as required to produce mortar color indicated.
1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Pigments shall have a record of satisfactory performance in mortar.
1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. **Davis Colors;** True Tone Mortar Colors.
 - b. **Lanxess Corporation;** Bayferrox Iron Oxide Pigments.
 - c. **Solomon Colors;** SGS Mortar Colors.
 - d. **<Insert manufacturer's name; product name or designation>.**
 - e. or approved equal.
- D. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime.
- E. Colored Portland Cement-Lime Mix: Packaged blend of Portland cement, hydrated lime, and mortar pigments. Use a mix of formulation required to produce color indicated or, if not indicated, as selected from manufacturer's standard formulations. Pigments shall not exceed 10 percent of Portland cement by weight.
1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. **Holcim (US) Inc.;** Rainbow Mortamix Custom Color Cement/Lime.
 - b. **Lafarge North America Inc.;** Eaglebond.
 - c. **Lehigh Cement Company;** Lehigh Custom Color Portland/Lime Cement.
 - d. **<Insert manufacturer's name; product name or designation>.**
 - e. or approved equal.
- F. Aggregate: ASTM C 144, except with 100 percent passing **No. 16 (1.18-mm)** sieve.
1. White Aggregates: Natural white sand or ground white stone.
 2. Colored Aggregates: Natural-colored sand or ground marble, granite, or other durable stone; of color necessary to produce required mortar color.
- G. Water: Potable.

2.11 SEALANTS

- A. Joint Sealants: Manufacturer's standard sealants of characteristics indicated below that comply with applicable requirements in Section 079200 "Joint Sealants" and will not stain the stone they are applied to.

1. Mildew-Resistant Joint Sealant: **[Mildew resistant, single component, nonsag, neutral curing, silicone] [Single component, nonsag, mildew resistant, acid curing, silicone] <Insert joint sealant>**.
 2. Joint Sealant: **[Latex] [Acrylic based] [Butyl rubber based] [Single component, nonsag, neutral curing, silicone; Class 25] <Insert joint sealant>**.
 3. VOC Content: **[250] <Insert value>** g/L or less.
 4. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 5. Colors: Provide colors of exposed sealants to match other joints in stone adjoining sealed joints unless otherwise indicated.
- B. Sealant for Filling Kerfs: **[Same sealant used for joints in dimension stone] [Single-component, nonsag, urethane sealant; Class 25, Use T (traffic), and Use M (masonry) that complies with applicable requirements in Section 079200 "Joint Sealants" and that does not stain stone] [Single-component, nonsag, neutral-curing, medium- to high-modulus silicone sealant; Class 25, Use NT (nontraffic), and Use M (masonry) that complies with applicable requirements in Section 079200 "Joint Sealants" and that does not stain stone]**.
1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. **BASF Building Systems**; Sonolastic NP 1.
 - b. **BASF Building Systems**; Sonolastic Ultra.
 - c. **Sika Corporation**; Sikaflex - 1a.
 - d. **Tremco Incorporated**; Vulkem 116.
 - e. **BASF Building Systems**; Omniseal 50.
 - f. Dow Corning Corporation; 756 SMS.
 - g. **General Electric Company**; GE Advanced Materials - Silicones; SilPruf NB SCS9000.
 - h. **Tremco Incorporated**; Spectrem 2.
 - i. **<Insert manufacturer's name; product name or designation>**.
 - j. or approved equal.
 2. VOC Content: **[250] <Insert value>** g/L or less.
 3. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- 2.12 STONE ANCHORS AND ATTACHMENTS
- A. Fabricate anchors from stainless steel, ASTM A 240/A 240M or ASTM A 666, Type 304.

1. Fasteners for Stainless-Steel Anchors: Annealed stainless-steel bolts, nuts, and washers; [ASTM F 593](#) (ASTM F 738M) for bolts and [ASTM F 594](#) (ASTM F 836M) for nuts, Alloy Group 1 (A1).
- B. Fabricate dowels from stainless steel, ASTM A 276, Type 304.
- C. Fabricate anchors from extruded aluminum, [ASTM B 221](#) (ASTM B 221M), Alloy 6063-T6.
 1. Fasteners for Extruded-Aluminum Anchors: Annealed stainless-steel bolts, nuts, and washers; [ASTM F 593](#) (ASTM F 738M) for bolts and [ASTM F 594](#) (ASTM F 836M) for nuts, Alloy Group 1 (A1).
- D. Wire Tiebacks: [**No. 9 AWG copper or copper-alloy**] [or] [**0.120-inch- (3.0-mm-) diameter, stainless-steel**] wire.

2.13 STONE ACCESSORIES

- A. Temporary Setting Shims: Rigid plastic shims, nonstaining to stone, sized to suit joint thickness.
- B. Cleaner: Stone cleaner specifically formulated for stone types, finishes, and applications indicated, as recommended by stone producer. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.
- C. Stone Sealer: Colorless, stain-resistant sealer that does not affect color or physical properties of stone surfaces, as recommended by stone producer for application indicated.
 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Bostik, Inc.](#)
 - b. [Custom Building Products.](#)
 - c. [Hillyard, Inc.](#)
 - d. [HMK Stone Care; ACI International.](#)
 - e. [Miracle Sealants Company.](#)
 - f. [Stone Care International.](#)
 - g. [Summitville Tiles, Inc.](#)
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.

2.14 STONE FABRICATION, GENERAL

- A. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that could impair structural integrity or function.

1. Repairs that are characteristic of the varieties specified are acceptable provided they do not impair structural integrity or function and are not aesthetically unpleasing, as judged by DEN Project Manager.
- B. Fabricate stone trim in sizes and shapes required to comply with requirements indicated.
1. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."
 2. For marble, comply with recommendations in MIA's "Dimension Stone - Design Manual VII."
 3. For limestone, comply with recommendations in ILI's "Indiana Limestone Handbook."
- C. Cut stone to produce pieces of thickness, size, and shape indicated and to comply with fabrication and construction tolerances recommended by applicable stone association.
1. Where items are installed with adhesive or where stone edges are visible in the finished work, make items uniform in thickness and of identical thickness for each type of item; gage back of stone if necessary.
 2. Clean sawed backs of stones to remove rust stains and iron particles.
 3. Dress joints straight and at right angle to face unless otherwise indicated.
 4. Cut and drill sinkages and holes in stone for anchors, supports, and lifting devices as indicated or needed to set stone securely in place; shape beds to fit supports.
- D. Fabricate molded work to produce stone shapes with a uniform profile throughout entire unit length and with precisely formed arris slightly eased to prevent snipping, and matched at joints between units.
1. Produce moldings with machines having abrasive shaping wheels made to reverse contour of molding shape; do not sculpt moldings.
 2. Miter moldings at corners, unless otherwise indicated, with edges of miters slightly eased at outside corners.
- E. Finish exposed faces and edges of stone to comply with requirements indicated for finish of each stone type required and to match approved Samples and mockups.
- F. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.
1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved Samples[**and mockups**].

2.15 STONE TRIM

- A. Flat Trim:

1. Nominal Thickness: [**3/4 inch (20 mm)**] [**7/8 inch (22 mm)**] [**1-1/4 inches (32 mm)**] [**1-1/2 inches (40 mm)**] unless otherwise indicated.
2. Edge Detail: [**Straight, slightly eased at corners**] [**3/8-inch (10-mm) bevels**] [**3/4-inch (20-mm) radii**] [**3/8-inch (10-mm) radii**] [**As indicated**].
3. Joints: [**1/16-inch- (1.5-mm-) wide grouted joints**] [**1/8-inch- (3-mm-) wide grouted joints**] [**1/8-inch- (3-mm-) wide, sealant-filled joints**] [**Bonded joints, 1/32 inch (0.8 mm) or less in width**].

B. Molded Trim:

1. Profile: Match [**profiles indicated on Drawings**] [**existing**].
2. Joints: [**1/16-inch- (1.5-mm-) wide grouted joints**] [**1/8-inch- (3-mm-) wide grouted joints**] [**1/8-inch- (3-mm-) wide, sealant-filled joints**] [**Bonded joints, 1/32 inch (0.8 mm) or less in width**].

2.16 MIXES

A. Spotting Plaster: Stiff mix of molding plaster and water.

B. Mortar, General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortar of uniform quality and with optimum performance characteristics.

1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated. Do not use calcium chloride.
2. Combine and thoroughly mix cementitious materials, water, and aggregates in a mechanical batch mixer unless otherwise indicated. Discard mortar when it has reached initial set.

C. Setting Mortar: Comply with ASTM C 270, Proportion Specification.

1. Type: [**N**] [**O**].
2. Mix Proportions: 1 part Portland cement and 2-1/2 to 4 parts lime with aggregate ratio of 2-1/4 to 3 times the volume of cement and lime.

D. Pointing Mortar: Comply with ASTM C 270, Proportion Specification, for mortar types indicated. Provide pointing mortar mixed to match DEN Project Manager's sample and complying with the following:

1. Pigmented Pointing Mortar: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1:10, by weight.
2. Packaged Portland Cement-Lime Mix Mortar: Use Portland cement-lime mix of selected color.
3. Colored-Aggregate Pointing Mortar: Produce color required by combining colored aggregates with Portland cement of selected color.
4. Type: [**N**] [**O**].

5. Mix Proportions: 1 part Portland cement and 2-1/2 to 4 parts lime with aggregate ratio of 2-1/4 to 3 times the volume of cement and lime.
- E. Grout: Comply with mixing requirements of referenced ANSI standards and with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive stone trim and conditions under which stone trim will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone trim.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of stone trim.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SETTING STONE, GENERAL

- A. Before setting stone, clean surfaces that are dirty or stained by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.
- B. Do necessary field cutting as stone is set. Use power saws with diamond blades to cut stone. Cut lines straight and true, with edges eased slightly to prevent snipping.
- C. Contiguous Work: Provide reveals and openings as required to accommodate contiguous work.
- D. Set stone to comply with requirements indicated. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure stone in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.
- E. Erect stone units level, plumb, and true with uniform joint widths. Use temporary shims to maintain joint width.
- F. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.
 1. Sealing of expansion and other joints is specified in Section 079200 "Joint Sealants."
 2. Keep expansion joints free of plaster, mortar, grout, and other rigid materials.

3.3 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces, do not exceed **1/8 inch in 96 inches** (3 mm in 2400 mm), **1/4 inch** (6 mm) maximum.
- B. Variation from Level: For lintels, sills, chair rails, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed **1/8 inch in 10 feet** (3 mm in 3 m), **1/4 inch in 20 feet** (6 mm in 6 m), **3/8 inch** (10 mm) maximum.
- C. Variation of Linear Building Line: For position shown in plan and related portion of walls and partitions, do not exceed **1/8 inch in 10 feet** (3 mm in 3 m), **1/4 inch in 20 feet** (6 mm in 6 m), **3/8 inch** (10 mm) maximum.
- D. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated, do not exceed plus or minus **1/8 inch** (3 mm).
- E. Variation in Joint Width: Do not vary from average joint width more than plus or minus **1/16 inch** (1.5 mm) or one-fourth of nominal joint width, whichever is less.
- F. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed **1/32-inch** (0.8-mm) difference between planes of adjacent units.

3.4 INSTALLATION

- A. Stone Trim: At locations with stone paneling, set units by adhering to stone paneling with water-cleanable epoxy adhesive. Hold adhesive back from exposed edges of joints to allow for grouting.
- B. Stone Trim: At locations with stone paneling, set units firmly against setting spots. Locate setting spots at anchors and spaced not more than **18 inches** (450 mm) apart unless otherwise indicated. Provide no fewer than two anchors per piece for stone trim up to **48 inches** (1200 mm) in length, plus one additional anchor for each additional **24 inches** (600 mm) of length.
- C. Stone Trim: At locations without stone paneling, adhere units to plywood backing with full spread of water-cleanable epoxy adhesive. Hold adhesive back from exposed edges of joints to allow for grouting.
- D. Stone Trim: At locations without stone paneling, adhere units to gypsum board with full spread of **[organic] [water-cleanable epoxy]** adhesive. Hold adhesive back from exposed edges of joints to allow for grouting.
- E. Assemble indicated multiple-piece stone trim by bonding joints with stone adhesive as units are set. Mask areas adjacent to joints to prevent adhesive smears. Clamp units in place to ensure that surfaces are properly aligned and joints are minimum width.
- F. **[Grout] [Point]** joints after setting stone.
- G. Fill **[indicated]** joints with sealant after setting **[and grouting] [and pointing]** stone.

3.5 GROUTING JOINTS

- A. Grout stone to comply with ANSI A108.10.
 - 1. Use sanded grout mixture for joints wider than **1/8 inch (3 mm)**.
 - 2. Use unsanded grout mixture for joints **1/8 inch (3 mm)** and narrower.
- B. Remove temporary shims before grouting.
- C. Tool joints uniformly and smoothly with plastic tool.

3.6 POINTING JOINTS WITH MORTAR

- A. Prepare stone-joint surfaces for pointing with mortar by removing temporary shims, dust, and mortar particles. Where setting spots occur at joints, rake out excess setting mortar or plaster to a depth of not less than **1/2 inch (13 mm)**.
- B. Point stone joints by placing pointing mortar in layers of not more than **3/8 inch (10 mm)**. Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer. Apply mortar first to areas where depths are greater than surrounding areas until a uniform depth is formed.
- C. Tool joints when pointing mortar is thumbprint hard. Use a round jointer having a diameter **1/8 inch (3 mm)** larger than width of joint.

3.7 JOINT-SEALANT INSTALLATION

- A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants." Remove temporary shims before applying sealants.

3.8 ADJUSTING AND CLEANING

- A. In-Progress Cleaning: Clean interior stone trim as work progresses. Remove adhesive, grout, mortar, and sealant smears immediately.
- B. Remove and replace interior stone trim of the following description:
 - 1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by DEN Project Manager.
 - 2. Defective stone trim.
 - 3. Defective joints, including misaligned joints.
 - 4. Interior stone trim and joints not matching approved Samples and mockups.
 - 5. Interior stone trim not complying with other requirements indicated.
- C. Replace in a manner that results in interior stone trim that matches approved Samples and mockups, complies with other requirements, and shows no evidence of replacement.

- D. Clean interior stone trim no fewer than six days after completion of grouting and pointing, using clean water and soft rags or stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage stone.
- E. Sealer Application: Apply stone sealer to comply with stone producer's and sealer manufacturer's written instructions and recommendations.

3.9 PROTECTION

- A. Protect stone surfaces, edges, and corners from construction damage. Use securely fastened untreated wood, plywood, or heavy cardboard to prevent damage.
- B. Before inspection for Substantial Completion, remove protective coverings and clean surfaces.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 097519

SECTION 098433 - SOUND-ABSORBING WALL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes shop-fabricated, fabric-wrapped panel units tested for acoustical performance, including:
 - 1. Sound-absorbing wall panels.
 - 2. Sound-diffusing wall panels.
 - 3. Sound-reflecting wall panels.
- B. Related Sections:
 - 1. Section 097200 "Wall Coverings" for adhesively applied textile wall coverings[**and for coordinating requirements for fabric**].
 - 2. Section 097713 "Stretched-Fabric Wall Systems" for site-upholstered systems for walls[**and for coordinating requirements for fabric**].
 - 3. Section 097723 "Fabric-Wrapped Panels" for fabric-wrapped wall panels that are not required to be tested for acoustical performance[**and for coordinating requirements for fabric**].
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. NRC: Noise Reduction Coefficient.
- B. SAA: Sound Absorption Average.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of [**fabric facing**,] panel edge, core material, and mounting indicated.
 - 1. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5.1: For products and materials required to comply with requirements for regionally manufactured materials. Include statement indicating cost, location of manufacturer, and distance to Project for each regionally manufactured material.
3. Certificates for **[Credit MR 6] [Credit MR 7]**: Chain-of-custody certificates indicating that wood-based products used in sound-absorbing wall units comply with forest certification requirements. Include statement indicating cost for each certified wood product.
4. Product Data for Credit IEQ 4.1: For installation adhesives, documentation including printed statement of VOC content and chemical components.
5. Product Data for Credit IEQ 4.4: For composite wood products used in sound-absorbing wall units, documentation indicating that product contains no urea formaldehyde.
6. Laboratory Test Reports for Credit IEQ 4: For **[installation adhesives] [composite wood products] [and] [sound-absorbing wall units]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: For sound-absorbing wall units. Include mounting devices and details; details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Indicate panel edge and core materials.

1. Include elevations showing panel sizes and direction of fabric weave and pattern matching.

D. Samples for Initial Selection: For each type of fabric facing from sound-absorbing wall unit manufacturer's full range.

E. Samples for Verification: For the following products, prepared on Samples of size indicated below:

1. Fabric: Full-width by approximately **[36-inch- (900-mm-)] <Insert dimension>** long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
2. Panel Edge: **12-inch- (300-mm-)** long Sample(s) showing each edge profile, corner, and finish.
3. Core Material: **12-inch- (300-mm-)** square Sample at corner.
4. Mounting Devices: Full-size Samples.
5. Assembled Panels: Approximately **36 by 36 inches (900 by 900 mm)**, including joints and mounting methods.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Electrical outlets, switches, and thermostats.
 2. Items penetrating or covered by sound-absorbing wall units including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Alarms.
 - e. Sprinklers.
 - f. Access panels.
 - g. **<Insert item>**.
 3. Show operation of hinged and sliding components covered by or adjacent to sound-absorbing wall units.
- B. Product Certificates: For each type of sound-absorbing wall unit, from manufacturer.
- C. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sound-absorbing wall units to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal recommendations.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials from same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fabric: For each fabric, color, and pattern installed, provide length equal to **[10] <Insert number>** percent of amount installed, but no fewer than **[10 yards (9 m)] <Insert quantity>**.
 2. Mounting Devices: Full-size units equal to **[5] <Insert number>** percent of amount installed, but no fewer than **[five] <Insert number>** devices, including unopened adhesives.

1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain sound-absorbing wall units from single source from single manufacturer.
- B. Fire-Test-Response Characteristics: Provide sound-absorbing wall units meeting the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. Surface-Burning Characteristics: As determined by testing per ASTM E 84.
 - a. Flame-Spread Index: **[25] <Insert value>** or less.
 - b. Smoke-Developed Index: **[450] <Insert value>** or less.
 - 2. Fire Growth Contribution: Meeting acceptance criteria of local code and authorities having jurisdiction when tested according to **[NFPA 265] [NFPA 286]**.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials, fabrication, and installation.
 - 1. Build mockup of typical wall area **[as shown on Drawings] [as directed by DEN Project Manager] <Insert requirement>.[Include intersection of wall and ceiling, corners, and perimeters.]**
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
- D. Preinstallation Conference: Conduct conference at **[Project site] <[location and time as determined by DEN Project Manager] Insert location>**.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with fabric and sound-absorbing wall unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install sound-absorbing wall units until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

- B. Lighting: Do not install sound-absorbing wall units until [**a permanent level of lighting**] [**a lighting level of not less than 50 fc (538 lux)**] <Insert requirement> is provided on surfaces to receive the units.
- C. Field Measurements: Verify locations of sound-absorbing wall units and actual dimensions of openings and penetrations by field measurements before fabrication.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sound-absorbing wall units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to the following:
 - a. Acoustical performance.
 - b. Fabric sagging, distorting, or releasing from panel edge.
 - c. Warping of core.
 - 2. Warranty Period: Minimum [**two (2)**] <Insert number> years from date of Substantial Completion.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of this Section.

PART 2 - PRODUCTS

2.1 SOUND-ABSORBING WALL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acoustical Panel Systems (APS, Inc.).
 - 2. Acoustical Solutions, Inc.
 - 3. Armstrong World Industries.
 - 4. AVL Systems, Inc.
 - 5. Benton Brothers Solutions, Inc.
 - 6. Conwed Designscape; an Owens Corning company.
 - 7. Decoustics Limited; a CertainTeed Ceilings company.
 - 8. Essi Acoustical Products.
 - 9. Golterman & Sabo.
 - 10. Kinetics Noise Control, Inc.
 - 11. Lamvin, Inc.
 - 12. MBI Products Company, Inc.

13. Panel Solutions, Inc.
 14. Perdue Acoustics.
 15. Pinta Acoustic, Inc.
 16. Proudfoot Company, Inc. (The).
 17. Sound Concepts Canada, Inc.
 18. Sound Management Group LLC.
 19. Tectum Inc.
 20. Wall Technology, Inc.; an Owens Corning company.
 21. Working Walls, Inc.
 22. **<Insert manufacturer's name>**.
 23. or approved equal.
- B. General Requirements for Sound-Absorbing Wall Units: Units shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Sound-Absorbing Wall Panel **<Insert drawing designation>**: Manufacturer's standard panel construction consisting of facing material **[laminated to front face, edges, and back edge border of core] [stretched over front face of edge-framed core and bonded or attached to edges and back of frame] <Insert description>**.
1. Mounting: Edge mounted with splines secured to substrate.
 - a. Finish Color at Exposed Edges: **[White] [Black] [Match color of facing material] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert requirement>**.
 2. Mounting: Back mounted with manufacturer's standard **[adhesive] [adhesive tape strips] [hook-and-loop strips] [impaling clips] [magnetic devices] [metal clips or bar hangers]**, secured to substrate.
 3. Core: **[Manufacturer's standard] [glass-fiber board] [mineral-fiber board] [or] [cementitious-fiber board] <Insert requirement>**. **[Provide wood or plywood nailing strips in core where indicated.]**
 - a. Core-Face Layer: Manufacturer's standard **[tackable, impact-resistant, high-density board] [impact-resistant, acoustically transparent, copolymer sheet] <Insert requirement>**.
 4. Edge Construction: Manufacturer's standard **[chemically hardened core with no frame] [extruded-aluminum or zinc-coated, rolled-steel frame] [extruded PVC frame] [wood frame, rabbeted, and splined with glued joints and machined corners] <Insert requirement>**.
 5. Edge Profile: **[Long edges kerfed and rabbeted to receive splines] [Chamfered (beveled)] [Eased (small radius)] [Mitered (beveled to a point)] [Radiused (bullnosed)] [Square] [Custom profile as indicated on Drawings] <Insert profile>**.
 6. Corner Detail in Elevation: **[Square] [Round, radius as indicated on Drawings] [Custom as indicated on Drawings] <Insert description>** with continuous edge profile indicated.

7. Reveals between Panels: [**Recessed**] [**Flush**] [**Projecting**] reveals [**as selected by DEN Project Manager from manufacturer's full range**] [**as indicated on Drawings**] <Insert requirement>.
 8. Facing Material: [**Owner-furnished material**] [**As indicated on Drawings**] <Insert drawing designation>.
 9. Acoustical Performance: Sound absorption [**NRC**] [**or**] [**SAA**] of [**0.50 to 0.90**] [**0.60 to 0.70**] [**0.65 to 0.75**] [**not less than 0.65**] <Insert range or single value> according to ASTM C 423 for [**Type A**] <Insert Type> mounting according to ASTM E 795.
 10. Nominal [**Core**] [**Overall Panel**] Thickness: [**3/4 inch** (19 mm)] [**1 inch** (25 mm)] [**1-1/2 inches** (38 mm)] [**2 inches** (51 mm)] [**As indicated on Drawings**] <Insert dimension>.
 11. Panel Width: [**24 inches** (610 mm)] [**30 inches** (762 mm)] [**48 inches** (1220 mm)] [**As indicated on Drawings**] <Insert dimension>.
 12. Panel Height: [**72 inches** (1829 mm)] [**96 inches** (2438 mm)] [**108 inches** (2743 mm)] [**120 inches** (3048 mm)] [**As indicated on Drawings**] <Insert dimension>.
- D. Sound-~~[Diffusing]~~ [**Reflecting**] Wall Panel <Insert drawing designation>:
Manufacturer's standard panel construction consisting of facing material [**laminated to front face, edges, and back edge border of core**] <Insert description>.
1. Panel Shape: [**Barrel**] [**Pyramidal**] [**Radially curved flat panel**] [**As indicated on Drawings**] <Insert shape>.
 2. Mounting: Back mounted with manufacturer's standard [**adhesive**] [**adhesive tape strips**] [**hook-and-loop strips**] [**impaling clips**] [**magnetic devices**] [**metal clips or bar hangers**], secured to substrate.
 3. Core: [**Manufacturer's standard**] [**glass-fiber board with a reflective component**] [**mineral-fiber board with a reflective component**] [**cementitious-fiber board with a reflective component**] [**fire-retardant formed plastic**] [**medium-density fiberboard**] [**or**] [**particleboard**] <Insert requirement>, prepared for required acoustical performance.
 4. Edge Construction: Manufacturer's standard [**chemically hardened core with no frame**] <Insert requirement>.
 5. Reveals between Panels: [**Recessed**] [**Flush**] [**Projecting**] reveals [**as selected by DEN Project Manager from manufacturer's full range**] [**as indicated on Drawings**] <Insert requirement>.
 6. Facing Material: [**Owner-furnished material**] [**As indicated on Drawings**] <Insert drawing designation>.
 7. Acoustical Performance: Sound absorption [**NRC**] [**or**] [**SAA**] of [**0.05 to 0.10**] [**0.15 to 0.25**] [**0.30 to 0.40**] [**not more than 0.35**] <Insert range or single value> according to ASTM C 423 for [**Type A**] <Insert Type> mounting according to ASTM E 795.
 8. Panel Width: [**24 inches** (610 mm)] [**30 inches** (762 mm)] [**48 inches** (1220 mm)] [**As indicated on Drawings**] <Insert dimension>.
 9. Panel Height: [**72 inches** (1829 mm)] [**96 inches** (2438 mm)] [**108 inches** (2743 mm)] [**120 inches** (3048 mm)] [**As indicated on Drawings**] <Insert dimension>.

2.2 MATERIALS

A. General:

1. Minimum Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent by weight.
2. Regional Materials: Sound-absorbing wall units shall be manufactured within **500 miles** (800 km) of Project site.
3. Certified Wood: Fabricate products with wood-based components produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

B. Core Materials:[**Manufacturer's standard.**]

1. Glass-Fiber Board: ASTM C 612, Type standard with manufacturer; nominal density of [6 to 7 lb/cu. ft. (96 to 112 kg/cu. m)] **<Insert value>**, unfaced, and dimensionally stable, molded rigid board; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
2. Mineral-Fiber Board: Maximum flame-spread and smoke-developed indexes of 25 and 10, respectively; minimum density of [13 lb/cu. ft. (208 kg/cu. m)] [20 lb/cu. ft. (320 kg/cu. m)], and with perforated surface.
3. Cementitious-Fiber Board: Density of not less than [20 lb/cu. ft. (320 kg/cu. m)] **<Insert value>**.
4. Fire-Retardant Formed Plastic: Manufacturer's standard formed plastic with flame-spread index of 25 or less and smoke-developed index of 25 or less according to ASTM E 84.
5. Medium-Density Fiberboard: Panels complying with ANSI A208.2, Grade M-2.
 - a. Made with binder containing no urea formaldehyde.
 - b. Panels shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - c. Fire-retardant panels made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.
6. Particleboard: Panels complying with ANSI A208.1, Grade M-2.
 - a. Made with binder containing no urea formaldehyde.
 - b. Panels shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - c. Fire-retardant panels made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.
7. Tackable, Impact-Resistant, High-Density Board for Face Layer: **1/8-inch-** (3.2-mm-) thick layer of compressed molded glass-fiber board with a nominal density of **16 to 18 lb/cu. ft.** (256 to 288 kg/cu. m) laminated to face of core.

8. Impact-Resistant, Acoustically Transparent, Copolymer Sheet for Face Layer: **1/16- to 1/8-inch-** (1.6- to 3.2-mm-) thick layer of perforated, noncombustible, copolymer sheet laminated to face of core.
 9. Wood and Plywood: Manufacturer's standard plywood or clear, vertical grain, straight, kiln-dried hardwood.
 - a. Plywood shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - b. Fire-retardant treated by pressure process with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 feet** (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1) Treated material shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity.
 - 2) Kiln-dry material after treatment to 7 to 13 percent or less for lumber and 15 percent or less for plywood.
- C. Facing Material **<Insert drawing designation>**: Fabric from same dye lot; color and pattern **[as indicated by manufacturer's designations] [matching DEN Project Manager's samples] [as selected by DEN Project Manager from manufacturer's full range] [as indicated on Drawings] <Insert requirement>**.
1. Manufacturer: **<Insert manufacturer's name>**.
 2. Product Line/Pattern: **<Insert product name or designation>**.
 3. Pattern Repeat: **<Insert requirement>**.
 4. Style Number: **<Insert number>**.
 5. Color: **<Insert name or number, or both>**.
 6. Fiber Content: **[100] <Insert number>** percent **[woven polyester] [nonwoven polyester] [polyolefin] [acoustically transparent vinyl] <Insert fiber requirement>**.
 7. Width: **[54 inches (1371 mm)] [66 inches (1676 mm)] <Insert dimension>**.
 8. Source: **<Insert fabric-vendor's name>**.
 9. Applied Treatments: **[Stain resistance] <Insert treatment>**.
- D. Mounting Devices: Concealed on back of unit, recommended by manufacturer to support weight of unit, and as follows:
1. Splines: Manufacturer's standard concealed metal or plastic splines that engage the kerfed edges of the unit, with other moldings and trim for interior corners, exterior corners, and exposed edges, with factory-applied finish on exposed items.
 2. Adhesives: As recommended by sound-absorbing wall unit manufacturer and with a VOC content of **[70] <Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesives: As recommended by sound-absorbing wall unit manufacturer and that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
4. Adhesive Tape Strips: **[Manufacturer's standard 1/16-inch- (1.6-mm-) thick, double-sided foam tape]** <Insert requirement>.
5. Hook-and-Loop Strips: **[Manufacturer's standard]** <Insert requirement>.
6. Impaling Clips: **[Manufacturer's standard]** <Insert requirement>.
7. Magnetic Strip or Devices: **[Manufacturer's standard]** <Insert requirement>.
8. Metal Clips or Bar Hangers: Manufacturer's standard two-part metal "Z" clips, with one part of each clip mechanically attached to back of unit and the other part to substrate, designed to permit unit removal.

2.3 FABRICATION

- A. General: Use manufacturer's standard construction except as otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.
 1. **[Glass-Fiber Board] [and] [Mineral-Fiber Board]** Cores: Chemically harden core edges and areas of core where mounting devices are attached.
- B. Core-Face Layer: Evenly stretched over core face and edges and securely attached to core; free from puckers, ripples, wrinkles, or sags.
- C. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.
 1. Square Corners: Tailor corners. **[Heat seal vinyl fabric seams at corners.]**
 2. Radius and Other Nonsquare Corners: Attach facing material so there are no seams or gathering of material.
 3. Fabrics with Directional or Repeating Patterns or Directional Weave: Mark fabric top and attach fabric in same direction so pattern or weave matches in adjacent units.
- D. Dimensional Tolerances of Finished Units: Plus or minus **1/16 inch** (1.6 mm) for the following:
 1. Thickness.
 2. Edge straightness.
 3. Overall length and width.
 4. Squareness from corner to corner.
 5. Chords, radii, and diameters.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fabric, fabricated units, substrates, areas, and conditions, for compliance with requirements, installation tolerances, and other conditions affecting performance of sound-absorbing wall units.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sound-absorbing wall units in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with sound-absorbing wall unit manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.
- C. Align and level fabric pattern and grain among adjacent units.

3.3 INSTALLATION TOLERANCES

- A. Variation from Plumb and Level: Plus or minus [1/16 inch (1.6 mm)] **<Insert dimension>**.
- B. Variation of Panel Joints from Hairline: Not more than [1/16 inch (1.6 mm)] [1/32 inch (0.79 mm)] **<Insert dimension>** wide.

3.4 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 098433

SECTION 098436 - SOUND-ABSORBING CEILING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes shop-fabricated, fabric-wrapped panel units tested for acoustical performance, including:
 - 1. Sound-absorbing panels.
 - 2. Sound-diffusing panels.
 - 3. Sound-reflecting panels.
 - 4. Sound-absorbing baffle panels.
- B. Related Requirements:
 - 1. Section 097200 "Wall Coverings" for adhesively applied textile wall coverings[**and for coordinated requirements for fabric**].
 - 2. Section 095443 "Stretched-Fabric Ceiling Systems" for site-upholstered systems for ceilings[**and for coordinated requirements for fabric**].
 - 3. Section 095446 "Fabric-Wrapped Ceiling Panels" for shop-fabricated, fabric-wrapped ceiling panels that are not required to be tested for acoustical performance[**and for coordinated requirements for fabric**].
 - 4. Section 098433 "Sound-Absorbing Wall Units" for shop-fabricated fabric-wrapped wall panels tested for acoustical performance[**and for coordinated requirements for fabric**].
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. NRC: Noise reduction coefficient.
- B. SAA: Sound absorption average.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>**.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include construction details, mounting, material descriptions, dimensions of individual components and profiles, and finishes for sound-absorbing ceiling units.
2. Include furnished specialties and accessories.
3. Include data substantiating that materials comply with requirements.

- B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5, Option 1: For products and materials required to comply with requirements for regionally manufactured materials. Include statement indicating cost, location of manufacturer, and distance to Project for each regionally manufactured material.
3. Certificates for **[Credit MR 6] [Credit MR 7]**: Chain-of-custody certificates indicating that wood-based products used in sound-absorbing ceiling units comply with forest certification requirements. Include statement indicating cost for each certified wood product.
4. Product Data for Credit IEQ 4.4: For composite wood products used in sound-absorbing ceiling units, documentation indicating that product contains no urea formaldehyde.
5. Laboratory Test Reports for Credit IEQ 4: For **[composite wood products] [and] [sound-absorbing ceiling units]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Shop Drawings: For sound-absorbing ceiling units.

1. Include plans, elevations, sections, and mounting devices and details.
2. Include details at joints and corners; and details at ceiling intersections and intersections with walls. Indicate panel edge and core materials.
3. Include reflected ceiling plans showing panel sizes and direction of fabric weave and pattern matching.

- D. Samples for Initial Selection: For each type of fabric facing from sound-absorbing ceiling unit manufacturer's full range.

- E. Samples for Verification: For the following products:
1. Fabric: Full-width by approximately [36-inch- (900-mm-)] <Insert dimension> long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
 2. Panel Edge: 12-inch- (300-mm-) long Sample(s) showing each edge profile, corner, and finish.
 3. Core Material: 12-inch- (300-mm-) square Sample at corner.
 4. Mounting Devices: Full-size Samples.
 5. Assembled Panels: Approximately 36 by 36 inches (900 by 900 mm), including joints and mounting methods.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Electrical outlets, switches, and thermostats.
 2. Suspended ceiling components above sound-absorbing ceiling units.
 3. Structural members to which suspension devices will be attached.
 4. Items penetrating or covered by sound-absorbing ceiling units including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Alarms.
 - e. Sprinklers.
 - f. Access panels.
 - g. <Insert item>.
 5. Show operation of hinged and sliding components covered by or adjacent to sound-absorbing ceiling units.
- B. Product Certificates: For each type of sound-absorbing ceiling unit.
- C. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sound-absorbing ceiling units to include in maintenance manuals. Include fabric manufacturer's written cleaning and stain-removal recommendations.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fabric: For each fabric, color, and pattern installed, furnish length equal to **[10 <Insert number>** percent of amount installed, but no fewer than **[10 yards (9 m)] <Insert quantity>**.
 2. Mounting Devices: Full-size units equal to **[5] <Insert number>** percent of amount installed, but no fewer than **[five] <Insert number>** devices.

1.9 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials, fabrication, and installation.
1. Build mockup of typical ceiling area **[as shown on Drawings] [as directed by DEN Project Manager] <Insert requirement>**. **[Include intersection of wall and ceiling, corners, and perimeters.]**
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Comply with fabric and sound-absorbing ceiling unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.11 FIELD CONDITIONS

- A. Environmental Limitations: Do not install sound-absorbing ceiling units until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Lighting: Do not install sound-absorbing ceiling units until **[a permanent level of lighting] [a lighting level of not less than 50 fc (538 lux)] <Insert requirement>** is provided on surfaces to receive the units.
- C. Air-Quality Limitations: Protect sound-absorbing ceiling units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.

- D. Field Measurements: Verify locations of sound-absorbing ceiling units and actual dimensions of openings and penetrations by field measurements before fabrication.

1.12 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of sound-absorbing ceiling units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Acoustical performance.
 - b. Fabric sagging, distorting, or releasing from panel edge.
 - c. Warping of core.
2. Warranty Period: Minimum **[two (2)] <Insert number>** years from date of Substantial Completion.

1.13 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Acoustical Panel Systems (APS, Inc.).
 2. Acoustical Solutions, Inc.
 3. AVL Systems, Inc.
 4. Benton Brothers Solutions, Inc.
 5. Conwed Designscape; an Owens Corning company.
 6. Decoustics Limited; a CertainTeed Ceilings company.
 7. Essi Acoustical Products.
 8. Golterman & Sabo.
 9. Kinetics Noise Control, Inc.
 10. Lamvin, Inc.
 11. MBI Products Company, Inc.
 12. Panel Solutions, Inc.
 13. Perdue Acoustics.
 14. Proudfoot Company, Inc. (The).
 15. Sound Concepts Canada, Inc.
 16. Sound Management Group LLC.

17. Wall Technology, Inc.; an Owens Corning company.
18. Working Walls, Inc.
19. **<Insert manufacturer's name>**.
20. or approved equal.

- B. Source Limitations: Obtain sound-absorbing ceiling units from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General Requirements for Sound-Absorbing Ceiling Units: Provide **[sound-absorbing]** **[sound-diffusing]** **[sound-reflecting]** **[and]** **[sound-absorbing baffle]** panels that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Fire-Test-Response Characteristics: Provide sound-absorbing ceiling units meeting the following requirements as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: **[25]** **<Insert value>** or less.
 - b. Smoke-Developed Index: **[450]** **<Insert value>** or less.
 2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to **[NFPA 265]** **[NFPA 286]**.

2.3 SOUND-ABSORBING CEILING UNITS

- A. Sound-Absorbing Ceiling Panel **<Insert drawing designation>**: Manufacturer's standard panel construction consisting of facing material **[laminated to front face, edges, and back edge border of core]** **[stretched over front face of edge-framed core and bonded or attached to edges and back of frame]** **<Insert description>**.
1. Mounting: Back mounted with manufacturer's standard **[metal clips]** **[suspension system]** **[suspension system with stiffening, back-support angles]** **<Insert requirement>**, secured to substrate.
 2. Core: **[Manufacturer's standard]** **[Glass-fiber board]** **[Glass-fiber blanket]** **[Mineral-fiber board]** **[Cementitious-fiber board]** **<Insert requirement>**.
 3. Edge Construction: Manufacturer's standard **[chemically hardened core with no frame]** **[extruded-aluminum or zinc-coated, rolled-steel frame]** **[extruded PVC frame]** **[wood frame, rabbeted, and splined with glued joints and machined corners]** **<Insert requirement>**.
 4. Edge Profile: **[Chamfered (beveled)]** **[Eased (small radius)]** **[Mitered (beveled to a point)]** **[Radiused (bullnosed)]** **[Square]** **[Custom profile as indicated on Drawings]** **<Insert profile>**.

5. Corner Detail in Elevation: [**Square**] [**Round, radius as indicated on Drawings**] [**Custom as indicated on Drawings**] <Insert description> with continuous edge profile indicated.
 6. Reveals between Panels: [**Recessed**] [**Flush**] [**Projecting**] reveals [**as selected by DEN Project Manager from manufacturer's full range**] [**as indicated on Drawings**] <Insert requirement>.
 7. Facing Material: [**Owner-furnished material**] [**As indicated on Drawings**] <Insert drawing designation>.
 8. Acoustical Performance: Sound absorption [**NRC**] [**or**] [**SAA**] of [**0.50 to 0.90**] [**0.60 to 0.70**] [**0.65 to 0.75**] [**not less than 0.65**] <Insert range or single value> according to ASTM C 423 for [**Type A**] [**Type J**] <Insert mounting> mounting according to ASTM E 795.
 9. Nominal [**Core**] [**Overall Panel**] Thickness: [**3/4 inch (19 mm)**] [**1 inch (25 mm)**] [**1-1/2 inches (38 mm)**] [**2 inches (51 mm)**] [**As indicated on Drawings**] <Insert dimension>.
 10. Panel Width: [**24 inches (610 mm)**] [**30 inches (762 mm)**] [**48 inches (1220 mm)**] [**As indicated on Drawings**] <Insert dimension>.
 11. Panel Height: [**72 inches (1829 mm)**] [**96 inches (2438 mm)**] [**108 inches (2743 mm)**] [**120 inches (3048 mm)**] [**As indicated on Drawings**] <Insert dimension>.
- B. Sound-~~[Diffusing]~~ [**Reflecting**] Ceiling Panel <Insert drawing designation>:
Manufacturer's standard panel construction consisting of facing material [**laminated to front face, edges, and back edge border of core**] <Insert description>.
1. Basis-of-Design Product: [**Indicated on Drawings**] <Insert manufacturer's name; product name or designation>.
 2. Panel Shape: [**Barrel**] [**Pyramidal**] [**Radially curved flat panel**] [**As indicated on Drawings**] <Insert shape>.
 3. Mounting: Back mounted with manufacturer's standard [**metal clips**] [**suspension system**] [**suspension system with stiffening, back-support angles**] <Insert requirement>, secured to substrate.
 4. Core: [**Manufacturer's standard**] [**Glass-fiber board with a reflective component**] [**Mineral-fiber board with a reflective component**] [**Cementitious-fiber board with a reflective component**] [**Fire-retardant formed plastic**] [**Medium-density fiberboard**] [**Particleboard**] <Insert requirement>, prepared for required acoustical performance.
 5. Edge Construction: Manufacturer's standard [**chemically hardened core with no frame**] <Insert requirement>.
 6. Reveals between Panels: [**Recessed**] [**Flush**] [**Projecting**] reveals [**as selected by DEN Project Manager from manufacturer's full range**] [**as indicated on Drawings**] <Insert requirement>.
 7. Facing Material: [**Owner-furnished material**] [**As indicated on Drawings**] <Insert drawing designation>.
 8. Acoustical Performance: Sound absorption [**NRC**] [**or**] [**SAA**] of [**0.05 to 0.10**] [**0.15 to 0.25**] [**0.30 to 0.40**] [**not more than 0.35**] <Insert range or single value> according to ASTM C 423 for [**Type A**] [**Type J**] <Insert mounting> mounting according to ASTM E 795.
 9. Panel Width: [**24 inches (610 mm)**] [**30 inches (762 mm)**] [**48 inches (1220 mm)**] [**As indicated on Drawings**] <Insert dimension>.

10. Panel Height: [72 inches (1829 mm)] [96 inches (2438 mm)] [108 inches (2743 mm)] [120 inches (3048 mm)] [As indicated on Drawings] <Insert dimension>.

- C. Sound-Absorbing Baffle Panel <Insert drawing designation>: Manufacturer's standard panel construction consisting of facing material [laminated to front face, edges, and back edge border of core] [stretched over front face of edge-framed core and bonded or attached to edges and back of frame] <Insert description>.
1. Mounting: Back mounted with manufacturer's standard [metal clips] [suspension system] [suspension system with stiffening top-support angle] <Insert requirement>, secured to substrate.
 2. Core: [Manufacturer's standard] [Glass-fiber board] [Mineral-fiber board] [Cementitious-fiber board] <Insert requirement>.
 3. Edge Construction: Manufacturer's standard [chemically hardened core with no frame] [extruded-aluminum or zinc-coated, rolled-steel frame] [extruded PVC frame] [wood frame, rabbeted, and splined with glued joints and machined corners] <Insert requirement>.
 4. Edge Profile: [Chamfered (beveled)] [Eased (small radius)] [Mitered (beveled to a point)] [Radiused (bullnosed)] [Square] [Custom profile as indicated on Drawings] <Insert profile>.
 5. Corner Detail in Elevation: [Square] [Round, radius as indicated on Drawings] [Custom as indicated on Drawings] <Insert description> with continuous edge profile indicated.
 6. Facing Material: [Owner-furnished material] [As indicated on Drawings] <Insert drawing designation>.
 7. Acoustical Performance: Sound absorption [NRC] [or] [SAA] of [0.50 to 0.90] [0.60 to 0.70] [0.65 to 0.75] [not less than 0.65] <Insert range or single value> according to ASTM C 423 for [Type A] [Type J] <Insert mounting> mounting according to ASTM E 795.
 8. Nominal [Core] [Overall Panel] Thickness: [3/4 inch (19 mm)] [1 inch (25 mm)] [1-1/2 inches (38 mm)] [2 inches (51 mm)] [As indicated on Drawings] <Insert dimension>.
 9. Panel Width: [24 inches (610 mm)] [30 inches (762 mm)] [48 inches (1220 mm)] [As indicated on Drawings] <Insert dimension>.
 10. Panel Height: [72 inches (1829 mm)] [96 inches (2438 mm)] [108 inches (2743 mm)] [120 inches (3048 mm)] [As indicated on Drawings] <Insert dimension>.

2.4 MATERIALS

A. General:

1. Recycled Content of Sound-Absorbing Ceiling Units: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent.
2. Regional Materials: Sound-absorbing ceiling units shall be manufactured within 500 miles (800 km) of Project site.
3. Certified Wood: Sound-absorbing ceiling units fabricated with wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

B. Core Materials: **[Manufacturer's standard.]**

1. Glass-Fiber Board: ASTM C 612, Type standard with manufacturer; nominal density of [6 to 7 lb/cu. ft. (96 to 112 kg/cu. m)] **<Insert value>**, unfaced, and dimensionally stable, molded rigid board; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
2. Glass-Fiber Blanket: ASTM C 612, ASTM C 553, or ASTM C 665; Type standard with manufacturer; nominal density of [3 to 4 lb/cu. ft. (48 to 64 kg/cu. m)] **<Insert value>**; flexible; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
3. Mineral-Fiber Board: Maximum flame-spread and smoke-developed indexes of 25 and 10, respectively; minimum density of [13 lb/cu. ft. (208 kg/cu. m)] [20 lb/cu. ft. (320 kg/cu. m)], and with perforated surface.
4. Cementitious-Fiber Board: Density of not less than [20 lb/cu. ft. (320 kg/cu. m)] **<Insert value>**.
5. Fire-Retardant Formed Plastic: Manufacturer's standard formed plastic with flame-spread index of 25 or less and smoke-developed index of 25 or less according to ASTM E 84.
6. Medium-Density Fiberboard: Panels complying with ANSI A208.2, Grade M-2.
 - a. Made with binder containing no urea formaldehyde.
 - b. Use panels that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - c. Fire-retardant panels made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less when tested according to ASTM E 84.
7. Particleboard: Panels complying with ANSI A208.1, Grade M-2.
 - a. Made with binder containing no urea formaldehyde.
 - b. Use panels that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - c. Fire-retardant panels made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less when tested according to ASTM E 84.
8. Wood and Plywood: Manufacturer's standard plywood or clear, vertical grain, straight, kiln-dried hardwood.
 - a. Use plywood that meets the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- b. Fire-retardant treated by pressure process with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 feet** (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1) Treated material shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity.
 - 2) Kiln-dry material after treatment to 7 to 13 percent or less for lumber and 15 percent or less for plywood.
- C. Facing Material **<Insert drawing designation>**: Fabric from same dye lot; color and pattern **[as indicated by manufacturer's designations] [matching DEN Project Manager's samples] [as selected by DEN Project Manager from manufacturer's full range] [as indicated on Drawings] <Insert requirement>**.
 1. Manufacturer: **<Insert manufacturer's name>**.
 2. Product Line/Pattern: **<Insert product name or designation>**.
 3. Pattern Repeat: **<Insert requirement>**.
 4. Style Number: **<Insert number>**.
 5. Color: **<Insert name or number, or both>**.
 6. Fiber Content: **[100] <Insert number>** percent **[woven polyester] [nonwoven polyester] [polyolefin] [acoustically transparent vinyl] <Insert fiber requirement>**.
 7. Width: **[54 inches (1371 mm)] [66 inches (1676 mm)] <Insert dimension>**.
 8. Source: **<Insert fabric-vendor's name>**.
 9. Applied Treatments: **[Stain resistance] <Insert treatment>**.
 10. Light Reflectance: Average value not less than **[0.75] <Insert value>** when tested according to ASTM E 1477.
- D. Mounting Devices: Concealed on back of unit, recommended by manufacturer to support weight of unit.

2.5 FABRICATION

- A. General: Use manufacturer's standard construction except as otherwise indicated, with facing material applied to face, edges, and back border of dimensionally stable core and with rigid edges to reinforce panel perimeter against warpage and damage.
- B. Measure each area and establish layout of panels and joints of **[uniform size with balanced borders at opposite edges] [sizes indicated on Drawings]** within a given area.
- C. **[Glass-Fiber Board] [and] [Mineral-Fiber Board]** Cores: Chemically harden core edges and areas of core where mounting devices are attached.

- D. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.
1. Square Corners: Tailor corners.[**Heat seal vinyl fabric seams at corners.**]
 2. Radius and Other Nonsquare Corners: Attach facing material so there are no seams or gathering of material.
 3. Fabrics with Directional or Repeating Patterns or Directional Weave: Mark fabric top and attach fabric in same direction so pattern or weave matches adjacent units.
- E. Dimensional Tolerances of Finished Units: Plus or minus **1/16 inch** (1.6 mm) for the following:
1. Thickness.
 2. Edge straightness.
 3. Overall length and width.
 4. Squareness from corner to corner.
 5. Chords, radii, and diameters.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting performance of sound-absorbing ceiling units.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sound-absorbing ceiling units in locations indicated with edges in alignment with walls and other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with sound-absorbing ceiling unit manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.
- C. Align fabric pattern and grain with adjacent units.

3.3 INSTALLATION TOLERANCES

- A. Variation from Alignment with Surfaces: Plus or minus [**1/16 inch** (1.6 mm)] **<Insert dimension>**.

- B. Variation from Level or Slope: Plus or minus [1/16 inch (1.6 mm)] [1/8 inch (3.2 mm)] <Insert dimension>.
- C. Variation of Panel Joints from Hairline: Not more than [1/16 inch (1.6 mm)] [1/32 inch (0.79 mm)] <Insert dimension> wide.

3.4 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 098436

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. SUMMARY

1. This Section includes surface preparation and field painting of exposed exterior items and surfaces.
 - a. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
2. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
 - a. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
3. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 - a. Prefinished items include the following factory-finished components:
 - 1) Architectural woodwork.
 - 2) Acoustical wall panels.
 - 3) Metal toilet enclosures.
 - 4) Metal lockers.
 - 5) Unit kitchens.
 - 6) Elevator entrance doors and frames.
 - 7) Elevator equipment.
 - 8) Finished mechanical and electrical equipment.
 - 9) Light fixtures.
 - 10) **<Insert other prefinished items if required.>**
 - b. Concealed surfaces include walls or ceilings in the following

generally inaccessible spaces:

- 1) Foundation spaces.
- 2) Furred areas.
- 3) Ceiling plenums.
- 4) Utility tunnels.
- 5) Pipe spaces.
- 6) Duct shafts.
- 7) Elevator shafts.
- 8) **<Insert other concealed surfaces if required.>**

c. Finished metal surfaces include the following:

- 1) Anodized aluminum.
- 2) Stainless steel.
- 3) Chromium plate.
- 4) Copper and copper alloys.
- 5) Bronze and brass.
- 6) **<Insert other finished metal surfaces if required.>**

d. Operating parts include moving parts of operating equipment and the following:

- 1) Valve and damper operators.
- 2) Linkages.
- 3) Sensing devices.
- 4) Motor and fan shafts.
- 5) **<Insert other operating parts if required.>**

e. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

4. Related Sections include the following:

- a. Division 2 Section "Hot-Mix Asphalt Paving" for traffic-marking paint.
- b. Division 2 Section "Cement Concrete Pavement" for traffic-marking paint.
- c. Division 5 Section "Structural Steel" for shop priming structural steel.
- d. Division 5 Section "Metal Fabrications" for shop priming ferrous metal.
- e. Division 6 Section "Exterior Architectural Woodwork" for shop priming exterior architectural woodwork.
- f. Division 8 Section "Steel Doors and Frames" for factory priming steel doors and frames.
- g. Division 8 Section "Custom Steel Doors and Frames" for factory priming steel doors and frames.
- h. Division 8 Section "Wood Windows" for shop priming unclad wood windows.
- i. Division 9 Section "Gypsum Board Assemblies" for surface

- preparation of gypsum board.
 - j. Division 9 Section "Exterior Wood Stain."
 - k. Division 9 Section "Wall Coverings" for substrate sealer under wall coverings.
 - l. Division 9 Section "High-Performance Coatings" for industrial paints and maintenance and for special coatings.
5. Alternates: Refer to Division 1 Section "Alternates" for description of Work in this Section affected by alternates.

C. DEFINITIONS

1. General: Standard coating terms defined in ASTM D 16 apply to this Section.
- a. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
 - b. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
 - c. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
 - d. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

D. SUBMITTALS

1. Product Data: For each paint system indicated. Include block fillers and primers.
- a. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 - b. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
2. Samples for Initial Selection: For each type of finish-coat material indicated.
- a. After color selection, Architect will furnish color chips for surfaces to be coated.
3. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
- a. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.

- b. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
- c. Submit **<Insert number>** Samples on the following substrates for Architect's review of color and texture only:
 - 1) Concrete: **[4-inch- square] [4-by-6-inch] <Insert size and shape>** Samples for each color and finish.
 - 2) Concrete Unit Masonry: **[4-by-8-inch] [6-by-10-inch] <Insert size>** Samples of masonry, with mortar joint in the center, for each finish and color.
 - 3) Painted Wood: **[8-inch-] [12-inch-] <Insert size>** square Samples for each color and material on hardboard.
 - 4) Stained or Natural Wood: **[4-by-8-inch] [6-by-10-inch] <Insert size>** Samples of natural- or stained-wood finish on representative **<Insert species of wood to be used>** surfaces.
 - 5) Ferrous Metal: **[3-inch-] [4-inch-] <Insert size>** square Samples of flat metal and **[6-inch-] [8-inch-] <Insert size>** long Samples of solid metal for each color and finish.

4. Qualification Data: For Applicator.

E. QUALITY ASSURANCE

- 1. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- 2. Source Limitations: Obtain **[block fillers] [and] [primers]** for each coating system from the same manufacturer as the finish coats.
- 3. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.
 - a. Architect will select one room or surface to represent surfaces and conditions for application of each type of coating and substrate.
 - 1) Wall Surfaces: Provide samples on at least **[100 sq. ft.] <Insert size>**.
 - 2) Small Areas and Items: Architect will designate items or areas required.
 - b. Apply benchmark samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.
 - 1) After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.

- c. Final approval of colors will be from benchmark samples.

F. DELIVERY, STORAGE, AND HANDLING

1. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
 - a. Product name or title of material.
 - b. Product description (generic classification or binder type).
 - c. Manufacturer's stock number and date of manufacture.
 - d. Contents by volume, for pigment and vehicle constituents.
 - e. Thinning instructions.
 - f. Application instructions.
 - g. Color name and number.
 - h. VOC content.
2. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.
 - a. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

G. PROJECT CONDITIONS

1. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.
2. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.
3. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
 - a. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

H. EXTRA MATERIALS

1. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.
 - a. Quantity: Furnish Owner with extra paint materials in quantities indicated below:
 - 1) Exterior, Flat Acrylic Paint: **[1 gal.] [2 gal.] [One case]**
[<Insert other number> cases] of each color applied.

- 2) Exterior, Low-Luster Acrylic Finish: [1 gal.] [2 gal.] [One case] [<Insert other number> cases] of each color applied.
 - 3) Exterior, Semigloss Acrylic Enamel: [1 gal.] [2 gal.] [One case] [<Insert other number> cases] of each color applied.
 - 4) Exterior, Full-Gloss Alkyd Enamel: [1 gal.] [2 gal.] [One case] [<Insert other number> cases] of each color applied.
- b. Quantity: Furnish Owner with an additional [3] [5] [7] <Insert percent> percent, but not less than 1 gal. or 1 case, as appropriate, of each material and color applied.

PART 2 - PRODUCTS

A. MANUFACTURERS

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.
2. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.
3. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - a. Benjamin Moore & Co. (Benjamin Moore).
 - b. Coronado Paint Company (Coronado).
 - c. ICI Dulux Paint Centers (ICI Dulux Paints).
 - d. Kelly-Moore Paint Co. (Kelly-Moore).
 - e. M. A. Bruder & Sons, Inc. (M. A. B. Paint).
 - f. PPG Industries, Inc. (Pittsburgh Paints).
 - g. Sherwin-Williams Co. (Sherwin-Williams).
 - h. <Insert manufacturer's name.>

B. PAINT MATERIALS, GENERAL

1. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
2. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 - a. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

3. Colors: **[Match Architect's samples] [As indicated by manufacturer's designations] [As selected by Architect from manufacturer's full range].**

C. CONCRETE UNIT MASONRY BLOCK FILLERS

1. Concrete Unit Masonry Block Filler: Factory-formulated high-performance latex block fillers.
 - a. Benjamin Moore; Moorcraft Super Craft Latex Block Filler No. 285: Applied at a dry film thickness of not less than 8.1 mils.
 - b. Benjamin Moore; Moore's IMC Latex Block Filler No. M88: Applied at a dry film thickness of not less than 8.1 mils.
 - c. Coronado; 946-11 Super Kote 5000 Commercial Latex Block Filler: Applied at a dry film thickness of not less than 8.4 mils.
 - d. ICI Dulux Paints; Bloxfil 4000-1000 Interior/Exterior Heavy Duty Acrylic Block Filler: Applied at a dry film thickness of not less than 7.0 to 14.5 mils.
 - e. Kelly-Moore; 521 Fill and Prime Acrylic Block Filler: Applied at a dry film thickness of not less than 10.0 mils.
 - f. M. A. B. Paint; Block Kote No. 1000 Acrylic Latex Block Filler 064-145: Applied at a dry film thickness of not less than 12.0 mils.
 - g. Pittsburgh Paints; 6-7 SpeedHide Interior/Exterior Masonry Latex Block Filler: Applied at a dry film thickness of not less than 6.0 to 12.5 mils.
 - h. Sherwin-Williams; PrepRite Interior/Exterior Block Filler B25W25: Applied at a dry film thickness of not less than 8.0 mils.
 - i. **<Insert manufacturer's block filler.>**

D. EXTERIOR PRIMERS

1. Exterior Concrete and Masonry Primer: Factory-formulated alkali-resistant acrylic-latex primer for exterior application.
 - a. Benjamin Moore; Moore's Acrylic Masonry Sealer No. 066: Applied at a dry film thickness of not less than 0.7 mils.
 - b. Benjamin Moore; Moore's Alkyd Masonry Sealer No. 077: Applied at a dry film thickness of not less than 2.7 mils.
 - c. Coronado; 48-11 Elast-O-Meric Acrylic Masonry Sealer: Applied at a dry film thickness of not less than 1.2 mils.
 - d. ICI Dulux Paints; 2000-1200 Dulux Professional Exterior 100 Percent Acrylic Latex Primer: Applied at a dry film thickness of not less than 1.6 mils.
 - e. Kelly-Moore; 247 Chem-Guard Acrylic Masonry Primer: Applied at a dry film thickness of not less than 1.9 mils.
 - f. M. A. B. Paint; Lok Tite Latex Masonry Primer 056-125: Applied at a dry film thickness of not less than 1.5 mils.
 - g. Pittsburgh Paints; 6-603 SpeedHide Interior/Exterior Acrylic Latex Alkali Resistant Primer: Applied at a dry film thickness of not less than 1.5 mils.
 - h. Sherwin-Williams; Loxon Exterior Masonry Acrylic Primer A24W300:

- Applied at a dry film thickness of not less than 3.0 mils.
 - i. Sherwin-Williams; A-100 Latex Exterior Wood Primer B42W41: Applied at a dry film thickness of not less than 1.4 mils.
 - j. **<Insert manufacturer's exterior primer.>**
- 2. Exterior Gypsum Soffit Board Primer: Factory-formulated alkyd- or alkali-resistant acrylic-latex primer for exterior application.
 - a. Benjamin Moore; Moorcraft Super Spec Alkyd Exterior Primer No. 176: Applied at a dry film thickness of not less than 1.8 mils.
 - b. Coronado; 8-11 Supreme Acrylic Bonding Primer: Applied at a dry film thickness of not less than 1.4 mils.
 - c. ICI Dulux Paints; 2000-1200 Dulux Professional Exterior 100 Percent Acrylic Latex Primer: Applied at a dry film thickness of not less than 1.6 mils.
 - d. Kelly-Moore; 250 Color Shield Exterior Acrylic Primer: Applied at a dry film thickness of not less than 1.7 mils.
 - e. M. A. B. Paint; Lok Tite Latex Masonry Primer 056-125: Applied at a dry film thickness of not less than 1.5 mils.
 - f. Pittsburgh Paints; 6-603 SpeedHide Interior/Exterior Acrylic Latex Alkali Resistant Primer: Applied at a dry film thickness of not less than 1.5 mils.
 - g. Sherwin-Williams; A-100 Exterior Latex Wood Primer B42W41: Applied at a dry film thickness of not less than 1.4 mils.
 - h. **<Insert manufacturer's exterior primer.>**
- 3. Exterior Wood Primer for Acrylic Enamels: Factory-formulated alkyd or latex wood primer for exterior application.
 - a. Benjamin Moore; Moorcraft Super Spec Alkyd Exterior Primer No. 176: Applied at a dry film thickness of not less than 1.8 mils.
 - b. Coronado; 8-11 Supreme Acrylic Bonding Primer: Applied at a dry film thickness of not less than 2.0 mils.
 - c. ICI Dulux Paints; 2000-1200 Dulux Professional Exterior 100 Percent Acrylic Latex Primer: Applied at a dry film thickness of not less than 1.6 mils.
 - d. Kelly-Moore; 255 Stain--Lock II Stain Resistant Acrylic Primer: Applied at a dry film thickness of not less than 2.0 mils.
 - e. M. A. B. Paint; Sea Shore/Four Seasons Latex Primer Coat 056-958: Applied at a dry film thickness of not less than 1.6 mils.
 - f. Pittsburgh Paints; 6-609 SpeedHide Exterior House & Trim Wood Primer 100 Percent Acrylic Latex: Applied at a dry film thickness of not less than 1.6 mils.
 - g. Sherwin-Williams; A-100 Exterior Latex Wood Primer B42W41: Applied at a dry film thickness of not less than 1.4 mils.
 - h. **<Insert manufacturer's exterior primer.>**
- 4. Exterior Wood Primer for Alkyd Enamels: Factory-formulated alkyd or latex wood primer for exterior application.
 - a. Benjamin Moore; Moorcraft Super Spec Alkyd Exterior Primer No.

- 176: Applied at a dry film thickness of not less than 1.8 mils.
 - b. Coronado; 5-11 Supreme Collection Oil House Paint Primer: Applied at a dry film thickness of not less than 2.2 mils.
 - c. ICI Dulux Paints; 2110-1200 Ultra-Hide Durus Exterior Alkyd Primecoat: Applied at a dry film thickness of not less than 1.9 mils.
 - d. Kelly-Moore; 220 Weather Shield Exterior Alkyd Primer: Applied at a dry film thickness of not less than 2.3 mils.
 - e. M. A. B. Paint; Sea Shore/Four Seasons Latex Primer Coat 056-958: Applied at a dry film thickness of not less than 1.5 mils.
 - f. Pittsburgh Paints; 6-609 SpeedHide Exterior House & Trim Wood Primer 100 Percent Acrylic Latex: Applied at a dry film thickness of not less than 1.6 mils.
 - g. Sherwin-Williams; A-100 Exterior Latex Wood Primer B42W42: Applied at a dry film thickness of not less than 1.4 mils.
 - h. **<Insert manufacturer's exterior primer.>**
5. Exterior Ferrous-Metal Primer: Factory-formulated rust-inhibitive metal primer for exterior application.
- a. Benjamin Moore; Moore's IMC Alkyd Metal Primer No. M06: Applied at a dry film thickness of not less than 2.0 mils.
 - b. Coronado; 35-147 Rust Scat Alkyd Metal Primer: Applied at a dry film thickness of not less than 2.0 mils.
 - c. ICI Dulux Paints; 4160-XXXX Devguard Multi-Purpose Tank & Structural Primer. Applied at a dry film thickness of not less than 2.0 mils.
 - d. Kelly-Moore; 1711 Kel-Guard Alkyd White Rust Inhibitive Primer: Applied at a dry film thickness of not less than 2.0 mils.
 - e. Kelly-Moore; 5725 DTM-Acrylic Metal Primer: Applied at a dry film thickness of not less than 1.8 mils.
 - f. M. A. B. Paint; Rust-O-Lastic Anti-Corrosive Primer 073-132: Applied at a dry film thickness of not less than 2.0 mils.
 - g. Pittsburgh Paints; 90-712 Pitt-Tech One Pack Interior/Exterior Primer Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 3.0 mils.
 - h. Sherwin-Williams; Kem Kromik Universal Metal Primer B50NZ6/B50WZ1: Applied at a dry film thickness of not less than 3.0 mils.
 - i. **<Insert manufacturer's exterior primer.>**
6. Exterior Galvanized Metal Primer: Factory-formulated galvanized metal primer for exterior application.
- a. Benjamin Moore; Moore's IMC Acrylic Metal Primer No. M04: Applied at a dry film thickness of not less than 2.0 mils.
 - b. Coronado; 36-11 Rust Scat Latex Metal Primer: Applied at a dry film thickness of not less than 1.4 mils.
 - c. ICI Dulux Paints; 4020-XXXX Devflex DTM Flat Interior/Exterior Waterborne Primer & Finish: Applied at a dry film thickness of not less than 2.2 mils.
 - d. ICI Dulux Paints; 4160-XXXX Devguard Multi-Purpose Tank &

- Structural Primer: Applied at a dry film thickness of not less than 2.0 mils.
- e. Kelly-Moore; 1722 Kel-Guard Acrylic Galvanized Iron Primer: Applied at a dry film thickness of not less than 1.8 mils.
 - f. Kelly-Moore; 5725 DTM-Acrylic Metal Primer: Applied at a dry film thickness of not less than 1.8 mils.
 - g. M. A. B. Paint; Rust-O-Lastic Hydro-Prime II Acrylic (DTM) Maintenance Primer 073-189: Applied at a dry film thickness of not less than 2.0 mils.
 - h. Pittsburgh Paints; 90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 3.0 mils.
 - i. Sherwin-Williams; primer not required over this substrate.
 - j. Sherwin-Williams; Galvite HS Paint B50WZ3: Applied at a dry film thickness of not less than 2.0 mils.
 - k. **<Insert manufacturer's exterior primer.>**
7. Exterior Aluminum Primer under Acrylic Finishes: Factory-formulated acrylic-based metal primer for exterior application.
- a. Benjamin Moore; Moore's IMC Acrylic Metal Primer No. M04: Applied at a dry film thickness of not less than 2.0 mils.
 - b. Coronado; 36-11 Rust Scat Latex Metal Primer: Applied at a dry film thickness of not less than 2.0 mils.
 - c. ICI Dulux Paints; 4020-XXXX Devflex DTM Flat Interior/Exterior Waterborne Primer & Finish: Applied at a dry film thickness of not less than 2.2 mils.
 - d. ICI Dulux Paints; 4160-XXXX Devguard Multi-Purpose Tank & Structural Primer: Applied at a dry film thickness of not less than 2.0 mils.
 - e. Kelly-Moore; 1722 Kel-Guard Acrylic Galvanized Iron Primer: Applied at a dry film thickness of not less than 1.8 mils.
 - f. Kelly-Moore; 5725 DTM-Acrylic Metal Primer: Applied at a dry film thickness of not less than 1.8 mils.
 - g. M. A. B. Paint; Rust-O-Lastic Hydro-Prime II Acrylic (DTM) Maintenance Primer 073-189: Applied at a dry film thickness of not less than 2.0 mils.
 - h. Pittsburgh Paints; 90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 3.0 mils.
 - i. Sherwin-Williams; primer not required over this substrate.
 - j. Sherwin-Williams; DTM Acrylic Primer/Finish B66W1: Applied at a dry film thickness of not less than 2.5 mils.
 - k. **<Insert manufacturer's exterior primer.>**
8. Exterior Aluminum Primer under Alkyd Finishes: Factory-formulated acrylic-based metal primer for exterior application.
- a. Benjamin Moore; Moore's IMC Acrylic Metal Primer No. M04: Applied at a dry film thickness of not less than 2.0 mils.
 - b. Coronado; 180-11 High Performance Acrylic Metal Primer: Applied

- at a dry film thickness of not less than 2.0 mils.
- c. ICI Dulux Paints; 4020-XXXX Devflex DTM Flat Interior/Exterior Waterborne Primer & Finish: Applied at a dry film thickness of not less than 2.2 mils.
 - d. Kelly-Moore; 1722 Kel-Guard Acrylic Galvanized Iron Primer: Applied at a dry film thickness of not less than 1.8 mils.
 - e. M. A. B. Paint; Rust-O-Lastic Hydro-Prime II Acrylic (DTM) Maintenance Primer 073-189: Applied at a dry film thickness of not less than 2.0 mils.
 - f. Pittsburgh Paints; 90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 3.0 mils.
 - g. Sherwin-Williams; DTM Wash Primer B71Y1: Applied at a dry film thickness of not less than 2.5 mils.
 - h. **<Insert manufacturer's exterior primer.>**

E. EXTERIOR FINISH COATS

- 1. Exterior Flat Acrylic Paint: Factory-formulated flat acrylic-emulsion latex paint for exterior application.
 - a. Benjamin Moore; Moorcraft Super Spec Flat Latex House Paint No. 171: Applied at a dry film thickness of not less than 1.2 mils.
 - b. Coronado; 8-Line Supreme Acrylic Latex Flat: Applied at a dry film thickness of not less than 1.3 mils.
 - c. ICI Dulux Paints; 2200-XXXX Dulux Professional Exterior 100 Percent Acrylic Flat Finish: Applied at a dry film thickness of not less than 1.4 mils.
 - d. Kelly-Moore; 1205 Color Shield Exterior Flat Acrylic House Paint: Applied at a dry film thickness of not less than 1.9 mils.
 - e. M. A. B. Paint; Fresh Kote Latex House Paint 409 Line: Applied at a dry film thickness of not less than 1.7 mils.
 - f. Pittsburgh Paints; 6-600 Series SpeedHide Exterior House Paint Flat Latex: Applied at a dry film thickness of not less than 1.3 mils.
 - g. Sherwin-Williams; A-100 Exterior Latex Flat House & Trim Paint A6 Series: Applied at a dry film thickness of not less than 1.3 mils.
 - h. **<Insert manufacturer's comparable exterior finish-coat material.>**
- 2. Exterior Low-Luster Acrylic Paint: Factory-formulated low-sheen (eggshell) acrylic-latex paint for exterior application.
 - a. Benjamin Moore; Moorcraft Super Spec Low Lustre Latex House Paint No. 185: Applied at a dry film thickness of not less than 1.0 mil.
 - b. Coronado; 408-Line Supreme Acrylic Satin Exterior: Applied at a dry film thickness of not less than 1.3 mils.
 - c. ICI Dulux Paints; 2402-XXXX Dulux Professional Exterior 100 Percent Acrylic Satin Finish: Applied at a dry film thickness of not less than 1.4 mils.
 - d. Kelly-Moore; 1245 Acry-Velvet Exterior Low Sheen Acrylic Finish:

- Applied at a dry film thickness of not less than 1.8 mils.
 - e. M. A. B. Paint; Fresh Kote Latex Eggshell 405 Line: Applied at a dry film thickness of not less than 1.5 mils.
 - f. Pittsburgh Paints; 6-2000 Series SpeedHide Exterior House & Trim Satin--Acrylic Latex: Applied at a dry film thickness of not less than 1.0 mil.
 - g. Pittsburgh Paints; 90-400 Series Pitt-Tech One Pack High Performance Waterborne Satin DTM Industrial Enamels: Applied at a dry film thickness of not less than 3.0 mils.
 - h. Sherwin-Williams; A-100 Exterior Latex Satin House & Trim Paint A82 Series: Applied at a dry film thickness of not less than 1.5 mils.
 - i. **<Insert manufacturer's comparable exterior finish-coat material.>**
- 3. Exterior Semigloss Acrylic Enamel: Factory-formulated semigloss waterborne acrylic-latex enamel for exterior application.
 - a. Benjamin Moore; Moorcraft Super Spec Latex House & Trim Paint No. 170: Applied at a dry film thickness of not less than 1.1 mils.
 - b. Coronado; 12-Line Supreme Acrylic Semi-Gloss: Applied at a dry film thickness of not less than 1.5 mils.
 - c. ICI Dulux Paints; 2406-XXXX Dulux Professional Exterior 100 Percent Acrylic Semi-Gloss Finish: Applied at a dry film thickness of not less than 1.3 mils.
 - d. Kelly-Moore; 1250 Acry-Lustre Exterior Semi-Gloss Acrylic Finish: Applied at a dry film thickness of not less than 1.6 mils.
 - e. M. A. B. Paint; Sea Shore/Four Seasons Acrylic Latex Trim Enamel 024 Line: Applied at a dry film thickness of not less than 1.5 mils.
 - f. Pittsburgh Paints; 6-900 Series SpeedHide Exterior House & Trim Semi-Gloss Acrylic Latex Paint: Applied at a dry film thickness of not less than 1.5 mils.
 - g. Sherwin-Williams; A-100 Latex Gloss A8 Series: Applied at a dry film thickness of not less than 1.3 mils.
 - h. **<Insert manufacturer's comparable exterior finish-coat material.>**
- 4. Exterior Full-Gloss Acrylic Enamel for Concrete, Masonry, and Wood: Factory-formulated full-gloss waterborne acrylic-latex enamel for exterior application.
 - a. Benjamin Moore; Moore's IMC Acrylic Gloss Enamel M28: Applied at a dry film thickness of not less than 2.0 mils.
 - b. Coronado; 414 Super Kote 5000 Acrylic Gloss Enamel: Applied at a dry film thickness of not less than 1.5 mils.
 - c. ICI Dulux Paints; 3028-XXXX Dulux Interior/Exterior Acrylic Gloss Finish: Applied at a dry film thickness of not less than 1.6 mils.
 - d. Kelly-Moore; 1780 Kel-Guard Acrylic Gloss Enamel: Applied at a dry film thickness of not less than 1.5 mils.
 - e. M. A. B. Paint; Rust-O-Lastic Gloss Acrylic (DTM) Maintenance Finish 043 Line: Applied at a dry film thickness of not less than 1.6 mils.

- f. Pittsburgh Paints; 90 Line Pitt-Tech One Pack Interior/Exterior High Performance Waterborne High Gloss DTM Industrial Enamels: Applied at a dry film thickness of not less than 3.0 mils.
 - g. Sherwin-Williams; DTM Acrylic Coating Gloss (Waterborne) B66W100 Series: Applied at a dry film thickness of not less than 2.4 mils.
 - h. Sherwin-Williams; SuperPaint Exterior High Gloss Latex Enamel A85 Series: Applied at a dry film thickness of not less than 1.2 mils.
 - i. **<Insert manufacturer's comparable exterior finish-coat material.>**
5. Exterior Full-Gloss Acrylic Enamel for Ferrous and Other Metals: Factory-formulated full-gloss waterborne acrylic-latex enamel for exterior application.
- a. Benjamin Moore; Moore's IMC Acrylic Gloss Enamel M28: Applied at a dry film thickness of not less than 2.0 mils.
 - b. Coronado; 80 Line Rust Scat Acrylic Latex High Gloss Enamel: Applied at a dry film thickness of not less than 1.4 mils.
 - c. ICI Dulux Paints; 3028-XXXX Dulux Interior/Exterior Acrylic Gloss Finish: Applied at a dry film thickness of not less than 1.6 mils.
 - d. Kelly-Moore; 5780 DTM Acrylic Gloss Enamel: Applied at a dry film thickness of not less than 1.7 mils.
 - e. M. A. B. Paint; Rust-O-Lastic Gloss Acrylic (DTM) Maintenance Finish 043 Line: Applied at a dry film thickness of not less than 3.0 mils.
 - f. Pittsburgh Paints; 90-300 Series Pitt-Tech One Pack Interior/Exterior High Performance Waterborne High Gloss DTM Industrial Enamels: Applied at a dry film thickness of not less than 3.0 mils.
 - g. Sherwin-Williams; DTM Acrylic Coating Gloss (Waterborne) B66W100 Series: Applied at a dry film thickness of not less than 2.4 mils.
 - h. **<Insert manufacturer's comparable exterior finish-coat material.>**
6. Exterior Full-Gloss Alkyd Enamel: Factory-formulated full-gloss alkyd enamel for exterior application.
- a. Benjamin Moore; Moore's IMC Urethane Alkyd Enamel M22: Applied at a dry film thickness of not less than 2.0 mils.
 - b. Coronado; 1223 Line Super Kote 5000 High Gloss Alkyd Enamel: Applied at a dry film thickness of not less than 1.5 mils.
 - c. ICI Dulux Paints; 4308-XXXX Devguard Alkyd Industrial Gloss Enamel: Applied at a dry film thickness of not less than 2.0 mils.
 - d. Kelly-Moore; 1700 Kel-Guard Gloss Alkyd Rust Inhibitive Enamel: Applied at a dry film thickness of not less than 2.0 mils.
 - e. M. A. B. Paint; Rust-O-Lastic Finish Coating 074 Line: Applied at a dry film thickness of not less than 2.0 mils.
 - f. Pittsburgh Paints; 7-814 Pittsburgh Paints Industrial Gloss-Oil Interior/Exterior Enamel: Applied at a dry film thickness of not less

- than 1.5 mils.
- g. Sherwin-Williams; Industrial Enamel B-54 Series: Applied at a dry film thickness of not less than 2.0 mils.
- h. **<Insert manufacturer's comparable exterior finish-coat material.>**

PART 3 - EXECUTION

A. EXAMINATION

1. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application. Comply with procedures specified in PDCA P4.
 - a. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 - b. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
2. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - a. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

B. PREPARATION

1. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
 - a. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
2. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
 - a. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
3. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

- a. Provide barrier coats over incompatible primers or remove and reprime.
- b. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - 1) Use abrasive blast-cleaning methods if recommended by paint manufacturer.
 - 2) Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
 - 3) Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.
- c. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
 - 1) Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - 2) Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
 - 3) If transparent finish is required, backprime with spar varnish.
 - 4) Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.
 - 5) Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
- d. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
 - 1) Blast steel surfaces clean as recommended by paint system manufacturer and according to **[SSPC-SP 6/NACE No. 3]** **[SSPC-SP 10/NACE No. 2]**.
 - 2) Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.

- 3) Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
 - e. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
 4. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
 - a. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 - b. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 - c. Use only thinners approved by paint manufacturer and only within recommended limits.
 5. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

C. APPLICATION

1. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
 - a. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
 - b. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 - c. Provide finish coats that are compatible with primers used.
 - d. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convactor covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 - e. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - f. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 - g. Paint back sides of access panels and removable or hinged covers

- to match exposed surfaces.
 - h. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 - i. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
 - j. Sand lightly between each succeeding enamel or varnish coat.
- 2. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
 - a. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 - b. Omit primer over metal surfaces that have been shop primed and touchup painted.
 - c. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 - d. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- 3. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
 - a. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 - b. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 - c. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- 4. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- 5. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
- 6. Mechanical items to be painted include, but are not limited to, the following:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.

- c. Pipe hangers and supports.
 - d. Tanks that do not have factory-applied final finishes.
 - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - f. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
 - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 - h. **<Insert mechanical items to be painted.>**
7. Electrical items to be painted include, but are not limited to, the following:
- a. Switchgear.
 - b. Panelboards.
 - c. Electrical equipment that is indicated to have a factory-primed finish for field painting.
 - d. **<Insert electrical items to be painted.>**
8. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
9. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
10. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
11. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
- a. Provide satin finish for final coats.
12. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
13. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

D. FIELD QUALITY CONTROL

1. Owner reserves the right to invoke the following test procedure at any time and as often as Owner deems necessary during the period when paint is being applied:
- a. Owner will engage a qualified independent testing agency to sample

paint material being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.

- b. Testing agency will perform appropriate tests for the following characteristics as required by Owner:
 - 1) **<Insert salient characteristics.>**
- c. Owner may direct Contractor to stop painting if test results show material being used does not comply with specified requirements. Contractor shall remove noncomplying paint from Project site, pay for testing, and repaint surfaces previously coated with the noncomplying paint. If necessary, Contractor may be required to remove noncomplying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

E. CLEANING

1. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
 - a. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

F. PROTECTION

1. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
2. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
 - a. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

G. EXTERIOR PAINT SCHEDULE

1. Concrete, Stucco, and Masonry (Other Than Concrete Unit Masonry): Provide the following finish systems over exterior concrete, stucco, and brick masonry substrates:
 - a. Flat Acrylic Finish: [**One finish coat**] [**Two finish coats**] [**<Insert number> finish coats**] over a primer.
 - 1) Primer: Exterior concrete and masonry primer.
 - 2) Finish Coats: Exterior flat acrylic paint.
 - b. Low-Luster Acrylic Finish: [**One finish coat**] [**Two finish coats**]

- [<Insert number> finish coats] over a primer.
- 1) Primer: Exterior concrete and masonry primer.
 - 2) Finish Coats: Exterior low-luster acrylic paint.
- c. Semigloss Acrylic-Enamel Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a primer.
- 1) Primer: Exterior concrete and masonry primer.
 - 2) Finish Coats: Exterior semigloss acrylic enamel.
- d. Full-Gloss Acrylic-Enamel Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a primer.
- 1) Primer: Exterior concrete and masonry primer.
 - 2) Finish Coats: Exterior full-gloss acrylic enamel for concrete, masonry, and wood.
2. Concrete Unit Masonry: Provide the following finish systems over exterior concrete unit masonry:
- a. Flat Acrylic Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a block filler.
 - 1) Block Filler: Concrete unit masonry block filler.
 - 2) Finish Coats: Exterior flat acrylic paint. - b. Low-Luster Acrylic Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a block filler.
 - 1) Block Filler: Concrete unit masonry block filler.
 - 2) Finish Coats: Exterior low-luster acrylic paint. - c. Semigloss Acrylic-Enamel Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a block filler.
 - 1) Block Filler: Concrete unit masonry block filler.
 - 2) Finish Coats: Exterior semigloss acrylic enamel. - d. Full-Gloss Acrylic-Enamel Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a block filler.
 - 1) Block Filler: Concrete unit masonry block filler.
 - 2) Finish Coats: Exterior full-gloss acrylic enamel for concrete, masonry, and wood.
3. Mineral-Fiber-Reinforced Cement Panels: Provide the following finish systems over exterior, mineral-fiber-reinforced cement panels:
- a. Flat Acrylic Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a primer.

- 1) Primer: Exterior concrete and masonry primer.
 - 2) Finish Coats: Exterior flat acrylic paint.
4. Exterior Gypsum Soffit Board: Provide the following finish systems over exterior gypsum soffit board:
- a. Flat Acrylic Finish: [**One finish coat**] [**Two finish coats**] [**<Insert number> finish coats**] over an exterior alkyd- or alkali-resistant primer.
 - 1) Primer: Exterior gypsum soffit board primer.
 - 2) Finish Coats: Exterior flat acrylic paint.
 - b. Low-Luster Acrylic Finish: [**One finish coat**] [**Two finish coats**] [**<Insert number> finish coats**] over a primer.
 - 1) Primer: Exterior gypsum soffit board primer.
 - 2) Finish Coats: Exterior low-luster acrylic paint.
 - c. Semigloss Acrylic-Enamel Finish: [**One finish coat**] [**Two finish coats**] [**<Insert number> finish coats**] over a primer.
 - 1) Primer: Exterior gypsum soffit board primer.
 - 2) Finish Coats: Exterior semigloss acrylic enamel.
 - d. Full-Gloss Acrylic-Enamel Finish: [**One finish coat**] [**Two finish coats**] [**<Insert number> finish coats**] over a primer.
 - 1) Primer: Exterior gypsum soffit board primer.
 - 2) Finish Coats: Exterior full-gloss acrylic enamel for concrete, masonry, and wood.
5. Smooth Wood: Provide the following finish systems over smooth wood siding, wood trim, and other smooth exterior wood surfaces:
- a. Flat Acrylic Finish: [**One finish coat**] [**Two finish coats**] [**<Insert number> finish coats**] over a primer.
 - 1) Primer: Exterior wood primer for acrylic enamels.
 - 2) Finish Coats: Exterior flat acrylic paint.
 - b. Low-Luster Acrylic Finish: [**One finish coat**] [**Two finish coats**] [**<Insert number> finish coats**] over a primer.
 - 1) Primer: Exterior wood primer for acrylic enamels.
 - 2) Finish Coats: Exterior low-luster acrylic paint.
 - c. Semigloss Acrylic-Enamel Finish: [**One finish coat**] [**Two finish coats**] [**<Insert number> finish coats**] over a primer.
 - 1) Primer: Exterior wood primer for acrylic enamels.
 - 2) Finish Coats: Exterior semigloss acrylic enamel.

- d. Full-Gloss Acrylic-Enamel Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a primer.
 - 1) Primer: Exterior wood primer for acrylic enamels.
 - 2) Finish Coats: Exterior full-gloss acrylic enamel for concrete, masonry, and wood.
 - e. Full-Gloss Alkyd-Enamel Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a primer.
 - 1) Primer: Exterior wood primer for alkyd enamels.
 - 2) Finish Coats: Exterior full-gloss alkyd enamel.
6. Wood Trim: Provide the following finish systems over exterior wood trim:
- a. Semigloss Acrylic-Enamel Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a primer.
 - 1) Primer: Exterior wood primer for acrylic enamels.
 - 2) Finish Coats: Exterior semigloss acrylic enamel.
 - b. Full-Gloss Acrylic-Enamel Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a primer.
 - 1) Primer: Exterior wood primer for acrylic enamels.
 - 2) Finish Coats: Exterior full-gloss acrylic enamel for concrete, masonry, and wood.
 - c. Full-Gloss Alkyd-Enamel Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a primer.
 - 1) Primer: Exterior wood trim primer for full-gloss alkyd enamels.
 - 2) Finish Coats: Exterior full-gloss alkyd enamel.
7. Plywood: Provide the following finish systems over exterior plywood:
- a. Flat Acrylic Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a primer.
 - 1) Primer: Exterior wood primer for acrylic enamels.
 - 2) Finish Coats: Exterior flat acrylic paint.
 - b. Low-Luster Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a primer.
 - 1) Primer: Exterior wood primer for acrylic enamels.
 - 2) Finish Coats: Exterior low-luster acrylic paint.
8. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
- a. Low-Luster Acrylic Finish: **[One finish coat] [Two finish coats]**

- [<Insert number> finish coats] over a rust-inhibitive primer.
- 1) Primer: Exterior ferrous-metal primer.
 - 2) Finish Coat: Exterior low-luster acrylic paint.
- b. Semigloss Acrylic-Enamel Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a rust-inhibitive primer.
- 1) Primer: Exterior ferrous-metal primer.
 - 2) Finish Coats: Exterior semigloss acrylic enamel.
- c. Full-Gloss Acrylic-Enamel Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a rust-inhibitive primer.
- 1) Primer: Exterior ferrous-metal primer.
 - 2) Finish Coats: Exterior full-gloss acrylic enamel for ferrous and other metals.
- d. Full-Gloss Alkyd-Enamel Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a rust-inhibitive primer.
- 1) Primer: Exterior ferrous-metal primer.
 - 2) Finish Coats: Exterior full-gloss alkyd enamel.
9. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated metal surfaces:
- a. Low-Luster Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a galvanized metal primer.
 - 1) Primer: Exterior galvanized metal primer.
 - 2) Finish Coat: Exterior low-luster acrylic paint. - b. Semigloss Acrylic-Enamel Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a galvanized metal primer.
 - 1) Primer: Exterior galvanized metal primer.
 - 2) Finish Coats: Exterior semigloss acrylic enamel. - c. Full-Gloss Acrylic-Enamel Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a galvanized metal primer.
 - 1) Primer: Exterior galvanized metal primer.
 - 2) Finish Coats: Exterior full-gloss acrylic enamel for ferrous and other metals. - d. Full-Gloss Alkyd-Enamel Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a galvanized metal primer.

- 1) Primer: Exterior galvanized metal primer.
 - 2) Finish Coats: Exterior full-gloss alkyd enamel.
10. Aluminum: Provide the following finish systems over exterior aluminum surfaces:
- a. Semigloss Acrylic-Enamel Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a primer.
 - 1) Primer: Exterior aluminum primer under acrylic finishes.
 - 2) Finish Coats: Exterior semigloss acrylic enamel.
 - b. Full-Gloss Acrylic-Enamel Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a primer.
 - 1) Primer: Exterior aluminum primer under acrylic finishes.
 - 2) Finish Coats: Exterior full-gloss acrylic enamel for ferrous and other metals.
 - c. Full-Gloss Alkyd-Enamel Finish: **[One finish coat] [Two finish coats] [<Insert number> finish coats]** over a primer.
 - 1) Primer: Exterior aluminum primer under alkyd finishes.
 - 2) Finish Coats: Exterior full-gloss alkyd enamel.

PART 4 - MEASUREMENT

A. METHOD OF MEASUREMENT

1. No separate measurement will be made for work under this Section.

PART 5 - PAYMENT

A. METHOD OF PAYMENT

1. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the lump sum contract price.

END OF SECTION 09912

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on **[interior substrates.] [the following interior substrates:]**

1. Concrete.
2. Clay masonry.
3. Concrete masonry units (CMU).
4. Steel.
5. Cast iron.
6. Galvanized metal.
7. Aluminum (not anodized or otherwise coated).
8. Wood.
9. Gypsum board.
10. Plaster.
11. Spray-textured ceilings.
12. Cotton or canvas insulation covering.
13. ASJ insulation covering.

- B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.
2. Section 099600 "High-Performance Coatings" for high-performance and special-use coatings.
3. Section 099113 "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.
4. Section 099300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.
5. Section 099419 "Multicolor Interior Finishing" for speckled finishes on interior surfaces.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Data for Credit EQ 4.2: For paints and coatings, including printed statement of VOC content.
 - a. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 - b. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
 - 2. Laboratory Test Reports for Credit EQ 4: For paints and coatings, documentation indicating that they meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - 3. Interior Paints: Manufacturer's product data and material safety data sheets (MSDS) for paints and coatings used on the interior of the building including printed statement of VOC content in g/L.
- C. Samples for Initial Selection: For each type of topcoat product.

- D. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
1. Submit Samples on rigid backing, **8 inches** (200 mm) square.
 2. Step coats on Samples to show each coat required for system.
 3. Label each coat of each Sample.
 4. Label each Sample for location and application area.
 5. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
 6. Resubmit until required sheen, color, and texture are achieved.
 7. Submit **<Insert number>** samples on the following substrates for DEN Project Manager's review of color and texture only:
 - a. Concrete: **[4-inch- square] [4-by-6-inch] <Insert size and shape>** Samples for each color and finish.
 - b. Concrete Unit Masonry: **[4-by-8-inch] [6-by-10-inch] <Insert size>** Samples of masonry, with mortar joint in the center, for each finish and color.
 - c. Painted Wood: **[8-inch-] [12-inch-] <Insert size>** square Samples for each color and material on hardboard.
 - d. Ferrous Metal: **[3-inch-] [4-inch-] <Insert size>** square Samples of flat metal and **[6-inch-] [8-inch-] <Insert size>** long Samples of solid metal for each color and finish.
- E. Product List: For each product indicated, include the following:
1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
 3. VOC content.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials[, **from the same product run,**] that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Paint: **[5] <Insert number>** percent, but not less than **[1 gal. (3.8 L)] <Insert number>** of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. DEN Project Manager will select one surface to represent surfaces and

conditions for application of each paint system specified in Part 3.

- a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: DEN Project Manager will designate items or areas required.
2. Final approval of color selections will be based on mockups.
- a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by DEN Project Manager at no added cost to Owner.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
1. Product name or title of material.
 2. Product description (generic classification or binder type).
 3. Manufacturer's stock number and date of manufacture.
 4. Contents by volume, for pigment and vehicle constituents.
 5. Thinning instructions.
 6. Application instructions.
 7. Color name and number.
 8. VOC content.
- B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 90 deg F (10 and 33 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.9 EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner, and store in location as determined by DEN Project Manager.
1. Quantity: Furnish Owner with extra paint materials in quantities indicated below:
 - a. Interior, Flat Acrylic Paint: [1 gal.] [2 gal.] [5 gal.] <Insert other number> of each color applied.
 - b. Interior, Low-Luster Acrylic Finish: [1 gal.] [2 gal.] [5 gal.] <Insert other number> of each color applied.
 - c. Interior, Semigloss Acrylic Enamel: [1 gal.] [2 gal.] [5 gal.] <Insert other number> of each color applied.
 - d. Interior, Full-Gloss Alkyd Enamel: [1 gal.] [2 gal.] [5 gal.] <Insert other number> of each color required.
 - e. <Insert other type and quantity>.
 2. Quantity: Furnish Owner with an additional [3] [5] [7] <Insert percent> percent, but not less than [1] <Insert number> gal., as appropriate, of each material and color applied.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
1. Benjamin Moore & Co.
 2. ICI Dulux Paints.
 3. Kelly-Moore Paints.
 4. M.A.B. Paints.
 5. PPG Architectural Finishes, Inc.
 6. Sherwin-Williams Company (The).
 7. Sico, Inc.
 8. <Insert manufacturer's name>.
 9. or approved equal.
- B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles for the paint category indicated, or equal approved by DEN

Project Manager.

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction[**and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24)**].
1. Flat Paints and Coatings: 50 g/L.
 2. Nonflat Paints and Coatings: 150 g/L.
 3. Dry-Fog Coatings: 400 g/L.
 4. Primers, Sealers, and Undercoaters: 200 g/L.
 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 7. Pretreatment Wash Primers: 420 g/L.
 8. Floor Coatings: 100 g/L.
 9. Shellacs, Clear: 730 g/L.
 10. Shellacs, Pigmented: 550 g/L.
- D. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Colors: [**As selected by DEN Project Manager from manufacturer's full range**] [**Match DEN Project Manager's samples**] [**As indicated in a color schedule**] <Insert requirements>.
1. [**10**] [**20**] [**30**] <Insert number> percent of surface area will be painted with deep tones.

2.3 BLOCK FILLERS

- A. Block Filler, Latex, Interior/Exterior:[**MPI #4.**]
1. Benjamin Moore; Moorcraft Super Craft Latex Block Filler No. 285: Applied at a dry film thickness of not less than 8.1 mils.

2. Benjamin Moore; Moore's IMC Latex Block Filler No. M88: Applied at a dry film thickness of not less than 8.1 mils.
3. ICI Dulux Paints; Bloxfil 4000-1000 Interior/Exterior Heavy Duty Acrylic Block Filler: Applied at a dry film thickness of not less than 7.0 to 14.5 mils.
4. Kelly-Moore; 521 Fill and Prime Acrylic Block Filler: Applied at a dry film thickness of not less than 10.0 mils.
5. M. A. B. Paint; Block Kote No. 1000 Acrylic Latex Block Filler 064-145: Applied at a dry film thickness of not less than 12.0 mils.
6. Pittsburgh Paints; 6-7 SpeedHide Interior/Exterior Masonry Latex Block Filler: Applied at a dry film thickness of not less than 6.0 to 12.5 mils.
7. Sherwin-Williams; PrepRite Interior/Exterior Block Filler B25W25: Applied at a dry film thickness of not less than 8.0 mils.
8. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
9. or approved equal.

2.4 PRIMERS/SEALERS

A. Primer Sealer, Latex, Interior:[**MPI #50.**]

1. Benjamin Moore; Moorcraft Super Spec Latex Enamel Undercoater & Primer Sealer No. 253: Applied at a dry film thickness of not less than 1.2 mils.
2. ICI Dulux Paints; 1000-1200 Dulux Ultra Basecoat Interior Latex Wall Primer: Applied at a dry film thickness of not less than 1.2 mils.
3. ICI Dulux Paints; 1030-1200 Ultra-Hide PVA Interior Primer Sealer General Purpose Wall Primer: Applied at a dry film thickness of not less than 1.9 mils.
4. Kelly-Moore; 971 Acry-Prime Interior Latex Primer/Sealer: Applied at a dry film thickness of not less than 1.6 mils.
5. M. A. B. Paint; Fresh Kote Vinyl Primer 037-100: Applied at a dry film thickness of not less than 1.5 mils.
6. Pittsburgh Paints; 6-2 SpeedHide Interior Quick-Drying Latex Sealer: Applied at a dry film thickness of not less than 1.0 mil.
7. Sherwin-Williams; PrepRite 200 Latex Wall Primer B28W200 Series: Applied at a dry film thickness of not less than 1.6 mils.
8. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
9. or approved equal.

B. Primer, Alkali Resistant, Water Based, for Concrete and Masonry:[**MPI #3.**]

1. Benjamin Moore; Moorcraft Super Spec Latex Enamel Undercoater & Primer Sealer No. 253: Applied at a dry film thickness of not less than 1.2 mils.
2. ICI Dulux Paints; 3030-1200 Bond-Prep Interior/Exterior Waterborne Pigmented Bonding Primer: Applied at a dry film thickness of not less than 1.8 mils.
3. Kelly-Moore; 971 Acry-Prime Interior Latex Primer/Sealer: Applied at a dry film thickness of not less than 1.6 mils.
4. M. A. B. Paint; Fresh Kote Vinyl Primer 037-100: Applied at a dry film thickness of not less than 1.5 mils.
5. Pittsburgh Paints; 6-2 SpeedHide Interior Quick-Drying Latex Sealer: Applied at a

- dry film thickness of not less than 1.0 mil.
6. Sherwin-Williams; PrepRite Masonry Primer B28W300: Applied at a dry film thickness of not less than 3.0 mils.
 7. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 8. or approved equal.
- C. Primer Sealer, Interior, Institutional Low Odor/VOC:[**MPI #149.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
- D. Primer, Latex, for Interior Wood:[**MPI #39.**]
1. Benjamin Moore; Moorcraft Super Spec Alkyd Enamel Underbody and Primer Sealer No. 245: Applied at a dry film thickness of not less than 1.5 mils.
 2. ICI Dulux Paints; 3210-1200 Ultra-Hide Aquacrylic GRIPPER Stain Killer Primer Sealer: Applied at a dry film thickness of not less than 1.8 mils.
 3. Kelly-Moore; 975 Acry Plex Interior Latex Enamel Undercoat: Applied at a dry film thickness of not less than 1.6 mils.
 4. M. A. B. Paint; Rich Lux Latex Undercoat 037-154: Applied at a dry film thickness of not less than 1.5 mils.
 5. Pittsburgh Paints; 6-855 SpeedHide Latex Enamel Undercoater: Applied at a dry film thickness of not less than 1.0 mil.
 6. Sherwin-Williams; PrepRite Wall and Wood Primer B49W200 Series: Applied at a dry film thickness of not less than 1.6 mils.
 7. Sherwin-Williams; PrepRite Classic Interior Primer B28W101 Series: Applied at a dry film thickness of not less than 1.6 mils.
 8. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
 9. or approved equal.
- E. Primer Sealer, Alkyd, Interior:[**MPI #45.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
- F. Primer, Bonding, Water Based:[**MPI #17.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
- G. Primer, Bonding, Solvent Based:[**MPI #69.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.
- H. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

2.5 METAL PRIMERS

A. Primer, Rust-Inhibitive, Water Based:[**MPI #107.**]

1. Benjamin Moore; Moore's IMC Alkyd Metal Primer No. M06: Applied at a dry film thickness of not less than 2.0 mils.
2. ICI Dulux Paints; 4130-6130 Devshield Rust Penetrating Metal Primer: Applied at a dry film thickness of not less than 2.2 mils.
3. ICI Dulux Paints; 4160-6130 Devguard Multi-Purpose Tank & Structural Primer: Applied at a dry film thickness of not less than 2.0 mils.
4. Kelly-Moore; 1711 Kel-Guard Alkyd White Rust Inhibitive Primer: Applied at a dry film thickness of not less than 2.0 mils.
5. M. A. B. Paint; Rust-O-Lastic Anti-Corrosive Primer 073-132: Applied at a dry film thickness of not less than 2.0 mils.
6. Pittsburgh Paints; 90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 1.5 mils.
7. Sherwin-Williams; Kem Kromik Universal Metal Primer B50NZ6/B50WZ1: Applied at a dry film thickness of not less than 3.0 mils.
8. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
9. or approved equal.

B. Primer, Alkyd, Anti-Corrosive, for Metal:[**MPI #79.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

C. Primer, Alkyd, Quick Dry, for Metal:[**MPI #76.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

D. Primer, Galvanized, Water Based:[**MPI #134.**]

1. Benjamin Moore; Moore's IMC Acrylic Metal Primer No. M04: Applied at a dry film thickness of not less than 2.0 mils.
2. ICI Dulux Paints; 4160-6130 Devguard Multi-Purpose Tank & Structural Primer: Applied at a dry film thickness of not less than 2.0 mils.
3. Kelly-Moore; 1722 Kel-Guard Acrylic Galvanized Iron Primer: Applied at a dry film thickness of not less than 1.8 mils.
4. M. A. B. Paint; Rust-O-Lastic Hydro-Prime II Acrylic (DTM) Maintenance Primer 073-189: Applied at a dry film thickness of not less than 2.0 mils.
5. Pittsburgh Paints; 90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 3.0 mils.
6. Sherwin-Williams; primer not required over this substrate.
7. Sherwin-Williams; Galvite HS B50WZ30: Applied at a dry film thickness of not

- less than 3.0 mils.
8. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
 9. or approved equal.

E. Primer, Vinyl Wash:[**MPI #80.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

F. Primer, Quick Dry, for Aluminum:[**MPI #95.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

2.6 WATER-BASED PAINTS

A. Latex, Interior, Flat, (Gloss Level 1):[**MPI #53.**]

1. Benjamin Moore; Moorecraft Super Spec Latex Flat No. 275: Applied at a dry film thickness of not less than 1.2 mils.
2. ICI Dulux Paints; 1200-XXXX Dulux Professional Velvet Matte Interior Flat Latex Wall & Trim Finish: Applied at a dry film thickness of not less than 1.4 mils.
3. Kelly-Moore; 450 Pro-Wall Interior Flat Latex Wall Paint: Applied at a dry film thick-ness of not less than 1.8 mils.
4. M. A. B. Paint; Fresh Kote Latex Flat 402 Line: Applied at a dry film thickness of not less than 1.5 mils.
5. Pittsburgh Paints; 6-70 Line SpeedHide Interior Wall Flat-Latex Paint: Applied at a dry film thickness of not less than 1.0 mil.
6. Sherwin-Williams; ProMar 200 Interior Latex Flat Wall Paint B30W200 Series: Applied at a dry film thickness of not less than 1.4 mils.
7. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
8. or approved equal.

B. Latex, Interior, Eggshell, (Gloss Level 2):[**MPI #44.**]

1. Benjamin Moore; Moorcraft Super Spec Latex Eggshell Enamel No. 274: Applied at a dry film thickness of not less than 1.3 mils.
2. ICI Dulux Paints; 1402-XXXX Dulux Professional Acrylic Eggshell Interior Wall & Trim Enamel: Applied at a dry film thickness of not less than 1.4 mils.
3. Kelly-Moore; 1610 Sat-N-Sheen Interior Latex Low Sheen Wall and Trim Finish: Ap-plied at a dry film thickness of not less than 1.6 mils.
4. Kelly-Moore; 1686 Dura-Poxy Eggshell Acrylic Enamel: Applied at a dry film thick-ness of not less than 1.6 mils.
5. M. A. B. Paint; Fresh Kote Latex Satin Eggshell Enamel 405 Line: Applied at a dry film thickness of not less than 1.5 mils.
6. Pittsburgh Paints; 6-400 Series SpeedHide Eggshell Acrylic Latex Enamel: Applied at a dry film thickness of not less than 1.25 mils.

7. Sherwin-Williams; ProMar 200 Interior Latex Egg-Shell Enamel B20W200 Series: Applied at a dry film thickness of not less than 1.6 mils.
 8. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
 9. or approved equal.
- C. Latex, Interior, (Gloss Level 3):[**MPI #52.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
- D. Latex, Interior, (Gloss Level 4):[**MPI #43.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
- E. Latex, Interior, Semi-Gloss, (Gloss Level 5):[**MPI #54.**]
1. Benjamin Moore; Moorcraft Super Spec Latex Semi-Gloss Enamel No. 276: Applied at a dry film thickness of not less than 1.2 mils.
 2. ICI Dulux Paints; 1406-XXXX Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel: Applied at a dry film thickness of not less than 1.5 mils.
 3. Kelly-Moore; 1649 Acrylic-Latex Semi-Gloss Enamel: Applied at a dry film thickness of not less than 1.7 mils.
 4. Kelly-Moore; 1685 Dura-Poxy Semi-Gloss Acrylic Enamel: Applied at a dry film thick-ness of not less than 1.5 mils.
 5. M. A. B. Paint; Fresh Kote Latex Semi-Gloss 410 Line: Applied at a dry film thickness of not less than 1.5 mils.
 6. Pittsburgh Paints; 6-500 Series SpeedHide Interior Semi-Gloss Latex: Applied at a dry film thickness of not less than 1.0 mil.
 7. Sherwin-Williams; ProMar 200 Interior Latex Semi-Gloss Enamel B31W200 Series: Applied at a dry film thickness of not less than 1.3 mils.
 8. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
 9. or approved equal.
- F. Latex, Interior, Gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees):[**MPI #114.**]
1. Benjamin Moore; Moore's IMC Acrylic Gloss Enamel No. M28: Applied at a dry film thickness of not less than 2.0 mils.
 2. ICI Dulux Paints; 3028-XXXX Dulux Interior/Exterior Acrylic Gloss Finish: Applied at a dry film thickness of not less than 1.6 mils.
 3. Kelly-Moore; 1680 Dura-Poxy Gloss Acrylic Enamel: Applied at a dry film thickness of not less than 1.6 mils.
 4. M. A. B. Paint; Rich Lux Architectural High Gloss Latex Enamel 022-127 Line: Applied at a dry film thickness of not less than 1.5 mils.
 5. Pittsburgh Paints; 6-8534 SpeedHide Interior Latex 100 Percent Acrylic Gloss Enamels: Applied at a dry film thickness of not less than 1.0 mil.
 6. Pittsburgh Paints; 90-374 Pitt-Tech One Pack Interior/Exterior High Performance

- Waterborne High Gloss DTM Industrial Enamel (recommended for ferrous and zinc-coated metal): Applied at a dry film thickness of not less than 3.0 mils.
7. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
 8. or approved equal.
- G. Latex, Interior, Institutional Low Odor/VOC, Flat (Gloss Level 1):[**MPI #143.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
- H. Latex, Interior, Institutional Low Odor/VOC, (Gloss Level 2):[**MPI #144.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
- I. Latex, Interior, Institutional Low Odor/VOC, (Gloss Level 3):[**MPI #145.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
- J. Latex, Interior, Institutional Low Odor/VOC, Semi-Gloss (Gloss Level 5):[**MPI #147.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
- K. Latex, Interior, High Performance Architectural, (Gloss Level 2):[**MPI #138.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
- L. Latex, Interior, High Performance Architectural, (Gloss Level 3):[**MPI #139.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
- M. Latex, Interior, High Performance Architectural, (Gloss Level 4):[**MPI #140.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
- N. Latex, Interior, High Performance Architectural, Semi-Gloss (Gloss Level 5):[**MPI #141.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
- O. Light Industrial Coating, Interior, Water Based (Gloss Level 3):[**MPI #151.**]
1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

P. Light Industrial Coating, Interior, Water Based, Semi-Gloss (Gloss Level 5):[**MPI #153.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

Q. Light Industrial Coating, Interior, Water Based, Gloss (Gloss Level 6):[**MPI #154.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

2.7 SOLVENT-BASED PAINTS

A. Alkyd, Interior, Flat (Gloss Level 1):[**MPI #49.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

B. Alkyd, Interior, (Gloss Level 3):[**MPI #51.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

C. Alkyd, Interior, Semi-Gloss (Gloss Level 5):[**MPI #47.**]

1. Benjamin Moore; Moorcraft Super Spec Alkyd Semi-Gloss Enamel No. 271: Applied at a dry film thickness of not less than 1.4 mils.
2. ICI Dulux Paints; 1516-XXXX Ultra-Hide Alkyd Semi-Gloss Interior Wall & Trim Enamel: Applied at a dry film thickness of not less than 1.7 mils.
3. Kelly-Moore; 1630--Kel-Cote Interior Alkyd Semi-Gloss Enamel: Applied at a dry film thickness of not less than 2.2 mils.
4. M. A. B. Paint; Fresh Kote Semi-Gloss 403 Line: Applied at a dry film thickness of not less than 2.0 mils.
5. Pittsburgh Paints; 6-1110 Series SpeedHide Interior Enamel Wall & Trim Semi-Gloss Oil: Applied at a dry film thickness of not less than 1.4 mils.
6. Sherwin-Williams; ProMar 200 Interior Alkyd Semi-Gloss Enamel B34W200 Series: Applied at a dry film thickness of not less than 1.7 mils.
7. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
8. or approved equal.

D. Alkyd, Interior, Gloss (Gloss Level 6):[**MPI #48.**]

1. Benjamin Moore; Moore's IMC Urethane Alkyd Enamel No. M22: Applied at a dry film thickness of not less than 2.0 mils.
2. ICI Dulux Paints; 4308-XXXX Devguard Alkyd Industrial Gloss Enamel: Applied at a dry film thickness of not less than 2.0 mils.
3. Kelly-Moore; 1700 Kel-Guard Gloss Alkyd Rust Inhibitive Enamel: Applied at a dry film thickness of not less than 2.0 mils.
4. M. A. B. Paint; Rich Lux Architectural Bright White Enamel 026-127 Line: Applied

- at a dry film thickness of not less than 1.9 mils.
5. Pittsburgh Paints; 7-814 Series Pittsburgh Paints Industrial Gloss-Oil Interior/Exterior Enamel: Applied at a dry film thickness of not less than 1.5 mils.
 6. Sherwin-Williams; ProMar 200 Alkyd Gloss Enamel B35W200 Series: Applied at a dry film thickness of not less than 1.6 mils.
 7. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
 8. or approved equal.

E. Alkyd, Quick Dry, Semi-Gloss (Gloss Level 5):[**MPI #81.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

F. Alkyd, Quick Dry, Gloss (Gloss Level 7):[**MPI #96.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

2.8 TEXTURED COATING

A. Primer for Textured Coating, Latex, Flat: As recommended in writing by topcoat manufacturer.

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

B. Intermediate Coat for Textured Coating, Latex, Flat: As recommended in writing by topcoat manufacturer.

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

C. Textured Coating, Latex, Flat:[**MPI #42.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

2.9 DRY FOG/FALL COATINGS

A. Dry Fall, Latex, Flat:[**MPI #118.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

B. Dry Fall, Water Based, for Galvanized Steel, Flat (Gloss Level 1):[**MPI #133.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

C. Dry Fall, Alkyd, Flat:[**MPI #55.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

2.10 ALUMINUM PAINT

A. Aluminum Paint:[**MPI #1.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

2.11 FLOOR COATINGS

A. Stain, Interior, for Concrete Floors:[**MPI #58.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

B. Sealer, Water Based, for Concrete Floors:[**MPI #99.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

C. Sealer, Solvent Based, for Concrete Floors:[**MPI #104.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

D. Floor Paint, Latex, Low Gloss (Maximum Gloss Level 3):[**MPI #60.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

E. Floor Enamel, Alkyd, Gloss (Gloss Level 6):[**MPI #27.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

2.12 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.

2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements.
4. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials.
5. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 2. Start of painting will be construed as Contractor's acceptance of surfaces and conditions within a particular area.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 1. Concrete: 12 percent.
 2. Masonry (Clay and CMU): 12 percent.
 3. Wood: 15 percent.
 4. Gypsum Board: 12 percent.
 5. Plaster: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Plaster Substrates: Verify that plaster is fully cured.
- E. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.
- F. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- G. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual"

applicable to substrates indicated.

- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
1. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
 2. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
 3. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.
- E. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer[.] [**but not less than the following:**]
1. SSPC-SP 2, "Hand Tool Cleaning."
 2. SSPC-SP 3, "Power Tool Cleaning."
 3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
 4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- H. Aluminum Substrates: Remove loose surface oxidation.

- I. Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - 5. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
 - 6. Seal tops, bottoms, and cutouts of pre-finished wood doors that are undercut or cut in the field.

- J. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

- K. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
 - 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 - 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 - 3. Use only thinners approved by paint manufacturer and only within recommended limits.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - a. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 - b. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 - c. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

6. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 7. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 8. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 9. Paint backsides of access panels and removable or hinged covers to match exposed surfaces.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. Omit primer over metal surfaces that have been shop primed and touchup painted.
 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
- C. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- D. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- E. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- F. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards[**and switch gear**].
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.

- g. Tanks that do not have factory-applied final finishes.
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - i. **<Insert mechanical items to be painted>**.
 2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by DEN Project Manager.
 - i. **<Insert mechanical items to be painted>**.
 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.
 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing, and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.
 3. If necessary, Contractor may be required to remove noncomplying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by DEN Project Manager, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.
- E. Provide "Wet Paint" signs, warning tape and any other measures required to protect newly painted finishes and prevent the public from encountering freshly painted surfaces.. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
 - 1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.6 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Latex System:

- a. Prime Coat: Primer sealer, latex, interior[, **MPI #50**].
- b. Prime Coat: Latex, interior, matching topcoat.
- c. Intermediate Coat: Latex, interior, matching topcoat.
- d. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
- e. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
- f. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
- g. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
- h. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
- i. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].

2. Latex over Latex Aggregate System:

- a. Prime Coat: Textured coating, latex, flat[, **MPI #42**].
- b. Intermediate Coat: Latex, interior, matching topcoat.
- c. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
- d. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
- e. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
- f. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
- g. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
- h. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].

3. Institutional Low-Odor/VOC Latex System:

- a. Prime Coat: Primer sealer, interior, institutional low odor/VOC[, **MPI #149**].
- b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

- c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1)[, **MPI #143**].
 - d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2)[, **MPI #144**].
 - e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3)[, **MPI #145**].
 - f. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5)[, **MPI #147**].
4. High-Performance Architectural Latex System:
- a. Prime Coat: Primer, alkali resistant, water based[, **MPI #3**].
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural, (Gloss Level 2)[, **MPI #138**].
 - d. Topcoat: Latex, interior, high performance architectural, (Gloss Level 3)[, **MPI #139**].
 - e. Topcoat: Latex, interior, high performance architectural, (Gloss Level 4)[, **MPI #140**].
 - f. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5)[, **MPI #141**].
5. Water-Based Light Industrial Coating System:
- a. Prime Coat: Primer, alkali resistant, water based[, **MPI #3**].
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based (Gloss Level 3)[, **MPI #151**].
 - d. Topcoat: Light industrial coating, interior, water based, semi-gloss (Gloss Level 5)[, **MPI #153**].
 - e. Topcoat: Light industrial coating, interior, water based, gloss (Gloss Level 6)[, **MPI #154**].
6. Alkyd System:
- a. Prime Coat: Primer, alkali resistant, water based[, **MPI #3**].
 - b. Intermediate Coat: Alkyd, interior, matching topcoat.
 - c. Topcoat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
 - d. Topcoat: Alkyd, interior, (Gloss Level 3)[, **MPI #51**].
 - e. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5)[, **MPI #47**].
 - f. Topcoat: Alkyd, interior, gloss (Gloss Level 6)[, **MPI #48**].
- B. Concrete Substrates, Traffic Surfaces:
1. Latex Floor Enamel System:
 - a. Prime Coat: Floor paint, latex, low gloss (maximum Gloss Level 3)[, **MPI #60**].

- b. Intermediate Coat: Floor paint, latex, low gloss (maximum Gloss Level 3)[, **MPI #60**].
 - c. Topcoat: Floor paint, latex, low gloss (maximum Gloss Level 3)[, **MPI #60**].
 2. Alkyd Floor Enamel System:
 - a. Prime Coat: Floor enamel, alkyd, gloss (Gloss Level 6)[, **MPI #27**].
 - b. Intermediate Coat: Floor enamel, alkyd, gloss (Gloss Level 6)[, **MPI #27**].
 - c. Topcoat: Floor enamel, alkyd, gloss (Gloss Level 6)[, **MPI #27**].
 3. Concrete Stain System:
 - a. First Coat: Stain, interior, for concrete floors[, **MPI #58**].
 - b. Topcoat: Stain, interior, for concrete floors[, **MPI #58**].
 4. Water-Based Clear Sealer System:
 - a. First Coat: Sealer, water based, for concrete floors[, **MPI #99**].
 - b. Topcoat: Sealer, water based, for concrete floors[, **MPI #99**].
 5. Solvent-Based Clear Sealer System:
 - a. First Coat: Sealer, solvent based, for concrete floors[, **MPI #104**].
 - b. Topcoat: Sealer, solvent based, for concrete floors[, **MPI #104**].
- C. Clay-Masonry Substrates:
 1. Latex System:
 - a. Prime Coat: Latex, interior, matching topcoat.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
 - d. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
 - e. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
 - f. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
 - g. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
 - h. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
 2. Latex Aggregate System:
 - a. Prime Coat: Primer for textured coating, latex, flat[, **as recommended in writing by topcoat manufacturer**].
 - b. Intermediate Coat: Intermediate coat for textured coating, latex, flat[, **as recommended in writing by topcoat manufacturer**].
 - c. Topcoat: Textured coating, latex, flat[, **MPI #42**].
 3. Institutional Low-Odor/VOC Latex System:
 - a. Prime Coat: Primer sealer, interior, institutional low odor/VOC[, **MPI #149**].

- b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1)[, **MPI #143**].
 - d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2)[, **MPI #144**].
 - e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3)[, **MPI #145**].
 - f. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5)[, **MPI #147**].
4. High-Performance Architectural Latex System:
- a. Prime Coat: Primer, alkali resistant, water based[, **MPI #3**].
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural, (Gloss Level 2)[, **MPI #138**].
 - d. Topcoat: Latex, interior, high performance architectural, (Gloss Level 3)[, **MPI #139**].
 - e. Topcoat: Latex, interior, high performance architectural, (Gloss Level 4)[, **MPI #140**].
 - f. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5)[, **MPI #141**].
5. Water-Based Light Industrial Coating System:
- a. Prime Coat: Primer, alkali resistant, water based[, **MPI #3**].
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based (Gloss Level 3)[, **MPI #151**].
 - d. Topcoat: Light industrial coating, interior, water based, semi-gloss (Gloss Level 5)[, **MPI #153**].
 - e. Topcoat: Light industrial coating, interior, water based, gloss (Gloss Level 6)[, **MPI #154**].
6. Alkyd System:
- a. Prime Coat: Primer sealer, latex, interior[, **MPI #50**].
 - b. Intermediate Coat: Alkyd, interior, matching topcoat.
 - c. Topcoat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
 - d. Topcoat: Alkyd, interior, (Gloss Level 3)[, **MPI #51**].
 - e. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5)[, **MPI #47**].
 - f. Topcoat: Alkyd, interior, gloss (Gloss Level 6)[, **MPI #48**].
- D. CMU Substrates:
- 1. Latex System:

- a. Block Filler: Block filler, latex, interior/exterior[, **MPI #4**].
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
 - d. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
 - e. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
 - f. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
 - g. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
 - h. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
2. Institutional Low-Odor/VOC Latex System:
- a. Block Filler: Block filler, latex, interior/exterior[, **MPI #4**].
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1)[, **MPI #143**].
 - d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2)[, **MPI #144**].
 - e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3)[, **MPI #145**].
 - f. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5)[, **MPI #147**].
3. High-Performance Architectural Latex System:
- a. Block Filler: Block filler, latex, interior/exterior[, **MPI #4**].
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural, (Gloss Level 2)[, **MPI #138**].
 - d. Topcoat: Latex, interior, high performance architectural, (Gloss Level 3)[, **MPI #139**].
 - e. Topcoat: Latex, interior, high performance architectural, (Gloss Level 4)[, **MPI #140**].
 - f. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5)[, **MPI #141**].
4. Water-Based Light Industrial Coating System:
- a. Block Filler: Block filler, latex, interior/exterior[, **MPI #4**].
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based (Gloss Level 3)[, **MPI #151**].
 - d. Topcoat: Light industrial coating, interior, water based, semi-gloss (Gloss Level 5)[, **MPI #153**].
 - e. Topcoat: Light industrial coating, interior, water based, gloss (Gloss Level 6)[, **MPI #154**].

5. Alkyd System:

- a. Block Filler: Block filler, latex, interior/exterior[, **MPI #4**].
- b. Sealer Coat: Primer sealer, latex, interior[, **MPI #50**].
- c. Intermediate Coat: Alkyd, interior, matching topcoat.
- d. Topcoat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
- e. Topcoat: Alkyd, interior, (Gloss Level 3)[, **MPI #51**].
- f. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5)[, **MPI #47**].
- g. Topcoat: Alkyd, interior, gloss (Gloss Level 6)[, **MPI #48**].

E. Steel Substrates:

1. Latex over Alkyd Primer System:

- a. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**].
- b. Prime Coat: Primer, alkyd, quick dry, for metal[, **MPI #76**].
- c. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**] or primer, alkyd, quick dry, for metal[, **MPI #76**].
- d. Prime Coat: Shop primer specified in Section 051200 "Structural Steel Framing" where substrate is specified.
- e. Intermediate Coat: Latex, interior, matching topcoat.
- f. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
- g. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
- h. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
- i. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
- j. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
- k. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].

2. Water-Based Dry-Fall System:

- a. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**].
- b. Prime Coat: Primer, alkyd, quick dry, for metal[, **MPI #76**].
- c. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**] or primer, alkyd, quick dry, for metal[, **MPI #76**].
- d. Prime Coat: Shop primer specified in Section 051200 "Structural Steel Framing" where substrate is specified.
- e. Topcoat: Dry fall, latex, flat[, **MPI #118**].
- f. Topcoat: Dry fall, water based, for galvanized steel, flat (Gloss Level 1)[, **MPI #133**].

3. Institutional Low-Odor/VOC Latex System:

- a. Prime Coat: Primer, rust-inhibitive, water based[**MPI #107**].
- b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
- c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1)[, **MPI #143**].
- d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2)[, **MPI #144**].

- e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3)[, **MPI #145**].
 - f. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5)[, **MPI #147**].
4. High-Performance Architectural Latex System:
- a. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**].
 - b. Prime Coat: Primer, alkyd, quick dry, for metal[, **MPI #76**].
 - c. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**] or primer, alkyd, quick dry, for metal[, **MPI #76**].
 - d. Prime Coat: Shop primer specified in Section 051200 "Structural Steel Framing" where substrate is specified.
 - e. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - f. Topcoat: Latex, interior, high performance architectural, (Gloss Level 2)[, **MPI #138**].
 - g. Topcoat: Latex, interior, high performance architectural, (Gloss Level 3)[, **MPI #139**].
 - h. Topcoat: Latex, interior, high performance architectural, (Gloss Level 4)[, **MPI #140**].
 - i. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5)[, **MPI #141**].
5. Water-Based Light Industrial Coating System:
- a. Prime Coat: Primer, rust-inhibitive, water based[**MPI #107**].
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based (Gloss Level 3)[, **MPI #151**].
 - d. Topcoat: Light industrial coating, interior, water based, semi-gloss (Gloss Level 5)[, **MPI #153**].
 - e. Topcoat: Light industrial coating, interior, water based, gloss (Gloss Level 6)[, **MPI #154**].
6. Alkyd System:
- a. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**].
 - b. Prime Coat: Primer, alkyd, quick dry, for metal[, **MPI #76**].
 - c. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**] or primer, alkyd, quick dry, for metal[, **MPI #76**].
 - d. Prime Coat: Shop primer specified in Section 051200 "Structural Steel Framing" where substrate is specified.
 - e. Intermediate Coat: Alkyd, interior, matching topcoat.
 - f. Topcoat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
 - g. Topcoat: Alkyd, interior, (Gloss Level 3)[, **MPI #51**].
 - h. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5)[, **MPI #47**].
 - i. Topcoat: Alkyd, interior, gloss (Gloss Level 6)[, **MPI #48**].

7. Quick-Drying Enamel System:
 - a. Prime Coat: Primer, alkyd, quick dry, for metal[, **MPI #76**].
 - b. Intermediate Coat: Alkyd, quick dry, matching topcoat.
 - c. Topcoat: Alkyd, quick dry, semi-gloss (Gloss Level 5)[, **MPI #81**].
 - d. Topcoat: Alkyd, quick dry, gloss (Gloss Level 7)[, **MPI #96**].

 8. Alkyd Dry-Fall System:
 - a. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**].
 - b. Prime Coat: Primer, alkyd, quick dry, for metal[, **MPI #76**].
 - c. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**] or primer, alkyd, quick dry, for metal[, **MPI #76**].
 - d. Prime Coat: Shop primer specified in Section 051200 "Structural Steel Framing" where substrate is specified.
 - e. Topcoat: Dry fall, alkyd, flat[, **MPI #55**].

 9. Aluminum Paint System:
 - a. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**].
 - b. Prime Coat: Primer, alkyd, quick dry, for metal[, **MPI #76**].
 - c. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, **MPI #79**] or primer, alkyd, quick dry, for metal[, **MPI #76**].
 - d. Prime Coat: Shop primer specified in Section 051200 "Structural Steel Framing" where substrate is specified.
 - e. Intermediate Coat: Aluminum paint[, **MPI #1**].
 - f. Topcoat: Aluminum paint[, **MPI #1**].
- F. Galvanized-Metal Substrates:
1. Latex over Waterborne Primer System:
 - a. Prime Coat: Primer, galvanized, water based[, **MPI #134**].
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
 - d. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
 - e. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
 - f. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
 - g. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
 - h. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].

 2. Water-Based Dry-Fall System:
 - a. Prime Coat: Dry fall, water based, for galvanized steel, flat (Gloss Level 1)[, **MPI #133**].
 - b. Topcoat: Dry fall, water based, for galvanized steel, flat (Gloss Level 1)[, **MPI #133**].

 3. Institutional Low-Odor/VOC Latex System:

- a. Prime Coat: Primer, galvanized, water based[, **MPI #134**].
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1)[, **MPI #143**].
 - d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2)[, **MPI #144**].
 - e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3)[, **MPI #145**].
 - f. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5)[, **MPI #147**].
4. High-Performance Architectural Latex System:
- a. Prime Coat: Primer, galvanized, water based[, **MPI #134**].
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural, (Gloss Level 2)[, **MPI #138**].
 - d. Topcoat: Latex, interior, high performance architectural, (Gloss Level 3)[, **MPI #139**].
 - e. Topcoat: Latex, interior, high performance architectural, (Gloss Level 4)[, **MPI #140**].
 - f. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5)[, **MPI #141**].
5. Water-Based Light Industrial Coating Over Waterborne Primer System:
- a. Prime Coat: Primer, galvanized, water based[, **MPI #134**].
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based (Gloss Level 3)[, **MPI #151**].
 - d. Topcoat: Light industrial coating, interior, water based, semi-gloss (Gloss Level 5)[, **MPI #153**].
 - e. Topcoat: Light industrial coating, interior, water based, gloss (Gloss Level 6)[, **MPI #154**].
6. Aluminum Paint System:
- a. Prime Coat: Primer, galvanized metal, as recommended in writing by topcoat manufacturer for use on galvanized-metal substrates with topcoat indicated.
 - b. Intermediate Coat: Aluminum paint[, **MPI #1**].
 - c. Topcoat: Aluminum paint[, **MPI #1**].
- G. Aluminum (Not Anodized or Otherwise Coated) Substrates:
1. Latex System:

- a. Prime Coat: Primer, quick dry, for aluminum[, **MPI #95**].
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
 - d. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
 - e. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
 - f. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
 - g. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
 - h. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
2. Institutional Low-Odor/VOC Latex System:
- a. Prime Coat: Primer, quick dry, for aluminum[, **MPI #95**].
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1)[, **MPI #143**].
 - d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2)[, **MPI #144**].
 - e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3)[, **MPI #145**].
 - f. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5)[, **MPI #147**].
3. High-Performance Architectural Latex System:
- a. Prime Coat: Primer, quick dry, for aluminum[, **MPI #95**].
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural, (Gloss Level 2)[, **MPI #138**].
 - d. Topcoat: Latex, interior, high performance architectural, (Gloss Level 3)[, **MPI #139**].
 - e. Topcoat: Latex, interior, high performance architectural, (Gloss Level 4)[, **MPI #140**].
 - f. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5)[, **MPI #141**].
4. Water-Based Light Industrial Coating System:
- a. Prime Coat: Primer, quick dry, for aluminum[, **MPI #95**].
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based (Gloss Level 3)[, **MPI #151**].
 - d. Topcoat: Light industrial coating, interior, water based, semi-gloss (Gloss Level 5)[, **MPI #153**].
 - e. Topcoat: Light industrial coating, interior, water based, gloss (Gloss Level 6)[, **MPI #154**].

5. Alkyd System:
 - a. Prime Coat: Primer, vinyl wash[, **MPI #80**].
 - b. Prime Coat: Primer, quick dry, for aluminum[, **MPI #95**].
 - c. Intermediate Coat: Alkyd, interior, matching topcoat.
 - d. Topcoat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
 - e. Topcoat: Alkyd, interior, (Gloss Level 3)[, **MPI #51**].
 - f. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5)[, **MPI #47**].
 - g. Topcoat: Alkyd, interior, gloss (Gloss Level 6)[, **MPI #48**].

6. Aluminum Paint System:
 - a. Prime Coat: Primer, vinyl wash[, **MPI #80**].
 - b. Intermediate Coat: Aluminum paint[, **MPI #1**].
 - c. Topcoat: Aluminum paint[, **MPI #1**].

- H. Wood Substrates: Including [**wood trim**] [**architectural woodwork**] [**doors**] [**windows**] [**wood-based panel products**] [**glued-laminated construction**] [**exposed joists**] [**exposed beams**] <Insert description>.
 1. Latex System:
 - a. Prime Coat: Primer, latex, for interior wood[, **MPI #39**].
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
 - d. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
 - e. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
 - f. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
 - g. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
 - h. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].

 2. Latex over Alkyd Primer System:
 - a. Prime Coat: Primer sealer, alkyd, interior[, **MPI #45**].
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
 - d. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
 - e. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
 - f. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
 - g. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
 - h. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].

 3. Institutional Low-Odor/VOC Latex System:
 - a. Prime Coat: Primer, latex, for interior wood[, **MPI #39**].
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

- c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1)[, **MPI #143**].
 - d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2)[, **MPI #144**].
 - e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3)[, **MPI #145**].
 - f. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5)[, **MPI #147**].
4. High-Performance Architectural Latex System:
- a. Prime Coat: Primer, latex, for interior wood[, **MPI #39**].
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural, (Gloss Level 2)[, **MPI #138**].
 - d. Topcoat: Latex, interior, high performance architectural, (Gloss Level 3)[, **MPI #139**].
 - e. Topcoat: Latex, interior, high performance architectural, (Gloss Level 4)[, **MPI #140**].
 - f. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5)[, **MPI #141**].
5. Alkyd System:
- a. Prime Coat: Primer sealer, alkyd, interior[, **MPI #45**].
 - b. Intermediate Coat: Alkyd, interior, matching topcoat.
 - c. Topcoat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
 - d. Topcoat: Alkyd, interior, (Gloss Level 3)[, **MPI #51**].
 - e. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5)[, **MPI #47**].
 - f. Topcoat: Alkyd, interior, gloss (Gloss Level 6)[, **MPI #48**].
- I. Wood Substrates, Traffic Surfaces:
- 1) Latex Floor Paint System:
 - b. Prime Coat: Primer sealer, alkyd, interior[, **MPI #45**].
 - c. Intermediate Coat: Floor paint, latex, low gloss (maximum Gloss Level 3)[, **MPI #60**].
 - d. Topcoat: Floor paint, latex, low gloss (maximum Gloss Level 3)[, **MPI #60**].
 2. Alkyd Floor Enamel System:
 - a. Prime Coat: Floor enamel, alkyd, gloss (Gloss Level 6)[, **MPI #27**].
 - b. Intermediate Coat: Floor enamel, alkyd, gloss (Gloss Level 6)[, **MPI #27**].
 - c. Topcoat: Floor enamel, alkyd, gloss (Gloss Level 6)[, **MPI #27**].
- J. Fiberglass and Plastic Substrates:
1. Latex System:

- a. Prime Coat: Primer, bonding, water based[, **MPI #17**].
 - b. Prime Coat: Primer, bonding, solvent based[, **MPI #69**].
 - c. Intermediate Coat: Latex, interior, matching topcoat.
 - d. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
 - e. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
 - f. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
 - g. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
 - h. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
 - i. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
2. Institutional Low-Odor/VOC Latex System:
- a. Prime Coat: Primer, bonding, water based[, **MPI #17**].
 - b. Prime Coat: Primer, bonding, solvent based[, **MPI #69**].
 - c. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - d. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1)[, **MPI #143**].
 - e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2)[, **MPI #144**].
 - f. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3)[, **MPI #145**].
 - g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5)[, **MPI #147**].
3. High-Performance Architectural Latex System:
- a. Prime Coat: Primer, bonding, water based[, **MPI #17**].
 - b. Prime Coat: Primer, bonding, solvent based[, **MPI #69**].
 - c. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - d. Topcoat: Latex, interior, high performance architectural, (Gloss Level 2)[, **MPI #138**].
 - e. Topcoat: Latex, interior, high performance architectural, (Gloss Level 3)[, **MPI #139**].
 - f. Topcoat: Latex, interior, high performance architectural, (Gloss Level 4)[, **MPI #140**].
 - g. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5)[, **MPI #141**].
4. Water-Based Light Industrial Coating System:
- a. Prime Coat: Primer, bonding, water based[, **MPI #17**].
 - b. Prime Coat: Primer, bonding, solvent based[, **MPI #69**].
 - c. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - d. Topcoat: Light industrial coating, interior, water based (Gloss Level 3)[, **MPI #151**].

- e. Topcoat: Light industrial coating, interior, water based, semi-gloss (Gloss Level 5)[, **MPI #153**].
 - f. Topcoat: Light industrial coating, interior, water based, gloss (Gloss Level 6)[, **MPI #154**].
5. Alkyd System:
- a. Prime Coat: Primer, bonding, water based[, **MPI #17**].
 - b. Prime Coat: Primer, bonding, solvent based[, **MPI #69**].
 - c. Intermediate Coat: Alkyd, interior, matching topcoat.
 - d. Topcoat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
 - e. Topcoat: Alkyd, interior, (Gloss Level 3)[, **MPI #51**].
 - f. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5)[, **MPI #47**].
 - g. Topcoat: Alkyd, interior, gloss (Gloss Level 6)[, **MPI #48**].
- K. **[Gypsum Board] [Plaster] Substrates:**
1. Latex System:
- a. Prime Coat: Primer sealer, latex, interior[, **MPI #50**].
 - b. Prime Coat: Latex, interior, matching topcoat.
 - c. Intermediate Coat: Latex, interior, matching topcoat.
 - d. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
 - e. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
 - f. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
 - g. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
 - h. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
 - i. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
2. Institutional Low-Odor/VOC Latex System:
- a. Prime Coat: Primer sealer, interior, institutional low odor/VOC[, **MPI #149**].
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1)[, **MPI #143**].
 - d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2)[, **MPI #144**].
 - e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3)[, **MPI #145**].
 - f. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5)[, **MPI #147**].
3. High-Performance Architectural Latex System:
- a. Prime Coat: Primer sealer, latex, interior[, **MPI #50**].
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

- c. Topcoat: Latex, interior, high performance architectural, (Gloss Level 2)[, **MPI #138**].
 - d. Topcoat: Latex, interior, high performance architectural, (Gloss Level 3)[, **MPI #139**].
 - e. Topcoat: Latex, interior, high performance architectural, (Gloss Level 4)[, **MPI #140**].
 - f. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5)[, **MPI #141**].
4. Water-Based Light Industrial Coating System:
- a. Prime Coat: Primer sealer, latex, interior[, **MPI #50**].
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based (Gloss Level 3)[, **MPI #151**].
 - d. Topcoat: Light industrial coating, interior, water based, semi-gloss (Gloss Level 5)[, **MPI #153**].
 - e. Topcoat: Light industrial coating, interior, water based, gloss (Gloss Level 6)[, **MPI #154**].
5. Alkyd over Latex Primer System:
- a. Prime Coat: Primer sealer, latex, interior[, **MPI #50**].
 - b. Intermediate Coat: Alkyd, interior, matching topcoat.
 - c. Topcoat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
 - d. Topcoat: Alkyd, interior, (Gloss Level 3)[, **MPI #51**].
 - e. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5)[, **MPI #47**].
 - f. Topcoat: Alkyd, interior, gloss (Gloss Level 6)[, **MPI #48**].
- L. Spray-Textured Ceiling Substrates:
- 1. Latex (Flat) System: Spray applied.
 - a. Prime Coat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
 - b. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
 - 2. Latex System: Spray applied.
 - a. Prime Coat: Latex, interior, matching topcoat.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
 - d. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
 - e. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
 - f. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
 - g. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
 - h. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
 - 3. Latex over Alkyd Primer System:

- a. Prime Coat: Primer sealer, alkyd, interior[, **MPI #45**].
 - b. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
 - c. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
 - d. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
 - e. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
 - f. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
 - g. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
4. Alkyd (Flat) System:
- a. Prime Coat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
 - b. Topcoat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
5. Alkyd System:
- a. Prime Coat: Primer sealer, alkyd, interior[, **MPI #45**].
 - b. Intermediate Coat: Alkyd, interior, matching topcoat.
 - c. Topcoat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
 - d. Topcoat: Alkyd, interior, (Gloss Level 3)[, **MPI #51**].
 - e. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5)[, **MPI #47**].
 - f. Topcoat: Alkyd, interior, gloss (Gloss Level 6)[, **MPI #48**].
- M. **[Cotton or Canvas] [and] [ASJ] Insulation-Covering Substrates: Including [pipe and duct coverings] <Insert description>**.
1. Latex System:
 - a. Prime Coat: Primer sealer, latex, interior[, **MPI #50**].
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat, (Gloss Level 1)[, **MPI #53**].
 - d. Topcoat: Latex, interior, (Gloss Level 2)[, **MPI #44**].
 - e. Topcoat: Latex, interior, (Gloss Level 3)[, **MPI #52**].
 - f. Topcoat: Latex, interior, (Gloss Level 4)[, **MPI #43**].
 - g. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)[, **MPI #54**].
 - h. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees)[, **MPI #114**].
 2. Institutional Low-Odor/VOC Latex System:
 - a. Prime Coat: Primer sealer, latex, interior[, **MPI #50**].
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1)[, **MPI #143**].
 - d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2)[, **MPI #144**].
 - e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3)[, **MPI #145**].

- f. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5)[, **MPI #147**].
3. Alkyd over Latex Primer System:
 - a. Prime Coat: Primer sealer, latex, interior[, **MPI #50**].
 - b. Intermediate Coat: Alkyd, interior, matching topcoat.
 - c. Topcoat: Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
 - d. Topcoat: Alkyd, interior, (Gloss Level 3)[, **MPI #51**].
 - e. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5)[, **MPI #47**].
 - f. Topcoat: Alkyd, interior, gloss (Gloss Level 6)[, **MPI #48**].
 4. Aluminum Paint System:
 - a. Prime Coat: Primer sealer, latex, interior[, **MPI #50**].
 - b. Intermediate Coat: Aluminum paint[, **MPI #1**].
 - c. Topcoat: Aluminum paint[, **MPI #1**].

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 099123

SECTION 099419 - MULTICOLOR INTERIOR FINISHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes surface preparation and field application of multicolor interior coating systems[.] [**applied on the following substrates:**]

1. Vertical concrete.
2. Cementitious composition board.
3. Clay masonry units.
4. Concrete masonry units (CMU).
5. Wood.
6. Fiberglass moldings and trim.
7. Plastic moldings and trim.
8. Plaster.
9. Gypsum veneer plaster.
10. Gypsum board.

- B. Related Requirements:

1. Section 099123 "Interior Painting" for special-use coatings and general field painting.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include data substantiating that materials comply with requirements.

- B. Installer's Qualifications: Provide evidence of installer's qualifications to apply multicolor paint products, with minimum five (5) years experience.

- C. LEED Submittals:

1. Product Data for Credit EQ 4.2: For coatings systems, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit EQ 4: For coating systems, documentation indicating that products comply with the testing and product requirements of the

California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- D. Samples: For each exposed product and for each color and texture specified, **8 inches** (200 mm) square in size.
- E. Samples for Initial Selection: For each multicolor coating system indicated.
- F. Samples for Verification: For each multicolor coating system and in each color, pattern, and pigment density indicated.
 - 1. Submit Samples on rigid backing, **8 inches** (200 mm) square.
 - 2. Label each Sample for location and application area.
- G. Product Schedule: For multicolor coating systems. [**Use same designations indicated on Drawings.**]

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials[, **from the same product run,**] that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: [**5**] **<Insert number>** percent, but not less than [**1 gal.** (3.8 L)] **<Insert number>** of each material and color application.

1.5 QUALITY ASSURANCE

- A. Mockups: Apply mockup of each coating system indicated to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. DEN Project Manager will select one surface to represent surfaces and conditions for application of each coating system and type of substrate.
 - a. Wall Surfaces: Provide samples of at least **100 sq. ft.** (9 sq. m).
 - b. Other Items: DEN Project Manager will designate items or areas required.
 - 2. Apply mockup after permanent lighting and other environmental services have been activated.
 - 3. Final approval of color and pattern selections will be based on mockup.
 - a. If preliminary color and pattern selections are not approved, apply additional mockups of colors and patterns selected by DEN Project Manager at no added cost to Owner.
 - 4. Repair Mockup: After approval of color and pattern selections, apply representative repairs to **100 sq. in.** (65 sq. cm) of mockup to establish quality

- standards for coating system repairs.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply coatings until spaces are enclosed and weatherproof, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 MULTICOLOR COATING SYSTEMS, GENERAL

- A. Master Painters Institute (MPI) Standards: Comply with recommendations in "MPI Architectural Painting Specification Manual" applicable to products and coating systems indicated.
- B. Material Compatibility: Provide materials for use within each coating system that are compatible with one another and substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction[**and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24)**].
 1. Flat Paints and Coatings: VOC content of not more than 50 g/L.
 2. Nonflat Paints and Coatings: VOC content of not more than 150 g/L.
 3. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
 4. Clear Wood Finishes and Varnishes: VOC content of not more than 350 g/L.
- D. Low-Emitting Materials: Provide multicolored coating products that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources

Using Small-Scale Environmental Chambers."

- E. Colors and Patterns: **[Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] [As indicated in finish schedule] <Insert requirements>**.

2.2 FILLERS AND PRIMERS

- A. General: Undercoatings recommended in writing for use in coating systems by manufacturer of multicolor interior coating on substrates and under conditions indicated.
- B. Latex Block Filler: Waterborne, high-solids, emulsion-type, pigmented coating product recommended in writing for use in coating system indicated by manufacturer of multicolor interior coating, with bridging and filling properties, and formulated for filling surfaces of CMU for subsequent applications of finish coatings.
- C. Wood Filler Paste: Solvent-based, high-solids, clear paste product recommended in writing for use in coating system indicated by manufacturer of multicolor interior coating, for use on open-grained or damaged woods. The paste fills hardwood pores with minimal surface residues and without showing cracking or shrinkage. When dry, sanding filler produces a smooth surface without clogging or gumming sandpaper.
- D. Wood-Knot Sealer: White shellac or other sealer recommended in writing for this purpose by manufacturer of multicolor interior coating.
- E. Primer/Sealer for Multicolor Systems: Acrylic or acrylic/polyvinyl acetate (PVA) co-polymer emulsion-type, pigmented primer/sealer product recommended in writing for use in coating system indicated by manufacturer of multicolor interior coating.
- F. Interior Alkyd Primer/Sealer: Solvent-based, pigmented primer/sealer.
- G. Water-Based Bonding Primer: Water-based, emulsion-type, pigmented primer product recommended in writing for use in coating system indicated by manufacturer of multicolor interior coating, and formulated to promote adhesion of subsequent coatings.
- H. Solvent-Based Bonding Primer: Solvent-based, pigmented product recommended in writing for use in coating system indicated by manufacturer of multicolor interior coating, and formulated to promote adhesion of subsequent coatings to substrate.

2.3 MULTICOLOR COATINGS

- A. Multicolor Coating: Water- or solvent-based coat that provides a decorative polychromatic finish. **[Complying with MPI #112 and listed in "MPI Approved Products List."]**
 - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Crafton Coatings, Bollen International, Inc.; **[Crafton] [Crafton Plus] [Ferroxtone]**.
 - b. Duron, Inc.; Vara-Flic, Int. Waterborne Multicolor Finish.
 - c. Multicolor Specialties, Inc.; Multispec **[Colorspec] [Duraspec] [WaterColors] [Fine Fleck]**.
 - d. Seagrave Coatings Corp.; Plextone.
 - e. Zolatone Interior Finishes, Master Coating Technologies; **[Luminations] [Polomyx] [Polomyx Airless]**.
 - f. **<Insert manufacturer's name; product name or designation>**.
 - g. or approved equal.
- B. Clear Topcoat: Product recommended by multicolor coating manufacturer for use in multicolor coating system indicated to add surface abrasion and detergent resistance; water-based, clear acrylic co-polymer emulsion or solvent-based, clear acrylic solution binder. **[Complying with MPI #121 and listed in "MPI Approved Products List."]**
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Benjamin Moore; Benwood, Stays Clear Acrylic Polyurethane Low Lustre.
 - b. Columbia Paint & Coatings; Multi-Spec, Clear.
 - c. Coronado Paint; Aqua-Plastic Waterborne Urethane.
 - d. PPG Architectural Finishes, Inc.; **[Olympic, Premium Interior Water Based Polyurethane Clear] [Rez, Interior Acrylic Polyurethane Gloss]**.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of coatings.
1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
 - b. Masonry (Clay and CMU): 12 percent.
 - c. Wood: 15 percent.
 - d. Plaster: 12 percent.
 - e. Gypsum Veneer Plaster: 12 percent.
 - f. Gypsum Board: 12 percent.
 2. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
 3. Plaster Substrates: Verify that plaster is fully cured.
 4. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

5. Begin coating application only after unsatisfactory conditions have been corrected.
6. Beginning coating application indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
 1. After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.
- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible primers, paints, and encapsulants.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Wood Substrates:
 1. Scrape and clean small, dry, seasoned knots, and apply a thin coat of knot sealer before applying primer.
 2. Sand surfaces that will be exposed to view; remove sanding dust from surfaces to be coated.
 3. Prime edges, ends, faces, undersides, and backsides of wood.
 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried and remove sanding dust.

3.3 APPLICATION

- A. Apply coatings according to manufacturer's written instructions using applicators and techniques suited for coating and substrate indicated.
- B. Coat surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
- C. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

- D. Apply coating systems to produce uniformly textured, colored, and patterned finished-surface films without substrates, undercoats, marks, or stains showing through. Produce sharp, even glass lines and color breaks.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by DEN Project Manager, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel in proper applicators and techniques for repairing multicolored interior coating systems on substrates indicated.
 - 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

3.6 MULTICOLOR INTERIOR COATING SCHEDULE

- A. Vertical Concrete Substrates:
 - 1. Prime Coat: Primer/sealer for multicolor systems.
 - 2. Multicolor Base Coat: Multicolor coating.
 - 3. Multicolor Pattern Coat: Multicolor coating.
 - 4. Topcoat: Clear topcoat.
- B. Cementitious Composition Board Substrates:
 - 1. Prime Coat: Primer/sealer for multicolor systems.
 - 2. Multicolor Base Coat: Multicolor coating.
 - 3. Multicolor Pattern Coat: Multicolor coating.
 - 4. Topcoat: Clear topcoat.
- C. Clay Masonry Unit Substrates:
 - 1. Prime Coat: Primer/sealer for multicolor systems tinted to match multicolor basecoat.

2. Multicolor Base Coat: Multicolor coating.
3. Multicolor Pattern Coat: Multicolor coating.
4. Topcoat: Clear topcoat.

D. CMU Substrates:

1. Block Filler: Latex block filler.
2. Prime Coat: Primer/sealer for multicolor systems.
3. Multicolor Base Coat: Multicolor coating.
4. Multicolor Pattern Coat: Multicolor coating.
5. Topcoat: Clear topcoat.

E. Wood Substrates:

1. Fill Coat: Wood filler paste.
2. Prime Coat: Interior alkyd primer/sealer [**tinted to match multicolor base coat**].
3. Multicolor Base Coat: Multicolor coating.
4. Multicolor Pattern Coat: Multicolor coating.
5. Topcoat: Clear topcoat.

F. Fiberglass Molding and Trim Substrates:

1. Prime Coat: [**Water**] [**Solvent**]-based bonding primer.
2. Multicolor Base Coat: Multicolor coating.
3. Multicolor Pattern Coat: Multicolor coating.
4. Topcoat: Clear topcoat.

G. Plastic Molding and Trim Substrates:

1. Prime Coat: Solvent-based bonding primer.
2. Multicolor Base Coat: Multicolor coating.
3. Multicolor Pattern Coat: Multicolor coating.
4. Topcoat: Clear topcoat.

H. [**Plaster**] [**Gypsum Veneer Plaster**] [**Gypsum Board**] Substrates:

1. Prime Coat: Primer/sealer for multicolor systems.
2. Multicolor Base Coat: Multicolor coating.
3. Multicolor Pattern Coat: Multicolor coating.
4. Topcoat: Clear topcoat.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 099419

SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes surface preparation and application of high-performance coating systems[.][**on the following substrates:**]

- 1. Exterior Substrates:

- a. Concrete, **[vertical] [and] [horizontal]** surfaces.
- b. Clay masonry.
- c. Concrete masonry units (CMU).
- d. Steel.
- e. Galvanized metal.
- f. Aluminum (not anodized or otherwise coated).
- g. Wood.

- 2. Interior Substrates:

- a. Concrete, **[vertical] [and] [horizontal]** surfaces.
- b. Clay masonry.
- c. Concrete masonry units (CMU).
- d. Steel.
- e. Galvanized metal.
- f. Aluminum (not anodized or otherwise coated).
- g. Wood.
- h. Gypsum board.

- B. Related Requirements:

- 1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.
- 2. Section 099113 "Exterior Painting" for special-use coatings and general field painting.
- 3. Section 099123 "Interior Painting" for special-use coatings and general field painting.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. Semi-Gloss: 30 to 65 units at 60 degrees, according to ASTM D16.
- B. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- C. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.
- D. Environments: The following terms are used in Part 2 of this Section to distinguish between different corrosive exposures:
 - 1. "Severe environments" are highly corrosive industrial atmospheres with sustained exposure to high humidity and condensation and with frequent cleaning using strong chemicals. Environments with heavy concentrations of strong chemical fumes and frequent splashing and spilling of harsh chemical products are severe environments.
 - 2. "Moderate environments" are corrosive industrial atmospheres with intermittent exposure to high humidity and condensation, occasional mold and mildew development, and regular cleaning with strong chemicals. Environments with exposure to heavy concentrations of chemical fumes and occasional splashing and spilling of chemical products are moderate environments.
 - 3. "Mild environments" are industrial atmospheres with normal exposure to moderate humidity and condensation, occasional mold and mildew development, and infrequent cleaning with strong chemicals. Environments with low levels of mild chemical fumes and occasional splashing and spilling of chemical products are mild environments. Normal outdoor weathering is also considered a mild environment.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.
 - 1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference the specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 - 2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each material specified.
 - 3. Certification by manufacturer that products supplied comply with requirements indicated that limit the amount of VOCs in coating products.
 - 4. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Data for Credit EQ 4.2: For interior coatings, documentation including printed statement of VOC content.

2. Laboratory Test Reports for Credit EQ 4: For interior coatings, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Samples for Initial Selection: For each type of topcoat product indicated. Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.
- D. Samples for Verification: For each type of coating system and in each color and gloss of topcoat indicated, with texture to simulate actual conditions, on representative samples of the actual substrate.
1. Provide stepped Samples defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
 2. List of material and application for each coat of each sample. Label each sample for location and application.
 3. Submit Samples on rigid backing, **8 inches** (200 mm) square, unless otherwise noted.
 4. Label each coat of each Sample.
 5. Label each Sample for location and application area.
 6. Submit samples on the following substrates for DEN Project Manager's review of color and texture:
 - a. Concrete: Provide two 4-inch- square samples for each color and finish.
 - b. Concrete Masonry: Provide two 8-inch- square samples of masonry, with mortar joint in the center, for each finish and color.
 - c. Wood: Provide two 12-inch- square samples of each color and material on hardboard.
 - d. Ferrous and Nonferrous Metal: Provide two 4-inch- square samples of flat metal and two 8-inch- long samples of solid metal for each color and finish.
- E. Product List: For each product indicated, include the following:
1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
 3. VOC content.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials[, **from the same product run,**] that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Package coating materials in unopened, factory-sealed containers for storage and identify with labels describing contents.
1. Coatings: [**Five (5)**] <Insert number> percent, but not less than [1 gal. (3.8 L)] <Insert number> of each material and color applied.
 2. Quantity: Furnish extra coating materials in quantities indicated below:
 - a. High-Gloss, Aliphatic Polyurethane Enamel: One (1) case of each color applied.
 - b. Semigloss, Aliphatic Polyurethane Enamel: Two (2) gal. of each color applied.
 - c. High-Gloss, Waterborne, Acrylic Enamel: One (1) case of each color applied.
 - d. Semigloss, Waterborne, Acrylic Enamel: One (1) gal. of each color applied.
 - e. High-Gloss, Polyamide Epoxy Coatings: One (1) case of each color applied.
 - f. Semigloss, Polyamide Epoxy Coatings: One (1) case of each color applied.

1.7 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced applicator who has completed high-performance coating system applications similar in material and extent to those indicated for Project and whose work has a record of successful in-service performance.
- B. Source Limitations: Obtain primers and undercoat materials for each coating system from the same manufacturer as the finish coats.
- C. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution. Duplicate finish of approved sample Submittals.
1. DEN Project Manager will select one surface to represent surfaces and conditions for application of each coating system specified in Part 3.
 - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: DEN Project Manager will designate items or areas required.
 2. After permanent lighting and other environmental services have been activated, apply coatings in this room or to each surface as specified. Provide the required sheen, color, and texture of each surface.
 - a. After finishes are accepted, DEN Project Manager will use the room or surface to evaluate coating systems of a similar nature.

3. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by DEN Project Manager at no added cost to Owner.
4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
5. Subject to compliance with requirements, and if approved by DEN Project Manager, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label with the following information:
 1. Name or title of material.
 2. Product description (generic classification or binder type).
 3. Manufacturer's stock number and date of manufacture.
 4. Contents by volume, for pigment and vehicle constituents.
 5. Thinning instructions.
 6. Application instructions.
 7. Color name and number.
 8. Handling instructions and precautions.
- B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.
 3. Protect materials from freezing. Keep storage area neat and orderly.
 4. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and applying coatings.
 5. All storage methods to comply with requirements of governing authorities.

1.9 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply coatings or when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior coatings in snow, rain, fog, or mist.
- D. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before proceeding with or continuing coating operation.

- E. Work may continue during inclement weather only if areas and surfaces to be coated are enclosed and temperature within the area can be maintained within limits specified by manufacturer during application and drying periods.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Behr Process Corporation.
 2. Benjamin Moore & Co.
 3. Bennette Paint Mfg. Co., Inc.
 4. Betonel Ltd.
 5. BLP Mobile Paint Manufacturing Company, Inc.
 6. Carboline Company.
 7. Cloverdale Paint.
 8. Color Wheel Paints & Coatings.
 9. Columbia Paint & Coatings.
 10. Conco Paints.
 11. Coronado Paint.
 12. Diamond Vogel Paints.
 13. Dunn-Edwards Corporation.
 14. DuPont Company.
 15. Duron, Inc.
 16. Euclid Chemical Company.
 17. Farrell-Calhoun.
 18. Frazee Paint.
 19. General Paint.
 20. Hirshfield's, Inc.
 21. ICI Paints.
 22. ICI Paints (Canada).
 23. Insl-x.
 24. International Protective Coatings; Courtaulds Coatings (International).
 25. Kelly-Moore Paints.
 26. Kwal Paint.
 27. M.A.B. Paints.
 28. Microblend Technologies Inc.
 29. Miller Paint.
 30. Mills Paint.

31. Moore: Benjamin Moore & Co.
32. PARA Paints.
33. Parex LaHabra Inc.
34. Parker Paint Mfg. Co. Inc.
35. PPG Architectural Finishes, Inc.
36. Pratt & Lambert.
37. Rodda Paint Co.
38. Rust-Oleum Corporation.
39. Scott Paint.
40. Sherwin-Williams Company (The).
41. Sico, Inc.
42. Tnemec Company, Inc.
43. Vista Paint.
44. Zinsser.
45. **<Insert manufacturer's name>**.
46. or approved equal.

- B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles for the paint category indicated.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and are listed in "MPI Approved Products List."

- B. Material Quality: Provide manufacturer's highest grade of the various high-performance coatings specified. Materials not displaying manufacturer's product identification are not acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

- C. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.
3. Provide products of same manufacturer for each coat in a coating system.

- D. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction[**and, for interior coatings applied at project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24)**].

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Primers, Sealers, and Undercoaters: 200 g/L.
4. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: 250 g/L.
5. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
6. Pre-Treatment Wash Primers: 420 g/L.
7. Floor Coatings: 100 g/L.
8. Shellacs, Clear: 730 g/L.
9. Shellacs, Pigmented: 550 g/L.

E. Low-Emitting Materials: Interior coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. Colors: **[As selected by DEN Project Manager from manufacturer's full range] [Match DEN Project Manager's samples] [As indicated in color schedule] <Insert requirements>**.

2.3 BLOCK FILLERS

A. Block Filler, Latex, Interior/Exterior: **[MPI #4.]**

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.

B. Block Filler, Epoxy: **[MPI #116.]**

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.

2.4 INTERIOR PRIMERS/SEALERS

A. Primer Sealer, Latex, Interior: **[MPI #50.]**

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.

B. Wood-Knot Sealer: White shellac or other sealer recommended in writing by manufacturer for this purpose.

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>**.

2.5 METAL PRIMERS

A. Primer, Zinc-Rich, Inorganic: **[MPI #19.]**

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
 - B. Primer, Zinc-Rich, Epoxy:[**MPI #20.**]
 1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
 - C. Primer, Rust-Inhibitive, Water Based:[**MPI #107.**]
 1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
 - D. Primer, Epoxy, Anti-Corrosive, for Metal:[**MPI #101.**]
 1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
 - E. Primer, Vinyl Wash:[**MPI #80.**]
 1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
- 2.6 EPOXY COATINGS
- A. Epoxy, Gloss:[**MPI #77.**]
 1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
 - B. Epoxy-Modified Latex, Interior, Gloss (Gloss Level 6):[**MPI #115.**]
 1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
 - C. Epoxy, High-Build, Low Gloss:[**MPI #108.**]
 1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
 - D. Epoxy Deck Coating (Slip-Resistant):[**MPI #82.**]
 1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
- 2.7 POLYURETHANE COATINGS
- A. Polyurethane, Two-Component, Pigmented, Gloss (Gloss Level 6):[**MPI #72.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

B. Varnish, Aliphatic Polyurethane, Two-Component (Gloss Level 6 or 7):[**MPI #78.**]

1. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**

2.8 SOURCE QUALITY CONTROL

A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

- a. Concrete: 12 percent.
- b. Masonry (Clay and CMU): 12 percent.
- c. Wood: 15 percent.
- d. Gypsum Board: 12 percent.

B. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

C. Plaster Substrates: Verify that plaster is fully cured.

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

- F. Coordination of Work: Review other Sections in which primers or other coatings are provided to ensure compatibility of total systems for various substrates. On request, furnish information on characteristics of specified finish materials to ensure compatible primers.
 - 1. If a potential incompatibility of primers applied by others exists, obtain the following from the primer Applicator before proceeding:
 - a. Confirmation of primer's suitability for expected service conditions.
 - b. Confirmation of primer's ability to be top coated with materials specified.
 - 2. Notify DEN Project Manager about anticipated problems before using the coatings specified over substrates primed by others.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods to prepare surfaces.
 - 1. Use abrasive blast-cleaning methods if recommended by coating manufacturer.
 - 2. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not coat surfaces if moisture content exceeds that permitted in manufacturer's written instructions.

3. Clean surfaces with pressurized water. Use pressure range of [1500 to 4000 psi (10 350 to 27 580 kPa)] [4000 to 10,000 psi (27 580 to 68 950 kPa)] at 6 to 12 inches (150 to 300 mm).
 4. Abrasive blast clean surfaces to comply with SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
- E. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions.
1. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not coat surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
 2. Clean surfaces with pressurized water. Use pressure range of [100 to 600 psi (690 to 4140 kPa)] [1500 to 4000 psi (10 350 to 27 580 kPa)] at 6 to 12 inches (150 to 300 mm).
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer[.][**but not less than the following:**]
1. SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
 2. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
 3. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 4. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."
 5. SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
1. Scrape and clean knots. Before applying primer apply coat of knot sealer recommended in writing by topcoat manufacturer for coating system indicated.
 2. Sand surfaces that will be exposed to view and dust off.
 3. Prime edges, ends, faces, undersides, and back sides of wood.
 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- K. Material Preparation: Carefully mix and prepare coating materials in strict accordance to manufacturer's written instructions.

1. Maintain containers used in mixing and applying coatings in a clean condition, free of foreign materials and residue.
 2. Stir materials before applying to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into the material. Remove film and, if necessary, strain coating material before using.
 3. Use only the type of thinners approved by manufacturer and only within recommended limits.
- L. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
1. Use applicators and techniques suited for coating and substrate indicated.
 2. Coating colors, surface treatments, and finishes are indicated in the coating system descriptions.
 3. Provide finish coats compatible with primers used.
 4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, grilles, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 5. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 6. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 7. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Application Procedures: Apply coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brush Application: Use brushes best suited for material applied and of appropriate size for the surface or item being coated.
 - a. Apply primers and first coats by brush unless manufacturer's written instructions permit using roller or mechanical applicators.
 - b. Brush out and work brush coats into surfaces in an even film.
 - c. Eliminate cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Neatly draw glass lines and color breaks.
 2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by manufacturer for the material and texture required.

3. Spray Equipment: Use mechanical methods to apply coating if permitted by manufacturer's written instructions and governing regulations.
 - a. Use spray equipment with orifice size recommended by manufacturer for material and texture required.
 - b. Apply each coat to provide the equivalent hiding of brush-applied coats.
 - c. Do not double back with spray equipment building-up film thickness of two coats in one pass, unless recommended by manufacturer.
 4. Minimum Coating Thickness: Apply each material no thinner than manufacturer's recommended spreading rate. Provide total dry film thickness of the entire system as recommended by manufacturer.
 5. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
 6. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by manufacturer, to material required to be coated or finished that has not been prime coated by others.
 - a. Recoat primed and sealed substrates if there is evidence of suction spots or unsealed areas in first coat, to ensure a finish coat with no burn-through or other defects caused by insufficient sealing.
- C. Completed Work: Match approved Samples for color, texture, and coverage. Remove, re-finish, or recoat work that does not comply with specified requirements.
- D. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- E. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- F. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.
- 3.4 FIELD QUALITY CONTROL
- A. Dry Film Thickness Testing: Owner will engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
 1. Contractor shall touch up and restore coated surfaces damaged by testing.
 2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.
- B. Owner reserves the right to invoke the following procedure at any time and as often as

Owner deems necessary during the period when coatings are being applied:

1. Owner will engage the services of a qualified testing agency to sample coating material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform appropriate tests for the following characteristics as required by Owner:
 - a. Quantitative materials analysis.
 - b. Absorption.
 - c. Accelerated weathering.
 - d. Accelerated yellowness.
 - e. Color retention.
 - f. Alkali and mildew resistance.
 - g. Abrasion resistance.
 - h. Apparent reflectivity.
 - i. Washability.
 - j. Dry opacity.
 - k. Recoating.
 - l. Skinning.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with specified requirements. Contractor shall remove non-complying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. If necessary, Contractor may be required to remove rejected materials from previously coated surfaces if, on recoating with specified materials, the two coatings are not compatible.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by DEN Project Manager, and leave in an undamaged condition.
 1. Provide "Wet Paint" signs to protect newly coated finishes. After completing coating operations, remove temporary protective wrappings provided by others to protect their work.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.
 1. Comply with procedures specified in PDCA P1.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Concrete Substrates, Vertical Surfaces:

1. Epoxy System:

- a. Prime Coat: Epoxy, gloss[, **MPI #77**].
- b. Intermediate Coat: Epoxy, gloss[, **MPI #77**].
- c. Topcoat: Epoxy, gloss[, **MPI #77**].

B. Concrete Substrates, Horizontal Surfaces:

1. Epoxy Slip-Resistant Deck Coating System:

- a. Topcoat: Epoxy deck coating (slip-resistant)[, **MPI #82**].

C. Clay-Masonry Substrates:

1. Epoxy System:

- a. Prime Coat: Epoxy, gloss[, **MPI #77**].
- b. Intermediate Coat: Epoxy, gloss[, **MPI #77**].
- c. Topcoat: Epoxy, gloss[, **MPI #77**].

2. Pigmented Polyurethane over Epoxy System:

- a. Prime Coat: Epoxy, gloss[, **MPI #77**].
- b. Intermediate Coat: Epoxy, gloss[, **MPI #77**].
- c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].

3. Pigmented Polyurethane System:

- a. Prime Coat: As recommended in writing by topcoat manufacturer.
- b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
- c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].

D. CMU Substrates:

1. Epoxy System:

- a. Block Filler: Block filler, epoxy[, **MPI #116**].
- b. Intermediate Coat: Epoxy, gloss[, **MPI #77**].
- c. Topcoat: Epoxy, gloss[, **MPI #77**].

2. Pigmented Polyurethane over High-Build Epoxy System:

- a. Block Filler: Block filler, epoxy[, **MPI #116**].
- b. Intermediate Coat: Epoxy, high-build, low gloss[, **MPI #108**].

- c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].

E. Steel Substrates:

1. High-Build Epoxy System:

- a. Prime Coat: Primer, epoxy, anti-corrosive, for metal[, **MPI #101**].
- b. Intermediate Coat: Epoxy, high-build, low gloss[, **MPI #108**].
- c. Topcoat: Epoxy, gloss[, **MPI #77**].

2. High-Build Epoxy System:

- a. Prime Coat: Primer, epoxy, as recommended in writing by topcoat manufacturer.
- b. Intermediate Coat: Epoxy, high-build, low gloss[, **MPI #108**].
- c. Topcoat: Epoxy, gloss[, **MPI #77**].

3. Pigmented Polyurethane over Epoxy System:

- a. Prime Coat: Primer, epoxy, anti-corrosive, for metal[, **MPI #101**].
- b. Intermediate Coat: Epoxy, gloss[, **MPI #77**].
- c. First Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
- d. Second Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].

4. Pigmented Polyurethane over Epoxy System:

- a. Prime Coat: Primer, epoxy, as recommended in writing by topcoat manufacturer.
- b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
- c. First Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].

5. Pigmented Polyurethane over Epoxy Zinc-Rich Primer System:

- a. Prime Coat: Primer, zinc-rich, epoxy[, **MPI #20**].
- b. Intermediate Coat: Epoxy, gloss[, **MPI #77**].
- c. First Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].

6. Pigmented Polyurethane over Epoxy Zinc-Rich Primer System:

- a. Prime Coat: Primer, zinc-rich, epoxy[, **MPI #20**].
- b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
- c. First Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].

7. Pigmented Polyurethane over High-Build Epoxy System:

- a. Prime Coat: Primer, epoxy, anti-corrosive, for metal[, **MPI #101**].
 - b. Intermediate Coat: Epoxy, high-build, low gloss[, **MPI #108**].
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
8. Pigmented Polyurethane over High-Build Epoxy System:
- a. Prime Coat: Primer, epoxy, as recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: Epoxy, high-build, low gloss[, **MPI #108**].
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
9. Pigmented Polyurethane over Epoxy Zinc-Rich Primer and High-Build Epoxy System:
- a. Prime Coat: Primer, zinc-rich, epoxy[, **MPI #20**].
 - b. Intermediate Coat: Epoxy, high-build, low gloss[, **MPI #108**].
 - c. First Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
 - d. Second Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
10. Pigmented Polyurethane over Inorganic Zinc-Rich Primer and High-Build Epoxy System:
- a. Prime Coat: Primer, zinc-rich, inorganic[, **MPI #19**].
 - b. Intermediate Coat: Epoxy, high-build, low gloss[, **MPI #108**].
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
- F. Galvanized-Metal Substrates:
1. Epoxy System:
 - a. Prime Coat: Primer, epoxy, anti-corrosive, for metal[, **MPI #101**].
 - b. Intermediate Coat: Epoxy, gloss[, **MPI #77**].
 - c. Topcoat: Epoxy, gloss[, **MPI #77**].
 2. Epoxy System:
 - a. Prime Coat: Primer, epoxy, as recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: Epoxy, gloss[, **MPI #77**].
 - c. Topcoat: Epoxy, gloss[, **MPI #77**].
 3. Pigmented Polyurethane System:
 - a. Prime Coat: Primer, epoxy, anti-corrosive, for metal[, **MPI #101**].
 - b. Intermediate Coat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].

- c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
 4. Pigmented Polyurethane System:
 - a. Prime Coat: Primer, epoxy, as recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
 5. Pigmented Polyurethane over Vinyl Wash and Epoxy Primer System:
 - a. Prime Coat: Primer, vinyl wash[, **MPI #80**].
 - b. Intermediate Coat: Primer, epoxy, anti-corrosive, for metal[, **MPI #101**].
 - c. First Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
 - d. Second Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
 6. Pigmented Polyurethane over Vinyl Wash and Epoxy Primer System:
 - a. Prime Coat: Primer, vinyl wash[, **MPI #80**].
 - b. Intermediate Coat: Primer, epoxy, as recommended in writing by topcoat manufacturer.
 - c. First Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
 - d. Second Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
- G. Aluminum (Not Anodized or Otherwise Coated) Substrates:
 1. Epoxy System:
 - a. Prime Coat: Primer, vinyl wash[, **MPI #80**].
 - b. Intermediate Coat: Epoxy, gloss[, **MPI #77**].
 - c. Topcoat: Epoxy, gloss[, **MPI #77**].
 2. Pigmented Polyurethane System:
 - a. Prime Coat: Primer, vinyl wash[, **MPI #80**].
 - b. Intermediate Coat: Primer, epoxy, anti-corrosive, for metal[, **MPI #101**].
 - c. First Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
 - d. Second Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
 3. Pigmented Polyurethane System:
 - a. Prime Coat: Primer, vinyl wash[, **MPI #80**].

- b. Intermediate Coat: Primer, epoxy, as recommended in writing by topcoat manufacturer.
- c. First Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
- d. Second Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].

H. Wood Substrates:

1. Pigmented Polyurethane System:

- a. Prime Coat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
- b. Intermediate Coat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
- c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].

3.7 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Concrete Substrates, Vertical Surfaces:

1. Epoxy System:

- a. Prime Coat: Epoxy, gloss[, **MPI #77**].
- b. Intermediate Coat: Epoxy, gloss[, **MPI #77**].
- c. Topcoat: Epoxy, gloss[, **MPI #77**].

2. Epoxy-Modified Latex System:

- a. Prime Coat: Epoxy-modified latex, interior, gloss (Gloss Level 6)[, **MPI #115**].
- b. Intermediate Coat: Epoxy-modified latex, interior, gloss (Gloss Level 6)[, **MPI #115**].
- c. Topcoat: Epoxy-modified latex, interior, gloss (Gloss Level 6)[, **MPI #115**].

B. Concrete Substrates, Horizontal Surfaces.

1. Epoxy System:

- a. Prime Coat: Epoxy, gloss[, **MPI #77**].
- b. Intermediate Coat: Epoxy, gloss[, **MPI #77**].
- c. Topcoat: Epoxy, gloss[, **MPI #77**].

2. Pigmented Polyurethane System:

- a. Prime Coat: Epoxy, gloss[, **MPI #77**].
- b. Intermediate Coat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].

- c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
 3. Pigmented Polyurethane System:
 - a. Prime Coat: Epoxy, as recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
 4. Clear Two-Component Polyurethane System:
 - a. Prime Coat: Varnish, aliphatic polyurethane, two-component (Gloss Level 6 or 7)[, **MPI #78**].
 - b. Intermediate Coat: Varnish, aliphatic polyurethane, two-component (Gloss Level 6 or 7)[, **MPI #78**].
 - c. Topcoat: Varnish, aliphatic polyurethane, two-component (Gloss Level 6 or 7)[, **MPI #78**].
- C. Clay-Masonry Substrates:
 1. Epoxy System:
 - a. Prime Coat: Epoxy, gloss[, **MPI #77**].
 - b. Intermediate Coat: Epoxy, gloss[, **MPI #77**].
 - c. Topcoat: Epoxy, gloss[, **MPI #77**].
 2. Epoxy-Modified Latex System:
 - a. Prime Coat: Epoxy-modified latex, interior, gloss (Gloss Level 6)[, **MPI #115**].
 - b. Intermediate Coat: Epoxy-modified latex, interior, gloss (Gloss Level 6)[, **MPI #115**].
 - c. Topcoat: Epoxy-modified latex, interior, gloss (Gloss Level 6)[, **MPI #115**].
 3. Clear Two-Component Polyurethane System:
 - a. Prime Coat: Varnish, aliphatic polyurethane, two-component (Gloss Level 6 or 7)[, **MPI #78**].
 - b. Intermediate Coat: Varnish, aliphatic polyurethane, two-component (Gloss Level 6 or 7)[, **MPI #78**].
 - c. Topcoat: Varnish, aliphatic polyurethane, two-component (Gloss Level 6 or 7)[, **MPI #78**].
- D. CMU Substrates:
 1. Epoxy System:
 - a. Block Filler: Block filler, latex, interior/exterior[, **MPI #4**].
 - b. Block Filler: Block filler, epoxy[, **MPI #116**].

- c. Intermediate Coat: Epoxy, gloss[, **MPI #77**].
 - d. Topcoat: Epoxy, gloss[, **MPI #77**].
 2. Epoxy-Modified Latex System:
 - a. Block Filler: Block filler, latex, interior/exterior[, **MPI #4**].
 - b. Intermediate Coat: Epoxy-modified latex, interior, gloss (Gloss Level 6)[, **MPI #115**].
 - c. Topcoat: Epoxy-modified latex, interior, gloss (Gloss Level 6)[, **MPI #115**].
- E. Steel Substrates:
1. High-Build Epoxy System:
 - a. Prime Coat: Primer, zinc-rich, epoxy[, **MPI #20**].
 - b. Intermediate Coat: Epoxy, high-build, low gloss[, **MPI #108**].
 - c. Topcoat: Epoxy, gloss[, **MPI #77**].
 - d. Topcoat: Epoxy, high-build, low gloss[, **MPI #108**].
 2. Epoxy System:
 - a. Prime Coat: Primer, epoxy, anti-corrosive, for metal[, **MPI #101**].
 - b. Intermediate Coat: Epoxy, gloss[, **MPI #77**].
 - c. Topcoat: Epoxy, gloss[, **MPI #77**].
 3. Epoxy System:
 - a. Prime Coat: Primer, epoxy, as recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: Epoxy, gloss[, **MPI #77**].
 - c. Topcoat: Epoxy, gloss[, **MPI #77**].
 4. Epoxy-Modified Latex System:
 - a. Prime Coat: Primer, rust-inhibitive, water based[, **MPI #107**].
 - b. Intermediate Coat: Epoxy-modified latex, interior, gloss (Gloss Level 6)[, **MPI #115**].
 - c. Topcoat: Epoxy-modified latex, interior, gloss (Gloss Level 6)[, **MPI #115**].
 5. Epoxy-Modified Latex System:
 - a. Prime Coat: Primer, rust-inhibitive, as recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: Epoxy-modified latex, interior, gloss (Gloss Level 6)[, **MPI #115**].
 - c. Topcoat: Epoxy-modified latex, interior, gloss (Gloss Level 6)[, **MPI #115**].
 6. Pigmented Polyurethane System:
 - a. Prime Coat: Primer, epoxy, anti-corrosive, for metal[, **MPI #101**].

- b. Intermediate Coat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
7. Pigmented Polyurethane System:
 - a. Prime Coat: Primer, epoxy, as recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
8. Pigmented Polyurethane over Inorganic Zinc-Rich Primer System:
 - a. Prime Coat: Primer, zinc-rich, inorganic[, **MPI #19**].
 - b. Intermediate Coat: Epoxy, gloss[, **MPI #77**].
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
9. Pigmented Polyurethane over Inorganic Zinc-Rich Primer System:
 - a. Prime Coat: Primer, zinc-rich, inorganic[, **MPI #19**].
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
10. Pigmented Polyurethane over Epoxy Zinc-Rich Primer System:
 - a. Prime Coat: Primer, zinc-rich, epoxy[, **MPI #20**].
 - b. Intermediate Coat: Epoxy, gloss[, **MPI #77**].
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
11. Pigmented Polyurethane over Epoxy Zinc-Rich Primer System:
 - a. Prime Coat: Primer, zinc-rich, epoxy[, **MPI #20**].
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
12. Pigmented Polyurethane over High-Build Epoxy System:
 - a. Prime Coat: Primer, epoxy, anti-corrosive, for metal[, **MPI #101**].
 - b. Intermediate Coat: Epoxy, high-build, low gloss[, **MPI #108**].
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
13. Pigmented Polyurethane over High-Build Epoxy System:

- a. Prime Coat: Primer, epoxy, as recommended in writing by topcoat manufacturer.
- b. Intermediate Coat: Epoxy, high-build, low gloss[, **MPI #108**].
- c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].

F. Galvanized-Metal Substrates:

1. Epoxy System:

- a. Prime Coat: Primer, epoxy, anti-corrosive, for metal[, **MPI #101**].
- b. Intermediate Coat: Epoxy, gloss[, **MPI #77**].
- c. Topcoat: Epoxy, gloss[, **MPI #77**].

2. Epoxy System:

- a. Prime Coat: Primer, epoxy, as recommended in writing by topcoat manufacturer.
- b. Intermediate Coat: Epoxy, gloss[, **MPI #77**].
- c. Topcoat: Epoxy, gloss[, **MPI #77**].

3. Pigmented Polyurethane System:

- a. Prime Coat: Primer, epoxy, as recommended in writing by topcoat manufacturer.
- b. Intermediate Coat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
- c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].

G. Aluminum (Not Anodized or Otherwise Coated) Substrates:

1. Epoxy System:

- a. Prime Coat: Primer, vinyl wash[, **MPI #80**].
- b. Intermediate Coat: Epoxy, gloss[, **MPI #77**].
- c. Topcoat: Epoxy, gloss[, **MPI #77**].

2. Pigmented Polyurethane System:

- a. Prime Coat: Primer, vinyl wash[, **MPI #80**].
- b. Intermediate Coat: Epoxy, gloss[, **MPI #77**].
- c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].

3. Pigmented Polyurethane System:

- a. Prime Coat: As recommended in writing by topcoat manufacture.
- b. Intermediate Coat: As recommended in writing by topcoat manufacture.
- c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].

- H. Wood Substrates:
1. Epoxy System:
 - a. Prime Coat: Epoxy, gloss[, **MPI #77**].
 - b. Intermediate Coat: Epoxy, gloss[, **MPI #77**].
 - c. Topcoat: Epoxy, gloss[, **MPI #77**].
 2. Pigmented Polyurethane System:
 - a. Prime Coat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
 - b. Intermediate Coat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
- I. **[Gypsum Board] [Plaster]** Substrates:
1. Epoxy System:
 - a. Prime Coat: Primer sealer, latex, interior[, **MPI #50**].
 - b. Intermediate Coat: Epoxy, gloss[, **MPI #77**].
 - c. Topcoat: Epoxy, gloss[, **MPI #77**].
 2. Epoxy-Modified Latex System:
 - a. Prime Coat: Primer sealer, latex, interior[, **MPI #50**].
 - b. Intermediate Coat: Epoxy-modified latex, interior, gloss (Gloss Level 6)[, **MPI #115**].
 - c. Topcoat: Epoxy-modified latex, interior, gloss (Gloss Level 6)[, **MPI #115**].

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 099600

SECTION 099633 - HIGH-TEMPERATURE-RESISTANT COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes surface preparation and application of high-temperature-resistant coating systems on steel substrates.
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.
 - 2. Section 099113 "Exterior Painting" for special-use coatings and general field painting.
 - 3. Section 099123 "Interior Painting" for special-use coatings and general field painting.
 - 4. Section 099600 "High-Performance Coatings" for special-use coatings and general field painting.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- B. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.
 - 1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference the specific coating, finish system, and application. Identify each material by the manufacturer's catalog number and general classification.
 - 2. Manufacturer's Information: Manufacturer's technical information, including label

analysis and instructions for handling, storing, and applying each material proposed for use.

3. Certification by the manufacturer that products supplied comply with local regulations controlling the use of VOCs.
4. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Product Data for Credit EQ 4.2: For interior coatings, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit EQ 4: For interior coatings, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Samples for Initial Selection: For each type of topcoat product indicated. Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.

D. Samples for Verification: For each type of coating system and in each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Step coats on Samples to show each coat required for system, including primers. Use representative colors when preparing Samples for review. Resubmit until the required sheen, color, and texture are achieved and approved by DEN Project Manager.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.
5. Submit two (2) 4-inch- square Samples of flat metal for the DEN Project Manager's review of color and texture.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.6 QUALITY ASSURANCE

A. Applicator Qualifications: An experienced applicator who has completed high-temperature-resistant coating system applications similar in material and extent to that indicated for the Project and with a record of successful in-service performance.

B. Source Limitations: Obtain primers and undercoat materials for each coating system from the same manufacturer as finish coats.

- C. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution. Duplicate finish of approved sample Submittals.
1. DEN Project Manager will select one surface to represent surfaces and conditions for application of each coating system specified in Part 3.
 - a. Surfaces Greater Than 200 Sq. Ft. (18.5 Sq. M): Provide mockups of at least 100 sq. ft. (9 sq. m).
 - b. Other Surfaces: DEN Project Manager will designate items or areas required.
 2. After permanent lighting and other environmental services have been activated, apply high-temperature-resistant coatings to each surface according to the Coating Schedule or as specified. Provide required sheen, color, and texture on each surface.
 3. After finishes are accepted, the DEN Project Manager will use the surface to evaluate coating systems of a similar nature.
 4. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by DEN Project Manager at no added cost to Owner.
 5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 6. Subject to compliance with requirements, and if approved by DEN Project Manager, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label with the following information:
1. Name or title of material.
 2. Product description (generic classification or binder type).
 3. Manufacturer's stock number and date of manufacture.
 4. Contents by volume, for pigment and vehicle constituents.
 5. Thinning instructions.
 6. Application instructions.
 7. Color name and number.
 8. Handling instructions and precautions.
- B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.
3. Protect materials from freezing. Keep storage area neat and orderly.
4. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and applying coatings.
5. All storage methods to comply with requirements of governing authorities.

1.8 FIELD CONDITIONS

- A. Manufacturer's Written Recommendations: Comply with manufacturer's written recommendations for optimum temperature and humidity conditions for applying and curing high-temperature-resistant coatings. Do not apply coatings until these conditions have been attained and stabilized.
- B. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between **50 and 104 deg F** (10 and 40 deg C).
- C. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than **5 deg F** (3 deg C) above the dew point; or to damp or wet surfaces.
- D. Do not apply exterior coatings in snow, rain, fog, or mist.
 1. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before proceeding with coating operation.
 2. Coating application may continue during inclement weather only if surfaces to be coated are enclosed and heated within temperature limits specified by the manufacturer during application and curing periods.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Benjamin Moore & Co.
 2. BLP Mobile Paint Manufacturing Company, Inc.
 3. Carboline Company.
 4. Cloverdale Paint.
 5. Columbia Paint & Coatings.

6. Coronado Paint.
7. Devoe Coatings Company.
8. Diamond Vogel Paints.
9. Frazee Paint.
10. General Paint.
11. Glidden Co., The.
12. ICI Paints.
13. ICI Paints (Canada).
14. Insl-x.
15. Kwal Paint.
16. M.A.B. Paints.
17. Mills Paint.
18. PARA Paints.
19. Parker Paint Mfg. Co. Inc.
20. Porter International.
21. PPG Architectural Finishes, Inc.
22. Rodda Paint Co.
23. Rust-Oleum Corporation.
24. Sherwin-Williams Company (The).
25. Sico, Inc.
26. Tnemec Company, Inc.
27. **<Insert manufacturer's name>**.
28. or approved equal.

- B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles for the category indicated.

2.2 HIGH-TEMPERATURE-RESISTANT COATINGS, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and are listed in "MPI Approved Products List."
- B. Material Quality: Provide manufacturer's highest grade of the various high-performance coatings specified. Materials not displaying manufacturer's product identification are not acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

- C. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.

3. Provide products of same manufacturer for each coat in a coating system.
- D. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction[**and, for interior coatings applied at project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24)**].
1. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: 250 g/L.
 2. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 3. High Temperature Industrial Maintenance Coatings: 420 g/L.
- E. Low-Emitting Materials: Interior coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. Colors: [As selected by DEN Project Manager from manufacturer's full range] [Match DEN Project Manager's samples] [As indicated in color schedule] <Insert requirements>.
- 2.3 HIGH-TEMPERATURE-RESISTANT COATINGS
- A. Primer, Zinc-Rich, Inorganic:[**MPI #19.**]
1. <Insert, in separate subparagraphs, manufacturer's name; product name or designation>.
- B. Heat Resistant Enamel (Gloss Level 5 or 6):[**MPI #21.**]
1. <Insert, in separate subparagraphs, manufacturer's name; product name or designation>.
- C. Aluminum Paint, Heat-Resistant:[**MPI #2.**]
1. <Insert, in separate subparagraphs, manufacturer's name; product name or designation>.
- D. Aluminum Paint, High Heat:[**MPI #22.**]
1. <Insert, in separate subparagraphs, manufacturer's name; product name or designation>.
- 2.4 SOURCE QUALITY CONTROL
- A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:
1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when

samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.

2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.
- D. Coordination of Work: Review other Sections in which primers or other coatings are provided to ensure compatibility of total systems for various substrates. On request, furnish information on characteristics of specified finish materials to ensure compatible primers.
 1. Where a potential incompatibility of primers applied by others exists, obtain the following from the applicator of the primer before proceeding:
 - a. Confirmation of the suitability of the primer for the expected service temperature.
 - b. Confirmation of the primer's ability to be topcoated with materials specified.
 2. Notify the DEN Project Manager about anticipated problems using the coatings specified over substrates primed by others.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer[.][**but not less than the following:**]
1. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
 2. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 3. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."
 4. SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Material Preparation: Mix and prepare materials according to coating manufacturer's written instructions.
1. Maintain containers used for mixing and applying coatings in a clean condition, free of foreign materials and residue.
 2. Stir materials before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain coating material before using.
 3. Use only the type of thinners approved by manufacturer and only within recommended limits.

3.3 APPLICATION

- A. Apply high-temperature-resistant coating systems according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
1. Use applicators and techniques suited for coating and substrate indicated.
 2. Do not apply coatings over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to forming a durable coating film.
 3. Coating colors, surface treatments, and finishes are indicated in the schedules.
 4. Provide finish coats compatible with primers used.

5. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, grilles, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 6. Coat surfaces behind movable items same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed items with prime coat only.
 7. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 8. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Scheduling Coating: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for coating as soon as practicable after preparation and before subsequent surface deterioration.
1. Number of coats and film thickness required is the same regardless of application method employed. Do not apply succeeding coats until previous coat has cured, as recommended by the manufacturer.
 2. When undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance. Give special attention to edges, corners, crevices, welds, exposed fasteners, and similar surfaces to ensure they receive a dry film thickness equivalent to that of flat surfaces.
 3. Allow sufficient drying time between successive coats to permit proper curing. Do not recoat until coating has dried so it feels firm and does not deform or feel sticky under moderate thumb pressure, and where applying another coat does not cause undercoat to lift or lose adhesion.
- C. Application Procedures: Apply coatings by brush, roller, or spray according to the manufacturer's written instructions.
1. Brushes: Use brushes best suited for material applied. Use brush of appropriate size for surface or item being coated.
 2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for material and texture required.
 3. Spray Equipment: Use spray equipment with orifice size as recommended by the manufacturer for material and texture required.
- D. Minimum Coating Thickness: Apply each material no thinner than the manufacturer's recommended spreading rate. Provide total dry film thickness of entire system as recommended by the manufacturer.
- E. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to substrate to be coated that has not been prime coated by others. Recoat primed and sealed substrates where there is evidence of suction spots or unsealed areas in first coat to ensure a finish coat with no burn through or other defects caused by insufficient sealing.
- F. Brush Application: Brush-out and work brush coats into surfaces in an even film.

Eliminate cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Neatly draw color breaks.

1. Apply primers and first coats by brush, unless the manufacturer's written instructions permit using mechanical applicators.
- G. Mechanical Applications: Use mechanical methods to apply coating when permitted by the manufacturer's written recommendations and governing regulations.
1. Where using spray application, apply each coat to provide equivalent hiding of brush-applied coats. Do not double back with spray equipment, building up film thickness of two coats in one pass, unless recommended by manufacturer.
- H. Completed Work: Match approved Samples for color, texture, and coverage. Remove, re-finish, or recoat work not complying with requirements.
- I. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- J. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner will engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
1. Contractor shall touch up and restore coated surfaces damaged by testing.
 2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.
- B. Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when coatings are being applied:
1. Owner will engage the services of a qualified testing agency to sample coating material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 2. Testing agency will perform appropriate tests for the following characteristics as required by Owner:
 - a. Quantitative materials analysis.
 - b. Absorption.
 - c. Accelerated weathering.
 - d. Accelerated yellowness.
 - e. Color retention.
 - f. Alkali and mildew resistance.
 - g. Abrasion resistance.
 - h. Apparent reflectivity.

- i. Washability.
 - j. Dry opacity.
 - k. Recoating.
 - l. Skinning.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with specified requirements. Contractor shall remove non-complying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. If necessary, Contractor may be required to remove rejected materials from previously coated surfaces if, on recoating with specified materials, the two coatings are not compatible.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by DEN Project Manager, and leave in an undamaged condition.
 1. Provide "Wet Paint" signs to protect newly coated finishes. After completing coating operations, remove temporary protective wrappings provided by others to protect their work.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.
 1. Comply with procedures specified in PDCA P1.

3.6 HIGH-TEMPERATURE-RESISTANT COATING SCHEDULE

- A. Heat-Resistant Enamel System:
 1. Prime Coat: Primer recommended in writing for use in coating system and under conditions indicated by manufacturer of topcoat.
 2. Top Coat(s): Heat resistant enamel (Gloss Level 5 or 6)[, **MPI #21**]. Provide number of topcoats recommended in writing for use in coating system and under conditions indicated by manufacturer[**but not less than two**].
- B. Inorganic Zinc-Rich Coating System:
 1. Prime Coat: Primer, zinc-rich, inorganic[, **MPI #19**].

2. Top Coat(s): Primer, zinc-rich, inorganic[, **MPI #19**]. Provide number of topcoats recommended in writing for use in coating system and under conditions indicated by manufacturer[**but not less than two**].
- C. Aluminum Heat-Resistant Paint System:
1. Prime Coat: Primer recommended in writing for use in coating system and under conditions indicated by manufacturer of topcoat.
 2. Top Coat(s): Aluminum paint, heat-resistant[, **MPI #2**]. Provide number of topcoats recommended in writing for use in coating system and under conditions indicated by manufacturer[**but not less than two**].
- D. High-Heat-Resistant Coating System:
1. Prime Coat: Primer recommended in writing for use in coating system and under conditions indicated by manufacturer of topcoat.
 2. Top Coat(s): Aluminum paint, high heat[, **MPI #22**]. Provide number of topcoats recommended in writing for use in coating system and under conditions indicated by manufacturer[**but not less than two**].

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 099633

SECTION 099646 - INTUMESCENT PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes surface preparation and application of fire-retardant intumescent paint to [**interior**] [**and**] [**exterior**] items and surfaces.
- B. Related Sections:
 - 1. Section 078100 "Applied Fireproofing" for fire-resistance-rated intumescent mastic materials.
 - 2. Section 099113 "Exterior Painting" for primers, finish coats, and wood stains that may be used with intumescent paint finishes.
 - 3. Section 099123 "Interior Painting" for primers, finish coats, and wood stains that may be used with intumescent paint finishes.
 - 4. Section 099300 "Staining and Transparent Finishing" for primers, finish coats, and wood stains that may be used with intumescent paint finishes.
 - 5. Section 099633 "High-Temperature-Resistant Coatings" for special coatings designed to protect steel from extremely high temperatures.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Product List: Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include manufacturer's recommended spreading rate for each separate coat for each type of substrate indicated.
 - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2 that specifies coatings approved by MPI, with the proposed product highlighted.
 - 3. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:

1. Product Data for Credit IEQ 4.2: For interior paints and coatings, documentation including printed statement of VOC content.
 2. Laboratory Test Reports for Credit IEQ 4: For interior paints and coatings, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Samples for Initial Selection: For each intumescent paint finish indicated.
- D. Samples for Verification: For each type of coating system and each color and gloss of intumescent paint finish indicated.
1. Submit Samples on [**rigid backing**] [**actual substrate**], not less than [**8 inches (200 mm) square**] <Insert dimension>.
 2. Step coats on Samples to show each coat required for system.
 3. Label each coat of each Sample.
 4. Label each Sample for location and application area.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Test Reports: For each intumescent paint.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that are from same production run (batch mix) as materials applied and that are packaged with protective covering for storage and identified with labels describing contents.
1. Quantity: Furnish an additional [**5**] <Insert number> percent of each color applied, but not less than [**1 gal. (3.8 L)**] <Insert value> of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain each paint system from single source from single manufacturer or provide a system approved in writing by intumescent paint manufacturer.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less..
 2. Smoke-Developed Index: [**450 or less**] <Insert requirements>.
- C. MPI Standards: Comply with indicated requirements for the following:

1. Products: MPI standards indicated and listed in "MPI Approved Products List."
 2. Preparation and Workmanship: "MPI Architectural Painting Specification Manual" for products and paint systems indicated.
- D. Mockups: Apply benchmark Samples of paint system indicated and of each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. DEN Project Manager will select one [**actual substrate of each type**] <Insert requirements> to represent surfaces and conditions for application of coating.
 - a. Wall Surfaces: Prepare Samples of at least [100 sq. ft. (9.3 sq. m)] <Insert dimension>.
 2. Apply benchmark Samples after permanent lighting and other environmental services have been activated.
 3. Final approval of color selections will be based on benchmark Samples.
 - a. If preliminary color selections are not approved, apply benchmark Samples of additional colors selected by DEN Project Manager at no added cost to Owner.
- E. Preinstallation Conference: Conduct conference at [**Project site**] [**location and time as determined by DEN Project Manager**] <Insert location>.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.8 PROJECT CONDITIONS

- A. Apply waterborne intumescent paints only when temperatures of surfaces to be painted and ambient air temperatures are between 50 and 90 deg F (10 and 32 deg C).
- B. Apply solvent-thinned intumescent paints only when temperatures of surfaces to be painted and ambient air temperatures are between 45 and 95 deg F (7 and 35 deg C).
- C. Do not apply intumescent paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
- D. Allow wet surfaces to dry thoroughly and to attain temperature and conditions specified before starting or continuing coating operation.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 INTUMESCENT PAINT MATERIALS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each material or coat, provide products and spreading rates recommended in writing by intumescent paint manufacturer for use on substrate indicated. Comply with requirements for fire-retardant coating classification and surface-burning characteristics indicated.

- B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction[**and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24)**].

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Primers, Sealers, and Undercoaters: VOC not more than 200 g/L.
4. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
5. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
6. Shellacs, Clear: 730 g/L.
7. Shellacs, Pigmented: 550 g/L.

- C. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- D. Colors and Gloss: [**As selected by DEN Project Manager from manufacturer's full range**] [**Match DEN Project Manager's samples**] [**As indicated in a color schedule**] <Insert requirements>.

2.2 EXTERIOR, PIGMENTED, INTUMESCENT PAINT SYSTEM

- A. Primer: Intumescent paint manufacturer's recommended primer, if required, compatible with substrate and other materials indicated.

1. VOC Content: <Insert number>.

- B. Fire-Retardant Intumescent Paint and Overcoat: Fire-retardant paint for exterior wood surfaces and fire-inert, weather-resistant, protective overcoat that will not affect fire-retardant class of intumescent coating.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Flame Control Coatings, LLC; No. 149; flat finish[**and No. 400; semigloss finish**].
 - b. Magna Coatings Technology Inc.; SafeCoat Exterior Intumescent and SafeCoat 725 Sealer/Overcoat; [**satin**] [**semigloss**] [**gloss**] finish.
 - c. Albi Manufacturing, a division of StanChem, Inc.; Albi-Cote 107A and Albi 144 Fire Inert Semigloss Overcoat.
 - d. Fire Research Laboratories/Ocean Fire Retardants Inc.; FireCoat 320 and [**TopCoat A, clear**] [**TopCoat X, pigmented**] **<Insert gloss>**.
 - e. NoFire Technologies, Inc.; A-18; flat finish[/**manufacturer-approved topcoat**] **<Insert topcoat>**.
 - f. **<Insert manufacturer's name; product name or designation>**.
 - g. or approved equal.
 2. VOC Content: **<Insert number>**.

2.3 INTERIOR, PIGMENTED, INTUMESCENT PAINT SYSTEM

- A. Primer: Intumescent paint manufacturer's recommended primer compatible with substrate and other materials indicated.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Albi Manufacturing, a division of StanChem, Inc.; [**no coating required**] [**primer approved by Albi**] [**Albi 490W**].
 - b. Benjamin Moore & Co.; Fresh Start 217 Alkyd Enamel Underbody or Super Spec C245 Alkyd Enamel Undercoater/Primer Sealer.
 - c. Fire Research Laboratories/Ocean Fire Retardants Inc.; latex primer approved by manufacturer.
 - d. Flame Control Coatings, LLC; [**no coating required**] [**No. 3001 Primer**].
 - e. International Fire Resistant Systems, Inc.; primer approved by manufacturer.
 - f. Magna Coatings Technology Inc.; [**no coating required**] [**SafeCoat 725 Sealer/Overcoat**].
 - g. Muralo Company (The); [**no coating required**] [**Cedar Solution #2201**].
 - h. NoFire Technologies, Inc.; [**no coating required**] [**primer approved by manufacturer**].
 - i. PPG Industries, Inc.; Speed Hide 6-6 interior quick-drying enamel undercoater.
 - j. **<Insert manufacturer's name; product name or designation>**.
 - k. or approved equal.
 2. VOC Content: **<Insert number>**.

- B. Fire-Retardant Intumescent Paint: Solvent-based, modified-alkyd-type, fire-retardant paint for interior wood and other combustible surfaces[; **MPI #63**].
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Flame Control Coatings, LLC; [**No. 10-10**] [**No. 10-10A**]; flat finish.
 - b. Albi Manufacturing; a division of StanChem, Inc.; Albi-Cote 107A; flat finish.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
 2. VOC Content: E Range of [**E1**] [**E2**] [**E3**].
 3. VOC Content: **<Insert number>**.
- C. Fire-Retardant Intumescent Paint: Water-based, latex-type, fire-retardant paint for interior wood and other combustible surfaces[; **MPI #64**].
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Benjamin Moore & Co.; M59 220.
 - b. Flame Control Coatings, LLC; No. 20-20; flat finish.
 - c. Magna Coatings Technology Inc.; SafeCoat 451.
 - d. Muralo Company (The); 1500; flat finish.
 - e. NoFire Technologies, Inc.; A-18; flat finish.
 - f. PPG Industries, Inc.; Speed Hide 42-7; flat finish.
 - g. **<Insert manufacturer's name; product name or designation>**.
 - h. Albi Manufacturing, a division of StanChem, Inc.; Albi-Cote FRL; flat finish.
 - i. Fire Research Laboratories/Ocean Fire Retardants Inc.; FireCoat 320; flat finish.
 - j. Flame Control Coatings, LLC; No. 320A.
 - k. International Fire Resistant Systems, Inc.; Firefree88; flat finish.
 - l. **<Insert manufacturer's name; product name or designation>**.
 - m. or approved equal.
 2. VOC Content: E Range of [**E1**] [**E2**] [**E3**].
 3. VOC Content: **<Insert number>**.
- D. Topcoat/Overcoat: Solvent-based, alkyd-type, pigmented, fire-inert, protective-finish coating that will not affect fire-retardant class of intumescent coating.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Albi Manufacturing, a division of StanChem, Inc.; Albi 144 semigloss fire-inert alkyd coating.
 - b. Fire Research Laboratories/Ocean Fire Retardants Inc.; [**no coating required**] [**TopCoat A, clear**] [**TopCoat X, pigmented**].
 - c. Flame Control Coatings, LLC; [**no coating required**] [**No. 30-30; semigloss finish**] [**No. 666A; semigloss finish**].
 - d. International Fire Resistant Systems, Inc.; [**no coating required**] [**coating approved by International Fire Resistant Systems**].
 - e. **<Insert manufacturer's name; product name or designation>**.

- f. or approved equal.
 2. VOC Content: **<Insert number>**.
- E. Topcoat/Overcoat: Water-based, latex-type, pigmented, fire-inert, protective-finish coating that will not affect fire-retardant class of intumescent coating[; **MPI #67**].
1. Products: Subject to compliance with requirements, provide one of the following:
 2. Product in second option in first subparagraph below complies with MPI #67. It can be used as an overcoat for No. 10-10 or No. 20-20. MPI lists the distributor of this product, rather than the manufacturer, as the listing manufacturer. Retain subparagraph if retaining only MPI-approved products. Other manufacturers do not recommend an overcoat but their intumescent product may be listed in MPI #67.
 - a. Flame Control Coatings, LLC; **[no coating required] [No. 40-40; low gloss finish]**.
 - b. Benjamin Moore & Co.; no coating permitted.
 - c. Magna Coatings Technology Inc.; no coating recommended.
 - d. Muralo Company (The); no coating required.
 - e. NoFire Technologies, Inc.; latex-based coating approved by NoFire.
 - f. PPG Industries, Inc.; no coating recommended.
 - g. Albi Manufacturing; a division of StanChem, Inc.; **[no coating required] [Albi-Cote TC Latex Semi Gloss]**.
 - h. **<Insert manufacturer's name; product name or designation>**.
 - i. or approved equal.
 3. VOC Content: E Range of **[E1] [E2] [E3]**.
 4. VOC Content: **<Insert number>**.

2.4 INTERIOR, CLEAR, INTUMESCENT PAINT SYSTEM

- A. Stain Coat: Factory-formulated, nonbleeding, solvent-based, alkyd-type penetrating wood stain.
1. Stain approved by intumescent paint manufacturer.
- B. Clear Sanding Sealer: Solvent-based, modified-alkyd type for interior wood surfaces[; **MPI #65**];
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Flame Control Coatings, LLC; No. 6 Clear Wood Sealer.
 - b. Fire Research Laboratories/Ocean Fire Retardants Inc.; sealer approved by Fire Research Laboratories.
 - c. Flame Control Coatings, LLC; No. 66 Clear Wood Sealer, Low VOC.
 - d. Magna Coatings Technology Inc.; SafeCoat 725 Sealer/Overcoat.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.

2. VOC Content: E Range of [E1] [E2] [E3].
 3. VOC Content: <Insert number>.
- C. Fire-Retardant Intumescent Paint: Solvent- or water-based, fire-retardant paint for interior wood and other combustible surfaces[; **MPI #62**].
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Flame Control Coatings, LLC; No. 166; satin finish.
 - b. Magna Coatings Technology Inc.; SafeCoat 747 Clear Fire-Retardant Coating; satin finish.
 - c. Fire Research Laboratories/Ocean Fire Retardants Inc.; ClearCoat II; [flat] [satin] finish.
 - d. <Insert manufacturer's name; product name or designation>.
 - e. or approved equal.
 2. VOC Content: E Range of [E1] [E2] [E3].
 3. VOC Content: <Insert number>.
- D. Topcoat/Overcoat: Protective fire-inert clear coating that will not affect fire-test-response characteristics of intumescent coating[; **MPI #66**].
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Flame Control Coatings, LLC; No. 167; [low gloss] [semigloss] [gloss] finish.
 - b. Fire Research Laboratories/Ocean Fire Retardants Inc.; TopCoat A; [flat] [satin] [semigloss] [gloss] finish.
 - c. Magna Coatings Technology Inc.; SafeCoat 725 Sealer/Overcoat; [satin] [semigloss] [gloss] finish.
 - d. <Insert manufacturer's name; product name or designation>.
 - e. or approved equal.
 2. VOC Content: E Range of [E1] [E2] [E3].
 3. VOC Content: <Insert number>.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with manufacturer's requirements for surface treatments, shop-primed surfaces, maximum moisture content, and other conditions affecting performance of the Work.
- B. Begin coating only when moisture content of wood substrate is 15 percent or less when measured with an electronic moisture meter.
- C. Begin coating no sooner than [28] <Insert number> days after substrate is constructed and is visually dry on both sides.

- D. Verify suitability of substrates, including surface conditions, and compatibility with existing finishes and primers.
- E. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions[**and recommendations in the "MPI Architectural Painting Specification Manual"**] applicable to substrates and coating systems indicated.
- B. Remove hardware and hardware accessories, plates, machined surfaces, light fixtures, and similar items already installed that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
 - 1. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances, including dirt, oil, grease, and incompatible paints and encapsulants, that could impair bond of coatings. Do not coat surfaces if surface moisture content or alkalinity exceeds that permitted in manufacturer's written instructions.
 - 1. Remove incompatible primers, and reprime substrate with compatible primers as required to produce coating systems indicated.
 - 2. Perform cleaning and coating application so dust and other contaminants from cleaning process will not fall on wet, newly coated surfaces.

3.3 APPLICATION

- A. General: Apply intumescent paints according to manufacturer's written instructions and to comply with requirements for fire-retardant coating classification.
 - 1. Use equipment and techniques best suited for substrate and type of material being applied.
 - 2. Coat surfaces behind movable items the same as similar exposed surfaces.
 - 3. Apply each coat separately according to manufacturer's written instructions.
 - 4. Finish doors on faces with intumescent finish. Paint tops, bottoms, and side edges with fire-inert finish.
- B. Apply coatings to prepared surfaces as soon as practical after preparation and before subsequent surface soiling or deterioration.
- C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

1. Pigmented Finishes: If undercoats or other conditions show through pigmented topcoat/overcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
2. Clear Finishes: Produce a smooth surface film of even sheen[**using multiple coats**].

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by DEN Project Manager, and leave in an undamaged condition.
- D. At completion of construction activities, touch up and restore damaged or defaced coated surfaces.

3.5 PAINT SYSTEM SCHEDULE

- A. Prime Coat: If required and approved by intumescent paint manufacturer.
- B. Fire-Retardant Intumescent Coating: Minimum [**two coats**] [**one coat**] to comply with requirements for fire-retardant coating classification and surface-burning characteristics indicated.
- C. Topcoat/Overcoat: Apply if required or recommended and approved by intumescent paint manufacturer.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 099646

SECTION 099653 - ELASTOMERIC COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes surface preparation and application of elastomeric coatings to the following exterior substrates:
 - 1. Concrete.
 - 2. Concrete unit masonry.
 - 3. Clay masonry.
 - 4. Stucco.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include data substantiating that materials comply with requirements.
 - 2. Samples for Initial Selection: For each type of elastomeric coating indicated.
- B. Samples for Verification: For each type of elastomeric coating indicated and in each color and gloss.
 - 1. Submit Samples on same type of substrate as that to receive application, **8 inches** (200-mm) square.
 - 2. Step coats on Samples to show each separate coat, including primers and block fillers as applicable.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- C. Product List: For each product indicated, including the following:
 - 1. Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Manufacturer's recommended spreading rate for each separate coat, including primers and block fillers for each type of substrate as applicable.

3. Printout of current "MPI Approved Products List" for each product category specified in Part 2 that specifies coatings approved by MPI, with the proposed product highlighted.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that are from same production run (batch mix) as materials applied and that are packaged for storage in unopened, factory-sealed containers and identified with labels describing contents.

1. Quantity: Furnish an additional [5] <Insert number> percent but not less than [1 gal. (3.8 L)] <Insert quantity> of each material, color, and texture applied.

1.5 QUALITY ASSURANCE

- A. MPI Standards: Comply with MPI standards indicated and provide elastomeric coatings listed in the "MPI Approved Products List."

1. Preparation and Workmanship: Comply with requirements in the "MPI Architectural Painting Specification Manual" for products and coating systems indicated.

- B. Mockups: Prepare [two] <Insert number> mockups of each coating system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. DEN Project Manager will select [two] <Insert number> wall surfaces of at least [100 sq. ft. (9.3 sq. m)] <Insert size> to represent surfaces and conditions for application of each type and texture of elastomeric coating.
2. Final approval of color and texture selections will be based on mockups.
 - a. If preliminary color selections are not approved, prepare additional mockups of additional color and textures selected by DEN Project Manager at no added cost to Owner.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 PROJECT CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and ambient air

temperatures are between **50 and 90 deg F** (10 and 32 deg C) unless otherwise permitted by manufacturer's written instructions.

- B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than **5 deg F** (3 deg C) above the dew point; or to damp or wet surfaces.
- C. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before starting or continuing coating operation.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace elastomeric coatings that fail within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Water penetration through the coating.
 - b. Deterioration of coating beyond normal weathering.
 - c. **<Insert failure modes>**.
 - 2. Warranty Period: Minimum [**five (5)**] [**ten (10)**] **<Insert number>** years from date of Substantial Completion.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Material Compatibility:
 - 1. Provide elastomeric finish coatings and crack fillers, primers, and block fillers as applicable for use within elastomeric finish coatings that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each material or coat, provide products and spreading rates recommended in writing by elastomeric coating manufacturer for use on substrate indicated.

2.2 ELASTOMERIC FINISH COATINGS

- A. Exterior Non-Flat Waterborne, Pigmented Elastomeric Coating[: **MPI #38**].

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Thoro Thorolastic.
 - b. Benjamin Moore & Co.; Moorlastic.
 - c. Envirocoat Technologies Inc.; [**Envirocoat, Ceramic Insulcoat - Wall**] [**Liquid Ceramic Exterior Wall Coat**].
 - d. Euclid Tamms; Tamms Tammolastic.
 - e. Flex Bon Paints; Ext. 100% Acrylic Elastomeric Waterproof.
 - f. Frazee Paint & Wallcovering; EMC Elasto-Wall, Smooth Elastomeric Finish.
 - g. Kryton Canada Corporation; Kryton Wall Gard.
 - h. Modco Technology Ltd.; General Paint, Elastocoat.
 - i. Parker Paint Mfg. Co. Inc., a subsidiary of PPI; Ext. Acrylic Elastomeric.
 - j. L & L Coatings Corporation; 300 Mastic (Brush, Roller, and Airless Spray Grade).
 - k. <Insert manufacturer's name; product name or designation>.
 - l. or approved equal.
2. Surface Profile: [**Smooth**] [**Fine**] <Insert profile> texture.
3. VOC Content: [**100 g/L or less**] [**Less than 51 g/L**] <Insert limit>.
4. Moisture-Vapor Transmission: Minimum <Insert perms (metric perms)>, based on testing according to ASTM D 1653.

B. Exterior Flat Waterborne, Pigmented Elastomeric Coating[: **MPI #113**].

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cloverdale Paint; [**Towerthon Elastomeric Coating**] [**Towerthon Plus Elastomeric Coating**].
 - b. Columbia Paint & Coatings; Hi Performance [**Flex Pro Elastomeric Coating**] [**Elastech 100% Acry. Elastomeric Coating**].
 - c. Coronado Paint Company; Elast-O-Meric Acrylic Membrane - 20 mil.
 - d. Diamond Vogel Paints; Permafex Elastomeric Latex Coating.
 - e. ICI Paints; Decra-Flex Elastomeric Coating.
 - f. Kelly-Moore Paints; Kel-Seal Terpolymer 100% Acrylic Elastomeric.
 - g. Kwal Paint; Kwal Accu-Pro Elasto Wall.
 - h. Miller Paint Co.; Milastic Elastomeric Coating.
 - i. Mills Paint; Weather Flex Elastomeric Coating.
 - j. Modco Technology Ltd.; Elastocoat Acrylic Elastomeric Paint.
 - k. Parker Paint Mfg. Co. Inc., a subsidiary of PPI; EMC Elastomeric Coating.
 - l. PPG Industries; Pitt-Flex Elastomeric Coating.
 - m. Pratt & Lambert; Pro-Hide Gold Ext. Elastomeric Coating.
 - n. Rodda Paint Co.; Super Roflex Acrylic Elastomeric Coating.
 - o. Sherwin-Williams Company (The); Sherlastic Elastomeric Coating.
 - p. Spectra-Tone Paint Corporation; Elasto-Coat High Build Waterproofing Coating.
 - q. Teifs; Professional Coatings, TeifsLastic.
 - r. Vista Paint; Solotex.
 - s. BASF Building Systems; Sonneborn Colorflex.
 - t. Fox Industries, Inc.; FX-501 Elastomeric Coating.

- u. L & L Coatings Corporation; 300 Mastic (Brush, Roller, and Airless Spray Grade).
 - v. M.A.B. Paints; [**Acra-Lastic Series**] [**Motite Elastomeric Coating**].
 - w. Neogard, a division of Jones-Blair Company; Neoflex.
 - x. Pacific Polymers International, Inc.; [**Elasto-Tex Wallcoating**] [**Elasto-Tex Wallcoating H.S.**].
 - y. Sto Corp.; Stochastic.
 - z. Tnemec Company, Inc.; Enviro-Crete Series.
 - aa. <Insert manufacturer's name; product name or designation>.
 - bb. or approved equal.
- 2. Surface Profile: [**Smooth**] [**Fine**] <Insert profile> texture.
 - 3. VOC Content: [**100 g/L or less**] [**Less than 51 g/L**] <Insert limit>.
 - 4. Moisture-Vapor Transmission: Minimum <Insert perms (metric perms)>, based on testing according to ASTM D 1653.

2.3 OTHER MATERIALS

- A. Crack Fillers: Elastomeric coating manufacturer's recommended, factory-formulated crack fillers or sealants, including crack filler primers, compatible with substrate and other materials indicated; VOC content complying with limits of authorities having jurisdiction.
- B. Primer: Elastomeric coating manufacturer's recommended, factory-formulated, alkali-resistant primer compatible with substrate and other materials indicated.
 - 1. VOC Content: [**650 g/L or less**] [**450 g/L or less**] [**Less than 351 g/L**] [**200 g/L or less when thinned to manufacturer's maximum recommendation**] [**100 g/L or less**] <Insert limit>.
- C. Concrete Unit Masonry Block Filler: Elastomeric coating manufacturer's recommended, factory-formulated, high-performance latex block filler compatible with substrate and other materials indicated.
 - 1. VOC Content: [**200 g/L or less**] [**100 g/L or less**] [**Less than 51 g/L**] <Insert limit>.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with manufacturer's requirements for maximum moisture content, alkalinity, and other conditions affecting performance of work.
- B. Begin coating only when moisture content of substrate is 12 percent or less when measured with an electronic moisture meter.

- C. Begin coating no sooner than [28] <Insert number> days after substrate is constructed and is visually dry on both sides.
- D. Verify that substrate is within the range of alkalinity recommended by manufacturer.
- E. Verify suitability of substrates including surface conditions and compatibility with existing finishes and primers.
- F. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions[**and recommendations in the "MPI Architectural Painting Specification Manual"**] applicable to substrates and coating systems indicated.
- B. Remove hardware and hardware accessories, plates, machined surfaces, light fixtures, and similar items already installed that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
 - 1. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce coating systems indicated.
 - 2. Perform cleaning and coating application so dust and other contaminants from cleaning process will not fall on wet, newly coated surfaces.
- D. Crack Repair: Fill cracks according to manufacturer's written instructions before coating surfaces.

3.3 APPLICATION

- A. Apply elastomeric coatings according to manufacturer's written instructions.
 - 1. Use equipment and techniques best suited for substrate and type of material being applied.
 - 2. Coat surfaces behind movable items the same as similar exposed surfaces.
 - 3. Apply each coat separately according to manufacturer's written instructions.
- B. Primers: Apply at a rate to ensure complete coverage.

- C. Block Fillers: Apply at a rate to ensure complete coverage with pores filled.
- D. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats similar to color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- E. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform finish, color, and appearance.
- F. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- G. Apply coatings to prepared surfaces as soon as practicable after preparation and before subsequent surface soiling or deterioration.
- H. Spray Application: Use spray equipment for application only when permitted by authorities having jurisdiction. Wherever spray application is used, do not double back with spray equipment to build up film thickness of two coats in one pass.

3.4 FIELD QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following testing procedures:
 - 1. Owner will engage the services of a qualified testing agency to sample materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 - 2. Testing agency will perform tests for compliance of materials with product requirements.
 - 3. Owner may direct Contractor to stop coating application if test results show materials being used do not comply with requirements. Remove noncomplying materials from Project site, pay for testing, and recoat surfaces that were coated with rejected materials. Remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.
- B. Field Testing and Inspection: Owner reserves the right to engage the services of a qualified testing agency to verify installed thickness of elastomeric coatings.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

- C. Protect work of other trades against damage from coating application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by DEN Project Manager, and leave in an undamaged condition.
- D. At completion of construction activities, touch up and restore damaged or defaced coated surfaces.

3.6 COATING SCHEDULE

A. Concrete Substrates:

- 1. Primer: Concrete primer[**if required by manufacturer**].
- 2. Elastomeric Finish Coat(s): [**Minimum two coats with a total dry film thickness of 16 to 18 mils** (0.41 to 0.45 mm)] [**Minimum one coat with a total dry film thickness of 7 to 10 mils** (0.18 to 0.25 mm)] [**Manufacturer's recommended number of coats and total dry film thickness for condition of substrate**] <Insert requirement>.
- 3. Finish-Coat Color: [**As selected by DEN Project Manager from manufacturer's full range**] [**Match DEN Project Manager's samples**] [**As indicated in a color schedule**] <Insert requirement>.

B. Concrete Unit Masonry Substrates:

- 1. Primer: Concrete unit masonry primer[**if required by manufacturer**].
- 2. Block Filler: Concrete unit masonry block filler[**if required by manufacturer**].
- 3. Elastomeric Finish Coat(s): [**Minimum two coats with a total dry film thickness of 16 to 18 mils** (0.41 to 0.45 mm)] [**Minimum one coat with a total dry film thickness of 7 to 10 mils** (0.18 to 0.25 mm)] [**Manufacturer's recommended number of coats and total dry film thickness for condition of substrate**] <Insert requirement>.
- 4. Finish-Coat Color: [**As selected by DEN Project Manager from manufacturer's full range**] [**Match DEN Project Manager's samples**] [**As indicated in a color schedule**] <Insert requirement>.

C. Clay Masonry Substrates:

- 1. Primer: Clay masonry primer[**if required by manufacturer**].
- 2. Elastomeric Finish Coat(s): [**Minimum two coats with a total dry film thickness of 16 to 18 mils** (0.41 to 0.45 mm)] [**Minimum one coat with a total dry film thickness of 7 to 10 mils** (0.18 to 0.25 mm)] [**Manufacturer's recommended number of coats and total dry film thickness for condition of substrate**] <Insert requirement>.
- 3. Finish-Coat Color: [**As selected by DEN Project Manager from manufacturer's full range**] [**Match DEN Project Manager's samples**] [**As indicated in a color schedule**] <Insert requirement>.

D. Stucco Substrates:

- 1. Primer: Stucco primer[**if required by manufacturer**].

2. Elastomeric Finish Coat(s): **[Minimum two coats with a total dry film thickness of 16 to 18 mils (0.41 to 0.45 mm)] [Minimum one coat with a total dry film thickness of 7 to 10 mils (0.18 to 0.25 mm)] [Manufacturer's recommended number of coats and total dry film thickness for condition of substrate] <Insert requirement>.**
3. Finish-Coat Color: **[As selected by DEN Project Manager from manufacturer's full range] [Match DEN Project Manager's samples] [As indicated in a color schedule] <Insert requirement>.**

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 099653

SECTION 101100 - VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Chalkboards.
2. Markerboards.
3. Tackboards.
4. Visual display rails.
5. Visual display wall panels.
6. Support systems for visual display boards.
7. Sliding visual display units.
8. Visual display conference units.
9. Visual display wall coverings.
10. Electronic markerboards.

B. Related Sections:

1. Section 097723 "Fabric-Wrapped Panels" for tackable, fabric-covered wall surfaces.
2. Section 101200 "Display Cases" for [**individually framed and enclosed, wall-mounted bulletin boards**] [**and for**] [**bulletin boards in built-in trophy and display cases**].
3. Section 101300 "Directories" for bulletin boards within built-in directories.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. Tackboard: Framed or unframed, tackable, visual display board assembly.
- B. Visual Display Board Assembly: Visual display surface that is factory fabricated into composite panel form, either with or without a perimeter frame; includes chalkboards, markerboards, and tackboards.

- C. Visual Display Surface: Surfaces that are used to convey information visually, including surfaces of chalkboards, markerboards, tackboards, and surfacing materials that are not fabricated into composite panel form but are applied directly to walls.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. [**Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for visual display surfaces.**]
1. Include [**rated capacities, operating characteristics, electrical characteristics and**] individual panel weights for sliding visual display units.
 2. Include computer system requirements for electronic markerboards.
 3. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
 2. Product Data for Credit IEQ 4.4: For composite wood products, documentation indicating that the product contains no urea formaldehyde.
 3. Laboratory Test Reports for Credit IEQ 4: For [**adhesives**] [**and**] [**composite wood products**], documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For visual display surfaces. Include plans, elevations, sections, details, and attachments to other work.
1. Show locations of panel joints.
 2. Show locations of special-purpose graphics for visual display surfaces.
 3. Include sections of typical trim members.
 4. Wiring Diagrams: For power, signal, and control wiring.
- D. Samples for Initial Selection: For each type of visual display surface indicated, for units with factory-applied color finishes, and as follows:
1. Actual sections of [**porcelain-enamel face sheet**] [**painted-finish chalkboard**] [**melamine visual display surface**] [**high-pressure-laminate visual display surface**] [**tackboard assembly**] [**visual display wall panel**] [**display rail**] [**visual display wall covering**].
 2. Fabric swatches of [**vinyl-**] [**and**] [**polyester-**] fabric-faced tack assemblies.
 3. Include accessory Samples to verify color selected.
- E. Samples for Verification: For each type of visual display surface indicated.

1. Visual Display Surface: Not less than **8-1/2 by 11 inches** (215 by 280 mm), mounted on substrate indicated for final Work. Include one panel for each type, color, and texture required.
2. Trim: **6-inch-** (152-mm-) long sections of each trim profile.
3. Display Rail: **6-inch-** (152-mm-) long sections.
4. **[Rail] [Modular] Support System:** **6-inch-** (152-mm-) long sections.
5. Accessories: Full-size Sample of each type of accessory.

F. Product Schedule: For visual display surfaces. **[Use same designations indicated on Drawings.]**

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of fabrics.
- C. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. **[Operation and]Maintenance Data:** For visual display surfaces **[and power-operated units]** to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of motor-operated, sliding visual display units required for this Project.
- B. Source Limitations: Obtain visual display surfaces from single source from single manufacturer.
- C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: **[25] <Insert value>** or less.
 2. Smoke-Developed Index: **[50] [450] <Insert value>** or less.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate appearance and aesthetic effects and set quality standards for installation.
 - 1. Build mockup of typical [**wall area**] <Insert description> as shown on Drawings. Include accessories.
 - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Preinstallation Conference: Conduct conference at [**Project site**] [**location and time as determined by DEN Project Manager**] <Insert location>.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-built visual display surfaces[, **including factory-applied trim where indicated,**] completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to DEN Project Manager. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site.
- B. Store visual display surfaces vertically with packing materials between each unit.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display surfaces until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of construction contiguous with visual display surfaces by field measurements before fabrication.
 - 1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.10 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Surfaces lose original writing and erasing qualities.
 - b. Surfaces exhibit crazing, cracking, or flaking.

2. Warranty Period: Minimum **[50]** <Insert number> years from date of Substantial Completion.
3. Warranty Period: Life of the building.

B. Special Warranty for Electronic Markerboards: Manufacturer's standard form in which manufacturer agrees to repair or replace electronic markerboards that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Minimum **[two (2)]** <Insert number> years from date of Substantial Completion.

1.11 CONSTRUCTION WASTE MANAGEMENT

A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Porcelain-Enamel Face Sheet: ASTM A 424, enameling-grade steel, uncoated thickness indicated; with exposed face and edges coated with primer, **1.7-to-2.5-mil-** (0.043-to-0.064-mm-) thick ground coat, and color cover coat; and with concealed face coated with primer and **1.7-to-2.5-mil-** (0.043-to-0.064-mm-) thick ground coat.

1. Matte-Finish Cover Coat: Low reflective; chalk wipes clean with dry cloth or standard eraser. Minimum **2.0-to-2.5-mil-** (0.051-to-0.064-mm-) thick cover coat. Cover and ground coats shall be fused to steel at manufacturer's standard firing temperatures but not less than **1250 deg F** (677 deg C).

a. Products: Subject to compliance with requirements, provide the following] [provide one of the following.

- 1) PolyVision Corporation, a Steelcase company; P³ ceramicsteel Chalkboard.
- 2) <Insert manufacturer's name; product name or designation>.
- 3) or approved equal.

2. Gloss-Finish Cover Coat: Gloss as indicated; dry-erase markers wipe clean with dry cloth or standard eraser. Minimum **3.0-to-4.0-mil-** (0.076-to-0.102-mm-) thick cover coat. Cover and ground coats shall be fused to steel at manufacturer's standard firing temperatures but not less than **1475 deg F** (802 deg C).

a. Products: Subject to compliance with requirements, provide one of the following.

- 1) PolyVision Corporation, a Steelcase company; P³ ceramicsteel Markerboard.
 - 2) **<Insert manufacturer's name; product name or designation>**.
 - 3) or approved equal.
- B. Porcelain-Enamel Face Sheet: Porcelain-enamel-clad, ASTM A 463/A 463M, Type 1, stretcher-leveled aluminized steel, with **0.024-inch** (0.60-mm) uncoated thickness; with porcelain-enamel coating fused to steel at approximately **1000 deg F** (538 deg C).
1. Matte Finish: Low reflective; chalk wipes clean with dry cloth or standard eraser.
 - a. Products: Subject to compliance with requirements, provide one of the following.
 - 1) Claridge Products and Equipment, Inc.; Vitracite Chalkboard.
 - 2) **<Insert manufacturer's name; product name or designation>**.
 - 3) or approved equal.
 2. Gloss Finish: Low gloss; dry-erase markers wipe clean with dry cloth or standard eraser. Suitable for use as projection screen.
 - a. Products: Subject to compliance with requirements, provide one of the following.
 - 1) Claridge Products and Equipment, Inc.; LCS Markerboard.
 - 2) **<Insert manufacturer's name; product name or designation>**.
 - 3) or approved equal.
- C. Porcelain-Enamel Face Sheet: Manufacturer's standard steel sheet with porcelain-enamel coating fused to steel; uncoated thickness indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Claridge Products and Equipment, Inc.
 - b. PolyVision Corporation; a Steelcase company.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.
 2. Matte Finish: Low reflective; chalk wipes clean with dry cloth or standard eraser.
 3. Gloss Finish: Gloss as indicated; dry-erase markers wipe clean with dry cloth or standard eraser.
- D. Melamine: Thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
- E. High-Pressure Plastic Laminate: NEMA LD 3.
- F. Natural Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish[**with surface-burning characteristics indicated**].

- G. Plastic-Impregnated Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout[**with surface-burning characteristics indicated**].
- H. Vinyl Fabric: Mildew resistant, washable, complying with FS CCC-W-408D, Type II, **[burlap weave] <insert texture or pattern>**; weighing not less than **13 oz./sq. yd.** (440 g/sq. m); with surface-burning characteristics indicated.
- I. Polyester Fabric: Nondirectional weave, 100 percent polyester; weighing not less than **15 oz./sq. yd.** (508 g/sq. m); with surface-burning characteristics indicated.
- J. Hardboard: ANSI A135.4, tempered.
- K. Particleboard: ANSI A208.1, Grade M-1[.], **made with binder containing no urea formaldehyde.], that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."**
- L. Fiberboard: ASTM C 208.
- M. Extruded Aluminum: **ASTM B 221** (ASTM B 221M), Alloy 6063.
- N. Adhesives: Manufacturer's standard product that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 CHALKBOARD ASSEMBLIES

- A. Porcelain-Enamel Chalkboards: Balanced, high-pressure, factory-laminated chalkboard assembly of three-ply construction consisting of backing sheet, core material, and **[0.021-inch- (0.53-mm-) thick,] [0.013-inch- (0.33-mm-) thick,]** porcelain-enamel face sheet with matte finish.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A-1 Visual Systems.
 - b. AARCO Products, Inc.
 - c. ADP Lemco, Inc.
 - d. Aywon.
 - e. Bangor Cork Company, Inc.
 - f. Best-Rite Manufacturing.
 - g. Claridge Products and Equipment, Inc.
 - h. Ghent Manufacturing, Inc.
 - i. Marsh Industries, Inc.; Visual Products Group.
 - j. Platinum Visual Systems; a division of ABC School Equipment, Inc.

- k. PolyVision Corporation; a Steelcase company.
 - l. Tri-Best Visual Display Products.
 - m. **<Insert manufacturer's name>**.
 - n. or approved equal.
 2. Hardboard Core: **1/4 inch** (6 mm) thick; with **[0.005-inch-** (0.127-mm-) **thick, aluminum foil] [0.015-inch-** (0.38-mm-) **thick, aluminum sheet] [0.0129-inch-** (0.35-mm-) **thick, galvanized-steel sheet]** backing.
 3. Particleboard Core: **3/8 inch** (9.5 mm) thick; with **[0.005-inch-** (0.127-mm-) **thick, aluminum foil] [0.015-inch-** (0.38-mm-) **thick, aluminum sheet] [0.0129-inch-** (0.35-mm-) **thick, galvanized-steel sheet]** backing.
 4. Fiberboard Core: **[3/8 inch** (9.5 mm)] **[1/2 inch** (13 mm)] thick; with **[0.001-inch-** (0.025-mm-) **thick, aluminum foil] [0.015-inch-** (0.38-mm-) **thick, aluminum sheet] [0.0129-inch-** (0.35-mm-) **thick, galvanized-steel sheet]** backing.
 5. Manufacturer's Standard Core: Minimum **1/4 inch** (6 mm) thick, with manufacturer's standard moisture-barrier backing.
 6. Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.
- B. High-Pressure-Laminate Chalkboards: Balanced, high-pressure, factory-laminated chalkboard assembly of two-ply construction consisting of fiberboard core material and high-pressure-laminate writing surface.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Best-Rite Manufacturing.
 - b. Ghent Manufacturing, Inc.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.
- C. Melamine Chalkboards: Fabricated from **1/4-inch-** (6-mm-) thick, sealed and primed hardboard panels permanently bonded with melamine writing surface.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Best-Rite Manufacturing.
 - b. Marsh Industries, Inc.; Visual Products Group.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.
- D. Painted-Finish Chalkboards: Fabricated from **[two plies of] 1/4-inch-** (6-mm-) thick, treated, tempered hardboard panels permanently surfaced with manufacturer's standard, heat-cured organic coating formulated for chalk-receptive matte finish.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AARCO Products, Inc.

- b. Marsh Industries, Inc.; Visual Products Group.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.
- E. Natural-Slate Chalkboards: Select grade, resurfaced, natural slate; free from ribbons and other natural marks that impair their functional use and durability as a writing surface.
1. Writing surface shall be free of tooling marks, pits, chipping, scratches, and surface spalls in excess of those that can be easily corrected; and shall be free of surface-applied stain, dye, or other artificial coloring.
 2. Thickness: Not less than **1/4 inch** (6 mm) or more than **3/8 inch** (9.5 mm) thick with maximum deviation of **1/16 inch** (1.6 mm) when an average thickness of at least **1/4 inch** (6 mm) is maintained.
 3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. **<Insert manufacturer's name>**.
 - b. or approved equal.

2.3 MARKERBOARD ASSEMBLIES

- A. Porcelain-Enamel Markerboards: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction consisting of backing sheet, core material, and **[0.021-inch- (0.53-mm-) thick,] [0.013-inch- (0.33-mm-) thick,]** porcelain-enamel face sheet with **[high] [low]**-gloss finish.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AARCO Products, Inc.
 - b. ADP Lemco, Inc.
 - c. Aywon.
 - d. Bangor Cork Company, Inc.
 - e. Best-Rite Manufacturing.
 - f. Claridge Products and Equipment, Inc.
 - g. Egan Visual Inc.
 - h. Ghent Manufacturing, Inc.
 - i. Marsh Industries, Inc.; Visual Products Group.
 - j. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 - k. PolyVision Corporation; a Steelcase company.
 - l. Tri-Best Visual Display Products.
 - m. **<Insert manufacturer's name>**.
 - n. or approved equal.
 2. Hardboard Core: **1/4 inch** (6 mm) thick; with **[0.005-inch- (0.127-mm-) thick, aluminum foil] [0.015-inch- (0.38-mm-) thick, aluminum sheet] [0.013-inch- (0.35-mm-) thick, galvanized-steel sheet]** backing.

3. Particleboard Core: [3/8 inch (9.5 mm)] [1/2 inch (13 mm)] thick; with [0.005-inch- (0.127-mm-) **thick, aluminum foil**] [0.015-inch- (0.38-mm-) **thick, aluminum sheet**] [0.013-inch- (0.35-mm-) **thick, galvanized-steel sheet**] backing.
 4. Fiberboard Core: [3/8 inch (9.5 mm)] [1/2 inch (13 mm)] thick; with [0.001-inch- (0.025-mm-) **thick, aluminum foil**] [0.015-inch- (0.38-mm-) **thick, aluminum sheet**] [0.013-inch- (0.35-mm-) **thick, galvanized-steel sheet**] backing.
 5. Manufacturer's Standard Core: Minimum 1/4 inch (6 mm) thick, with manufacturer's standard moisture-barrier backing.
 6. Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.
- B. Melamine Markerboards: Fabricated from 1/4-inch- (6-mm-) thick, sealed and primed hardboard panels permanently bonded with melamine or another high-pressure-laminate writing surface.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AARCO Products, Inc.
 - b. Ghent Manufacturing, Inc.
 - c. Marsh Industries, Inc.; Visual Products Group.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
- C. High-Pressure-Laminate Markerboard Assembly: Balanced, high-pressure, factory-laminated chalkboard assembly of three-ply construction consisting of backing sheet, fiberboard core material, and high-pressure-laminate writing surface.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Best-Rite Manufacturing.
 - b. EverProducts by Glenroy Inc.
 - c. Marsh Industries, Inc.; Visual Products Group.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
- ## 2.4 TACKBOARD ASSEMBLIES
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. A-1 Visual Systems.
 2. AARCO Products, Inc.
 3. ADP Lemco, Inc.
 4. Aywon.
 5. Bangor Cork Company, Inc.
 6. Best-Rite Manufacturing.
 7. Claridge Products and Equipment, Inc.

8. Egan Visual Inc.
 9. EverProducts by Glenroy Inc.
 10. Ghent Manufacturing, Inc.
 11. Marsh Industries, Inc.; Visual Products Group.
 12. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 13. PolyVision Corporation; a Steelcase company.
 14. Tri-Best Visual Display Products.
 15. **<Insert manufacturer's name>**.
 16. or approved equal.
- B. Natural-Cork Tackboard **<Insert designation>**: **1/16-inch-** (1.6-mm-) thick, natural cork sheet factory laminated to **3/8-inch-** (9.5-mm-) [**7/16-inch-** (11-mm-)] thick fiberboard backing.
- C. Natural-Cork Tackboard **<Insert designation>**: **1/8-inch-** (3-mm-) thick, natural cork sheet factory laminated to **3/8-inch-** (9.5-mm-) thick fiberboard backing.
- D. Natural-Cork Tackboard **<Insert designation>**: **1/4-inch-** (6-mm-) thick, natural cork sheet factory laminated to **1/4-inch-** (6-mm-) thick [**hardboard**] [**particleboard**] backing.
- E. Plastic-Impregnated-Cork Tackboard **<Insert designation>**: **1/8-inch-** (3-mm-) thick, plastic-impregnated cork sheet factory laminated to **3/8-inch-** (9.5-mm-) thick fiberboard backing.
- F. Plastic-Impregnated-Cork Tackboard **<Insert designation>**: **1/4-inch-** (6-mm-) thick, plastic-impregnated cork sheet factory laminated to **1/4-inch-** (6-mm-) thick [**hardboard**] [**particleboard**] backing.
- G. Vinyl-Fabric-Faced Tackboard **<Insert designation>**: Vinyl fabric factory laminated to [**3/8-inch-** (9.5-mm-)] [**7/16-inch-** (11-mm-)] [**1/2-inch-** (13-mm-)] thick fiberboard backing.
- H. Vinyl-Fabric-Faced Tackboard **<Insert designation>**: **1/16-inch-** (1.6-mm-) thick, vinyl-fabric-faced cork sheet factory laminated to **3/8-inch-** (9.5-mm-) thick fiberboard backing.
- I. Vinyl-Fabric-Faced Tackboard **<Insert designation>**: **1/8-inch-** (3-mm-) thick, vinyl-fabric-faced cork sheet factory laminated to **3/8-inch-** (9.5-mm-) thick fiberboard backing.
- J. Vinyl-Fabric-Faced Tackboard **<Insert designation>**: **1/4-inch-** (6-mm-) thick, vinyl-fabric-faced cork sheet factory laminated to **1/4-inch-** (6-mm-) thick [**hardboard**] [**particleboard**] backing.
- K. Polyester-Fabric-Faced Tackboard **<Insert designation>**: Polyester fabric factory laminated to [**3/8-inch-** (9.5-mm-)] [**1/2-inch-** (13-mm-)] thick fiberboard backing.
- L. Polyester-Fabric-Faced Tackboard **<Insert designation>**: **1/16-inch-** (1.6-mm-) thick, polyester-fabric-faced cork sheet factory laminated to **3/8-inch-** (9.5-mm-) thick fiberboard backing.

- M. Polyester-Fabric-Faced Tackboard <Insert designation>: 1/8-inch- (3-mm-) thick, polyester-fabric-faced cork sheet factory laminated to 3/8-inch- (9.5-mm-) thick fiberboard backing.
- N. Polyester-Fabric-Faced Tackboard <Insert designation>: 1/4-inch- (6-mm-) thick, polyester-fabric-faced cork sheet factory laminated to 1/4-inch- (6-mm-) thick [hardboard] [particleboard] backing.
- O. <Insert tackboard>.

2.5 VISUAL DISPLAY RAILS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AARCO Products, Inc.
 - 2. Bangor Cork Company, Inc.
 - 3. Best-Rite Manufacturing.
 - 4. Claridge Products and Equipment, Inc.
 - 5. Ghent Manufacturing, Inc.
 - 6. Marsh Industries, Inc.; Visual Products Group.
 - 7. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 - 8. PolyVision Corporation; a Steelcase company.
 - 9. Tri-Best Visual Display Products.
 - 10. <Insert manufacturer's name>.
 - 11. or approved equal.
- B. General: Manufacturer's standard, aluminum-framed, tackable [cork] [fabric] visual display surface fabricated into narrow rail shape and designed for displaying material.

2.6 VISUAL DISPLAY WALL PANELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. A-1 Visual Systems.
 - 2. ADP Lemco, Inc.
 - 3. Best-Rite Manufacturing.
 - 4. Claridge Products and Equipment, Inc.
 - 5. Egan Visual Inc.
 - 6. Marsh Industries, Inc.; Visual Products Group.
 - 7. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 - 8. PolyVision Corporation; a Steelcase company.
 - 9. Tri-Best Visual Display Products.
 - 10. <Insert manufacturer's name>.
 - 11. or approved equal.

- B. Marker Wall Sheets: Fabricated from[**0.021-inch** (0.53-mm) **uncoated thickness,**] porcelain-enamel face sheets; for direct application to wall surface.
- C. Marker Wall Panels: Fabricated from markerboard assembly indicated.
- D. Tack Wall Panels: With tackable surface.
 - 1. Fabricated from tackboard assembly indicated.
 - 2. Natural Cork: [**1/8-inch-** (3-mm-)] [**1/4-inch-** (6-mm-)] thick, natural cork sheet for direct application to wall surface.
 - 3. Plastic-Impregnated Cork: [**1/8-inch-** (3-mm-)] [**1/4-inch-** (6-mm-)] thick, plastic-impregnated cork sheet for direct application to wall surface.
 - 4. Vinyl Fabric-Faced Cork: **1/4-inch-** (6-mm-) thick, vinyl-fabric-faced cork sheet for direct application to wall surface.
 - 5. Polyester-Fabric-Faced Cork: **1/4-inch-** (6-mm-) thick, polyester-fabric-faced cork sheet for direct application to wall surface.
- E. Joint Accessories: Manufacturer's standard, [**exposed trim**] [**concealed aluminum or steel spline**] at butt joints.
- F. Adhesive: Mildew-resistant, nonstaining adhesive, for use with specific tack wall panels and substrate application, as recommended in writing by visual display surface manufacturer.
 - 1. Adhesive shall have a VOC content of [**50**] **<Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- G. Primer/Sealer: Mildew-resistant primer/sealer complying with requirements in [**Section 099113 "Interior Painting"**] **<Insert Section number>-<Insert Section title>** and recommended in writing by visual display surface manufacturer for intended substrate.

2.7 RAIL SUPPORT SYSTEM FOR VISUAL DISPLAY BOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Best-Rite Manufacturing.
 - 2. Egan Visual Inc.
 - 3. KOH Design, Inc.
 - 4. Peter Pepper Products, Inc.
 - 5. PolyVision Corporation; a Steelcase company.
 - 6. **<Insert manufacturer's name>**.
 - 7. or approved equal.

- B. Support Rails: Horizontal, wall-mounted, extruded-aluminum rails designed to receive hanger clip and to support visual display boards[; **capable of gripping and suspending paper directly from rail**].
1. Finish: **[Clear anodic] [Color anodic] [Baked enamel] [Powder coat]**.
 2. Color and Gloss: **[Light bronze] [Medium bronze] [Dark bronze] [Black] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>**.
- C. Hanger Clips: Extruded aluminum with finish to match rails; designed to support independent visual display boards by engaging support rail and top trim of board.
- D. Visual Display Panels: Fabricated from not less than **3/8-inch-** (9.5-mm-) thick, kraft-paper honeycomb core; designed to be rigid and to resist warpage, and with aluminum trim designed to engage hanger clips.

2.8 MODULAR SUPPORT SYSTEM FOR VISUAL DISPLAY BOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AARCO Products, Inc.
 2. Best-Rite Manufacturing.
 3. Claridge Products and Equipment, Inc.
 4. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 5. PolyVision Corporation; a Steelcase company.
 6. **<Insert manufacturer's name>**.
 7. or approved equal.
- B. Standards: **72-inch-** (1829-mm-) long, extruded-aluminum slotted standards designed for supporting visual display boards on panel clips. Standards shall be punched at not less than **[4 inches** (100 mm)] **<Insert dimension>** o.c.
1. Finish: **[Clear anodic] [Color anodic] [Baked enamel] [Powder coat]**.
 2. Color and Gloss: **[Light bronze] [Medium bronze] [Dark bronze] [Black] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>**.
- C. Panel Clips: Extruded aluminum or steel with finish to match standards.

2.9 SLIDING VISUAL DISPLAY UNITS

- A. Horizontal-Sliding Visual Display Units: Factory-fabricated units consisting of extruded-aluminum tubular frame, fixed-rear visual display panel, aluminum-framed horizontal-sliding panels, and extruded-aluminum fascia that conceals overhead sliding track; designed for recessed mounting. Provide panels that operate smoothly without vibration or chatter.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A-1 Visual Systems.
 - b. AARCO Products, Inc.
 - c. ADP Lemco, Inc.
 - d. Aywon.
 - e. Best-Rite Manufacturing.
 - f. Claridge Products and Equipment, Inc.
 - g. Ghent Manufacturing, Inc.
 - h. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 - i. PolyVision Corporation; a Steelcase company.
 - j. Tri-Best Visual Display Products.
 - k. **<Insert manufacturer's name>**.
 - l. or approved equal.
 2. Two-Track Units: Fabricate unit with fixed rear panel covering entire rear surface. Provide two sliding panels, each equal to not less than one-half of overall length of unit.
 3. Three-Track Units: Fabricate unit with fixed rear panel covering entire rear surface. Provide three sliding panels, each equal to not less than **[one-third]** **[one-half]** of overall length of unit.
 4. Four-Track Units: Fabricate unit with fixed rear panel centered in and covering not less than one-half of rear surface, and fixed front panel on each side of unit equal to not less than one-quarter of overall length of unit. Provide four sliding panels, each equal to not less than one-quarter of overall length of unit.
 - a. Swinging Doors: Fabricated from same construction as sliding panels and supported on full-height continuous hinges. Provide visual display surface on both sides of each door.
 5. Sliding Panels: Fabricated from not less than **[3/8-inch- (9.5-mm-)]** **<Insert dimension>** thick, kraft-paper honeycomb core; designed to be rigid and to resist warpage.
 - a. Fabricate sliding panels with **0.021-inch (0.53-mm)** uncoated thickness, porcelain-enamel face sheets.
 6. Hardware: Manufacturer's standard, extruded-aluminum overhead track and channel-shaped bottom guides; with two nylon ball-bearing carriers and two nylon rollers for each sliding panel.
- B. Vertical-Sliding Visual Display Units: Factory-fabricated units consisting of extruded-aluminum tubular frame, fixed-rear visual display panel, and aluminum-framed vertical-sliding panels; designed for recessed mounting. Provide panels that operate smoothly without vibration or chatter.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. AARCO Products, Inc.
 - b. ADP Lemco, Inc.
 - c. Aywon.
 - d. Claridge Products and Equipment, Inc.
 - e. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 - f. PolyVision Corporation; a Steelcase company.
 - g. Tri-Best Visual Display Products.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.
2. Type: Tubular frame on **[four sides] [top and two sides, with sides extending to floor; with kick panel to conceal sliding panels]**. Unit shall be designed to support panels independent of wall.
 3. Two-Track Units: Fabricate unit with fixed rear panel covering entire rear surface. Provide two sliding panels, each equal to not less than one-half of overall height of unit.
 4. Three-Track Units: Fabricate unit with fixed rear panel covering entire rear surface. Provide three sliding panels, each equal to not less than one-half of overall height of unit.
 5. Four-Track Units: Fabricate unit with fixed rear panel centered in and covering not less than one-half of rear surface. Provide four sliding panels, each equal to not less than one-half of overall height of unit.
 6. Sliding Panels: Fabricated from not less than **[3/8-inch- (9.5-mm-)] <Insert dimension>** thick, kraft-paper honeycomb core; designed to be rigid and to resist warpage.
 - a. Fabricate sliding panels with **0.021-inch (0.53-mm)** uncoated thickness, porcelain-enamel face sheets.
 7. Hardware: Manufacturer's standard, neoprene ball-bearing end rollers, four on each side of each sliding panel. Counterbalance each sliding panel with lead counterweights supported by steel aircraft cable over ball-bearing sheaves; with removable cover plate for access to counterweights. Provide rubber bumpers at top and bottom for each sliding panel.
 8. Motorized Operation: Provide not less than one motor with gearhead reducers for each sliding panel, mounted above visual display unit and connected to sliding panels with steel aircraft cable. Provide removable cover plate for access to motor. Equip motors with limit switches to automatically stop motor at each end of travel.
 - a. Electric Motors: UL approved or recognized, totally enclosed, complying with NEMA MG 1, with thermal-overload protection; 1/15 hp, single phase, **[110] [220] V**, 60 Hz.
 - b. Control Station: Three-position, **[maintained] [momentary]**-contact, switch-operated control station with open, close, and off functions; with NEMA ICS 6, Type 1 enclosure. Provide **[one] <Insert number>** control station(s) for each sliding panel unit.
 - c. Key Switch: Provide supplementary key switch for each control station. Furnish two keys for each control station, keyed alike.

2.10 VISUAL DISPLAY CONFERENCE UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. A-1 Visual Systems.
 2. AARCO Products, Inc.
 3. ADP Lemco, Inc.
 4. Best-Rite Manufacturing.
 5. Claridge Products and Equipment, Inc.
 6. Egan Visual Inc.
 7. Ghent Manufacturing, Inc.
 8. Marsh Industries, Inc.; Visual Products Group.
 9. Peter Pepper Products, Inc.
 10. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 11. PolyVision Corporation; a Steelcase company.
 12. **<Insert manufacturer's name>**.
 13. or approved equal.
- B. Visual Display Conference Units: Factory-fabricated units consisting of hinged-door wood cabinet with perimeter face frame, sides, and back; not less than **3-inch** (75-mm) interior depth and designed for surface wall mounting. Fabricate inside of cabinet and cabinet doors with fixed visual display surfaces.
1. Wood Cabinets: Fabricated from solid wood with integral, solid-wood markertray. Fabricate hinged door panels with solid wood frame and wood-veneer exterior surface.
 2. Plastic-Laminate Cabinets: Cabinet and hinged door panels fabricated from manufacturer's standard, high-pressure, plastic-laminate-finished panels; with integral markertray.
 3. Hardware: Manufacturer's standard, full-height continuous hinges[, **wire door pulls,**] and door bumpers.
 4. Projection Screens: Manufacturer's standard, pull-down, matte, white projection screen, not less than **8 inches** (200 mm) smaller in each direction than overall cabinet size, and mounted above rear visual display surface.
 5. Fluorescent Light: Manufacturer's standard, not less than **24 inches** (610 mm) long, and mounted above rear visual display surface.

2.11 VISUAL DISPLAY WALL COVERINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Best-Rite Manufacturing.
 2. Egan Visual Inc.
 3. Marsh Industries, Inc.; Visual Products Group.
 4. Omnova Solutions Inc.; Decorative Products; Commercial Wallcovering.
 5. walltalkers; a division of RJF International Corporation.
 6. **<Insert manufacturer's name>**.

7. or approved equal.

B. Visual Display Wall Covering: Intended for use with dry-erase markers[**and as a projection surface**] and consisting of [**low**] [**moderate**] [**high**]-gloss, plastic film bonded to fabric backing; not less than [**0.012-mil** (0.0003-mm)] [**0.020-mil** (0.0005-mm)] total thickness.

1. Surface Graphics: **2-inch-** (50-mm-) square grid.
2. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.

C. Magnetic Visual Display Wall Covering: Intended for use with dry-erase markers and magnetic aids and consisting of moderate-gloss plastic film bonded to ferrous-powdered fabric backing; not less than **0.025-mil** (0.0006-mm) total thickness.

1. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.

D. Adhesive: Mildew-resistant, nonstaining[, **strippable**] adhesive, for use with specific wall covering and substrate application, as recommended in writing by wall covering manufacturer.

1. Adhesive shall have a VOC content of [**50**] <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Primer/Sealer: Mildew-resistant primer/sealer complying with requirements in [**Section 099113 "Interior Painting"**] <Insert Section number>-<Insert Section title> and recommended in writing by wall covering manufacturer for intended substrate.

2.12 ELECTRONIC MARKERBOARDS

A. General: Provide manufacturer's standard electronic markerboard that consists of touch-sensitive writing surface connected to microcomputer via RS-232 serial cable and that electronically records writing with standard dry-erase markers. Equip unit with cables, software, pens, erasers, mounting hardware, and accessories required for a complete installation.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Claridge Products and Equipment, Inc.
 - b. Egan Visual Inc.
 - c. Ghent Manufacturing, Inc.

- d. PolyVision Corporation; a Steelcase company.
 - e. SMART Technologies Inc.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
- B. Software: Capable of real-time recording, saving, and printing of everything that is written and drawn on electronic markerboard; with **[Windows]** **[Macintosh]** operating system.
- 1. File Export Formats: BMP, WMF, HTML, and vector-based formats.
 - 2. Compatibility: Compatible with Microsoft NetMeeting or other T.120-compliant software.
 - 3. Features: Capable of the following:
 - a. Saving directly from screen.
 - b. Erasing portions of screen.
 - c. Printing directly from screen.
 - d. Saving individual screens as separate pages.
 - e. Showing onscreen **[toolbar]** **[keyboard]**.
 - f. Recognizing not less than four pen colors.
 - g. Recognizing finger touch control for presentations.
 - h. Connecting multiple electronic markerboards to a single computer.
 - i. Showing online help and tutorial.
- C. Overall Size: Approximately **[48 inches high by 60 inches wide]** (1219 mm high by 1524 mm wide) **<Insert dimensions>**.
- D. Mounting: **[Wall mounted]** **[Supported by rail support system]** **<Insert requirements>**.
- 2.13 **[CHALKBOARD]** **[MARKERBOARD]** **[AND]** **[TACKBOARD]** ACCESSORIES
- A. Aluminum Frames **[and Trim]**: Fabricated from not less than **0.062-inch-** (1.57-mm-) thick, extruded aluminum; **[standard size and shape]** **[slim size and standard shape]** **[of size and shape indicated on Drawings]** **<Insert size and shape>**.
- 1. Field-Applied Trim: Manufacturer's standard, **[snap-on trim with no visible screws or exposed joints]** **[slip-on trim]** **[screw-on trim with Phillips flat-head screws]**.
 - 2. Factory-Applied Trim: Manufacturer's standard.
- B. Factory-Applied Wood Trim: **[Red oak]** **[Walnut]** **[Manufacturer's standard species]** **<Insert species>**, not less than **1/2 inch** (13 mm) thick; **[standard size and shape]** **[of size and shape indicated on Drawings]** **<Insert size and shape>**.
- C. Field-Applied Wood Trim: Comply with requirements specified in **[Section 062000 "Finish Carpentry"]** **[Section 064023 "Interior Architectural Woodwork."]**
- D. chalk tray: Manufacturer's standard, continuous.

1. Box Type: Extruded aluminum with slanted front, grooved tray, and cast-aluminum end closures.
 2. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.
- E. Map Rail: Provide the following accessories:
1. Display Rail: Continuous and integral with map rail; fabricated from cork approximately **1 to 2 inches** (25 to 50 mm) wide.
 2. End Stops: Located at each end of map rail.
 3. Map Hooks: [**Two**] **<Insert number>** map hooks for every [**48 inches** (1219 mm)] [**1200 mm**] **<Insert dimension>** of map rail or fraction thereof.
 4. Map Hooks and Clips: [**Two**] **<Insert number>** map hooks with flexible metal clips for every [**48 inches** (1219 mm)] [**1200 mm**] **<Insert dimension>** of map rail or fraction thereof.
 5. Flag Holder: [**One**] **<Insert number>** for each room.
 6. Paper Holder: Extruded aluminum; designed to hold paper by clamping action.
- F. Special-Purpose Graphics: Fuse or paint the following graphics into surface of porcelain-enamel visual display unit:
1. Semivisible writing guidelines.
 2. Penmanship lines.
 3. Music staff lines.
 4. Grid, **1 inch** (25 mm) square.
 5. Graph coordinates, rectangular.
 6. Horizontal lines, **2 inches** (50 mm) o.c.
 7. Polar coordinates.
 8. USA map.
 9. World map.
 10. Soccer field.
 11. Football field.
 12. Basketball court.
 13. **<Insert description of special-purpose graphics>**.

2.14 FABRICATION

- A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.
- B. Natural-Slate Chalkboards: Surface slate panels to a natural plane. Grind and hone to smooth, uniform finish equivalent to that obtained by minimum 180 grit and maximum 220 grit.
1. Cut joints straight and true. Space joints symmetrically. Fit and match panels before shipment to provide continuous, uniform writing surface.
 2. Length: Furnish panels approximately equal in length with permissible variation not more than **3 inches** (75 mm) in either direction of equal spacing. Allow

1/4-inch (6-mm) clearance at trim in length and width for fitting. Provide lengths of panels in each space as follows:

- a. Up to 5 feet (1.5 m); one panel.
- b. More than 5 feet (1.5 m) but less than 9 feet (2.7 m); two panels.
- c. More than 9 feet (2.7 m) but less than 13.5 feet (4.1 m); three panels.
- d. More than 13.5 feet (4.1 m) but less than 18 feet (5.5 m); four panels.
- e. More than 18 feet (5.5 m) but less than 22.5 feet (6.9 m); five panels.
- f. More than 22.5 feet (6.9 m) but less than 27 feet (8.2 m); six panels.

C. Visual Display Boards: **[Factory]** **[Field]** assemble visual display boards unless otherwise indicated.

1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.

D. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.

1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, **[balanced around center of board, as acceptable to DEN Project Manager]** **[as indicated on approved Shop Drawings]**.
2. Provide manufacturer's standard vertical-joint **[spline]** **[H-trim]** system between abutting sections of **[chalkboards]** **[markerboards]**.
3. Provide manufacturer's standard mullion trim at joints between **[chalkboards]** **[markerboards]** **[and]** **[tackboards]** of combination units.
4. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports, or modify trim as indicated or as selected by DEN Project Manager from manufacturer's standard structural support accessories to suit conditions indicated.

E. Modular Visual Display Boards: Fabricated with integral panel clips attached to core material.

F. Aluminum Frames **[and Trim]**: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.

1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

2.15 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.16 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
- B. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils** (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.17 VISUAL DISPLAY SURFACE SCHEDULE

- A. Visual Display Board <Insert drawing designation>: **[Factory]** **[Field]** assembled.
 - 1. Chalkboard: **[Porcelain-enamel]** **[High-pressure laminate]** **[Melamine]** **[Painted-finish]** **[Natural-slate]** chalkboard assembly.
 - a. Color: **[Green]** **[Blue]** **[Brown]** **[Black]** **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from full range of industry colors]**.
 - 2. Markerboard: **[Porcelain-enamel]** **[Melamine]** **[High-pressure-laminate]** markerboard assembly.
 - a. Color: **[White]** **[Beige]** **[Tan]** **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from full range of industry colors]**.
 - 3. Corners: **[Square]** **[Rounded]**.
 - 4. Width: **[As indicated on Drawings]** <Insert dimension>.
 - 5. Height: **[As indicated on Drawings]** <Insert dimension>.
 - 6. Mounting: **[Wall]** **[Rail support system]**.
 - 7. Mounting Height: **[As indicated on Drawings]** <Insert dimension>.
 - 8. **[Factory]** **[Field]**-Applied Aluminum Trim: **[Manufacturer's standard]** <Insert description> with **[clear anodic]** **[color anodic]** **[baked-enamel]** **[powder-coat]** finish.
 - a. Color: **[Light bronze]** **[Medium bronze]** **[Dark bronze]** **[Black]** **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from full range of industry colors and color densities]**.
 - 9. **[Factory]** **[Field]**-Applied Wood Trim: <Insert species> with **[opaque]** **[transparent]** finish.

10. Factory-Applied Vinyl Trim: **[Dark brown] [Black] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors]**.
 11. Accessories:
 - a. chalk tray: **[Box] [Solid]** type.
 - b. Map rail with **[display rail] [end stops] [map hooks] [map hooks and clips] [and] [flag holder]**.
- B. Tackboard **<Insert drawing designation>**: **[Factory] [Field]** assembled.
1. Tack Surface: Natural-cork tackboard assembly **<Insert designation>**.
 2. Tack Surface: Plastic-impregnated-cork tackboard assembly **<Insert designation>**.
 3. Tack Surface: Vinyl-fabric-faced tackboard assembly **<Insert designation>**.
 4. Tack Surface: Polyester-fabric-faced tackboard assembly **<Insert designation>**.
 - a. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors]**.
 5. Corners: **[Square] [Rounded]**.
 6. Width: **[As indicated on Drawings] <Insert dimension>**.
 7. Height: **[As indicated on Drawings] <Insert dimension>**.
 8. Mounting: **[Wall] [Rail support system]**.
 9. Mounting Height: **[As indicated on Drawings] <Insert dimension>**.
 10. Edges: **[Concealed by trim] [Wrapped with fabric]**.
 - a. **[Factory] [Field]**-Applied Aluminum Trim: **[Manufacturer's standard] <Insert description>** style, with **[clear anodic] [color anodic] [baked-enamel] [powder-coat]** finish.
 - 1) Color: **[Light bronze] [Medium bronze] [Dark bronze] [Black] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors and color densities]**.
 - b. **[Factory] [Field]**-Applied Wood Trim: **<Insert species>** with **[opaque] [transparent]** finish.
- C. Visual Display Rail **<Insert drawing designation>**: **[Factory] [Field]** assembled.
1. Tack Surface: Natural-cork tackboard assembly **<Insert designation>**.
 2. Tack Surface: Plastic-impregnated-cork tackboard assembly **<Insert designation>**.
 3. Tack Surface: Vinyl-fabric-faced tackboard assembly **<Insert designation>**.
 4. Tack Surface: Polyester-fabric-faced tackboard assembly **<Insert designation>**.

- a. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors].**
 5. Size: **[1 inch (25 mm)] [2 inches (50 mm)] [3 inches (75 mm)]** high by length indicated on Drawings.
 6. Edges: **[Extruded-aluminum trim] [Wrapped with fabric].**
 7. Ends: **[Aluminum] [Not required].**
 8. Aluminum Finish: **[Clear anodic] <Insert description>** finish.
- D. Visual Display Wall Panels **<Insert drawing designation>**: Consisting of the following visual display surface:
1. Marker Wall Sheet: Porcelain-enamel face sheet with high-gloss cover coat.
 - a. Color: **[White] [Beige] [Tan] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors].**
 2. Marker Wall Panel: **[Porcelain-enamel] [High-pressure-laminate]** markerboard assembly.
 - a. Color: **[White] [Beige] [Tan] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors].**
 3. Tack Wall Panel: Natural-cork tack**[board]** assembly **<Insert designation>**.
 4. Tack Wall Panel: Plastic-impregnated-cork tack**[board]** assembly **<Insert designation>**.
 5. Tack Wall Panel: Vinyl-fabric-faced tack**[board]** assembly **<Insert designation>**.
 6. Tack Wall Panel: Polyester-fabric-faced tack**[board]** assembly **<Insert designation>**.
 - a. Panel-Joint Edges: **[Wrapped with fabric] [Concealed by fabric-covered trim].**
 - b. Top-of-Wall Edges: **[Wrapped with fabric] [Concealed by fabric-covered trim].**
 - c. Bottom-of-Wall Edges: **[Wrapped with fabric] [Concealed by fabric-covered trim].**
 - d. Corners: **[Wrapped with fabric] [Concealed by fabric-covered trim].**
 - e. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors].**
 7. Width: **[Full width of wall] [As indicated on Drawings] <Insert dimension>**.
 8. Height: **[Full height of wall] [Full height of wall above base] [As indicated on Drawings] <Insert dimension>**.
- E. Sliding Visual Display Unit **<Insert drawing designation>**:

1. Horizontal-Sliding Type: **[Two-track unit] [Three-track unit] [Four-track unit] [Four-track unit with two swinging doors]**.
2. Vertical-Sliding Type: **[Two] [Three] [Four]-track unit with tubular frame on [four sides] [top and two sides with kick panel]**.
 - a. Fixed Rear Panel: **[Porcelain-enamel] [Painted-finish] [High-pressure-laminate]** chalkboard assembly.
 - 1) Color: **[Green] [Blue] [Brown] [Black] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors]**.
 - b. Fixed Rear Panel: **[Porcelain-enamel] [High-pressure-laminate]** markerboard assembly.
 - 1) Color: **[White] [Beige] [Tan] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors]**.
 - c. Fixed Rear Panel: Natural-cork tackboard assembly **<Insert designation>**.
 - d. Fixed Rear Panel: Plastic-impregnated-cork tackboard assembly **<Insert designation>**.
 - e. Fixed Rear Panel: Vinyl-fabric-faced tackboard assembly **<Insert designation>**.
 - f. Fixed Rear Panel: Polyester-fabric-faced tackboard assembly **<Insert designation>**.
 - 1) Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors]**.
 - g. Sliding Panels: **[Porcelain-enamel] [Painted-finish] [High-pressure-laminate]** chalkboard assembly.
 - 1) Color: **[Green] [Blue] [Brown] [Black] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors]**.
 - h. Sliding Panels: **[Porcelain-enamel] [High-pressure-laminate]** markerboard assembly.
 - 1) Color: **[White] [Beige] [Tan] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors]**.
 - i. Sliding Panels: Natural-cork tackboard assembly **<Insert designation>**.

- j. Sliding Panels: Plastic-impregnated-cork tackboard assembly <Insert designation>.
- k. Sliding Panels: Vinyl-fabric-faced tackboard assembly <Insert designation>.
- l. Sliding Panels: Polyester-fabric-faced tackboard assembly <Insert designation>.
 - 1) Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors].
- 3. Overall Width: [As indicated on Drawings] <Insert dimension>.
- 4. Overall Height: [As indicated on Drawings] <Insert dimension>.
- 5. Mounting Height: [As indicated on Drawings] <Insert dimension>.
- 6. [Factory] [Field]-Applied Aluminum Trim: [Manufacturer's standard] <Insert description>.
 - a. Finish: [Clear anodic] <Insert description>.
- 7. Accessories:
 - a. Chalk tray.
 - b. Map rail with [display rail] [end stops] [map hooks] [map hooks and clips] [and] [flag holder].
 - c. Locks.
 - d. Easel pad clamps.
- F. Visual Display Conference Unit <Insert drawing designation>:
 - 1. Cabinet Material: Solid [red oak] [walnut] [mahogany] <Insert species> with [natural lacquered] [oiled] [stained] finish.
 - 2. Cabinet Material: High-pressure plastic laminate.
 - a. Color: [Match DEN Project Manager's sample] [As indicated by referencing manufacturer's designations] [As selected by DEN Project Manager from full range of industry colors].
 - 3. Fixed Rear Panel: [Porcelain-enamel] [High-pressure-laminate] markerboard assembly.
 - a. Color: [White] [Beige] [Tan] [Match DEN Project Manager's sample] [As indicated by referencing manufacturer's designations] [As selected by DEN Project Manager from full range of industry colors].
 - 4. Inside Surface of Doors: Natural-cork tackboard assembly <Insert designation>.
 - 5. Inside Surface of Doors: Plastic-impregnated-cork tackboard assembly <Insert designation>.
 - 6. Inside Surface of Doors: Vinyl-fabric-faced tackboard assembly <Insert designation>.

7. Inside Surface of Doors: Polyester-fabric-faced tackboard assembly **<Insert designation>**.
 - a. Color: **[Match DEN Project Manager's sample] [As indicated by referencing manufacturer's designations] [As selected by DEN Project Manager from full range of industry colors]**.
8. Inside Surface of Doors: **[Porcelain-enamel] [High-pressure-laminate]** markerboard assembly, color to match fixed rear panel.
9. Corners: **[Square] [Rounded]**.
10. Width: **[48 inches (1219 mm)] [As indicated on Drawings] <Insert dimension>**.
11. Height: **[36 inches (914 mm)] [48 inches (1219 mm)] [72 inches (1829 mm)] [As indicated on Drawings] <Insert dimension>**.
12. Mounting Height: **[As indicated on Drawings] <Insert dimension>**.
13. Accessories:
 - a. Flip-chart pad clamp.
 - b. Cylinder lock.
 - c. Pull-down projection screen.
 - d. Fluorescent light.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of connections before installation of motor-operated, sliding visual display units.
- C. Examine walls and partitions for proper preparation and backing for visual display surfaces.
- D. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair the performance of and affect the smooth, finished surfaces of visual display boards, including dirt, mold, and mildew.

- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display surfaces and wall surfaces.
1. Prime wall surfaces indicated to receive [**direct-applied, visual display tack wall panels**] [**visual display wall coverings**] and as recommended in writing by primer/sealer manufacturer and wall covering manufacturer.
 2. Prepare surfaces to receive visual display wall coverings and test for moisture according to requirements specified in Section 097200 "Wall Coverings."
 3. Prepare substrates indicated to receive visual display wall covering as required by manufacturer's written instructions to achieve a smooth, dry, clean, structurally sound surface that is uniform in color.
 - a. Moisture Content: Maximum of [4] <Insert number> percent when tested with an electronic moisture meter.
 - b. Plaster: Allow new plaster to cure. Neutralize areas of high alkalinity. Prime with primer as recommended in writing by primer/sealer manufacturer and wall covering manufacturer.
 - c. Metals: If not factory primed, clean and apply metal as recommended in writing by primer/sealer manufacturer and wall covering manufacturer.
 - d. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall covering manufacturer.
 - e. Painted Surfaces: Treat areas susceptible to pigment bleeding.
- D. Prepare recesses for sliding visual display units as required by type and size of unit.

3.3 INSTALLATION, GENERAL

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
1. Mounting Height [**for Grades K through 3**] <Insert description>: [24 inches (610 mm)] <Insert dimension> above finished floor to top of chalk tray.
 2. Mounting Height [**for Grades 4 through 6**] <Insert description>: [28 inches (711 mm)] <Insert dimension> above finished floor to top of chalk tray.
 3. Mounting Height [**for Grades 7 and Higher**] <Insert description>: [36 inches (914 mm)] <Insert dimension> above finished floor to top of chalk tray.

3.4 INSTALLATION OF FIELD-FABRICATED VISUAL DISPLAY BOARDS AND ASSEMBLIES

- A. Field-Assembled Visual Display Units: Coordinate field-assembled units with grounds, trim, and accessories indicated. Join parts with a neat, precision fit.
1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, [**balanced around center of board**,

as acceptable to DEN Project Manager] [as indicated on approved Shop Drawings].

2. Provide manufacturer's standard vertical-joint [**spline**] [**H-trim**] system between abutting sections of [**chalkboards**] [**markerboards**].
3. Provide manufacturer's standard mullion trim at joints between [**chalkboards**] [**markerboards**] [**and**] [**tackboards**] of combination units.
4. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports, or modify trim as indicated or as selected by DEN Project Manager from manufacturer's standard structural support accessories to suit conditions indicated.

- B. Natural-Slate Chalkboards: Align and level joints between adjoining panels and apply manufacturer's recommended joint-filler compound. Hone and finish joints to continuous even plane.

3.5 INSTALLATION OF FACTORY-FABRICATED VISUAL DISPLAY BOARDS AND ASSEMBLIES

- A. Visual Display Boards: Attach visual display boards to wall surfaces with [**egg-size**] <Insert coverage> adhesive gobs at **16 inches** (400 mm) o.c., horizontally and vertically.
- B. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than **16 inches** (400 mm) o.c. Secure both top and bottom of boards to walls.
1. Field-Applied Aluminum Trim: Attach trim over edges of visual display boards and conceal grounds and clips. Attach trim to boards with fasteners at not more than **24 inches** (610 mm) o.c.
 - a. Attach chalk trays to boards with fasteners at not more than **12 inches** (300 mm) o.c.
 2. Field-Applied Wood Trim: Install trim according to requirements in [**Section 062000 "Finish Carpentry"**] [**Section 064023 "Interior Architectural Woodwork."**]

3.6 INSTALLATION OF VISUAL DISPLAY RAILS

- A. Display Rails: Install rails in locations and at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to wall surface with fasteners at not more than **16 inches** (400 mm) o.c.
1. Mounting Height: [**48 inches** (1219 mm)] [**60 inches** (1524 mm)] <Insert dimension> above finished floor to top of rail.

3.7 INSTALLATION OF VISUAL DISPLAY WALL PANELS

- A. Marker Wall Sheets: Attach wall sheets to wall surface with thin layer of adhesive over entire wall surface. Butt join adjacent panels[**and cover joint with matching joint strip installed with double-stick tape**].
- B. Marker Wall Panels: Attach panels to wall surface with egg-size adhesive gobs at **16 inches** (400 mm) o.c., horizontally and vertically.
 - 1. Join adjacent wall panels with concealed steel splines for smooth alignment.
 - 2. Join adjacent wall panels with exposed, H-shaped aluminum trim painted to match wall panel.
- C. Tack Wall Panels: Attach panels to wall surface with egg-size adhesive gobs at **16 inches** (400 mm) o.c. horizontally and vertically.
 - 1. Install wrapped-edge wall panels with butt joints between adjacent wall panels.
 - 2. Join adjacent wall panels with exposed, H-shaped aluminum trim covered with same fabric as wall panels.

3.8 INSTALLATION OF [RAIL] [MODULAR] SUPPORT SYSTEM

- A. Rail Support System: Install horizontal support rail in locations and at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to wall surface with fasteners at **12 inches** (300 mm) o.c.
 - 1. Mounting Height: [**72 inches** (1829 mm)] **<Insert dimension>** above finished floor to top of rail.
 - 2. Hang visual display units on rail support system.
- B. Modular Support System: Install adjustable standards in locations and at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Install standards at **48 inches** (1219 mm) o.c., vertically aligned and plumb, and attached to wall surface with fasteners at **12 inches** (300 mm) o.c.
 - 1. Mounting Height: [**12 inches** (300 mm)] **<Insert dimension>** above finished floor to bottom of standard.
 - 2. Install single-slotted standard at each end of each run of standards and double-slotted standards at intermediate locations.
 - 3. Provide locking screw at top corner of visual display board at each standard.
 - 4. Hang visual display units on modular support system.

3.9 INSTALLATION OF FACTORY-FABRICATED VISUAL DISPLAY UNITS

- A. Sliding Visual Display Units: Install units in recessed locations and at mounting heights indicated. Attach to wall framing with fasteners at not more than **16 inches** (400 mm) o.c.

1. Adjust panels to operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

B. Visual Display Conference Units: Install units in locations and at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to wall surface with **[fasteners through back of cabinet]** **[concealed brackets screwed to wall]** **[concealed wood cleats screwed to wall]**.

1. Mounting Height: **[72 inches (1829 mm)]** **<Insert dimension>** above finished floor to top of cabinet.

3.10 INSTALLATION OF VISUAL DISPLAY WALL COVERING

A. Install visual display wall covering according to requirements specified in Section 097200 "Wall Coverings."

B. General: Comply with visual display wall covering manufacturers' written installation instructions.

C. Install seams horizontal and level, with lowest seam **[24 inches (610 mm)]** **<Insert dimension>** above finished floor. Railroad fabric (reverse roll direction) to ensure color matching.

D. Double cut seams, with no gaps or overlaps. Remove air bubbles, wrinkles, blisters, and other defects.

E. After installation, clean visual display wall covering according to manufacturer's written instructions. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.

3.11 INSTALLATION OF VISUAL ELECTRONIC MARKERBOARDS

A. Electronic Markerboards: Install units in locations and at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to **[wall]** **[cubicle]** surface with manufacturer's standard mounting hardware.

1. Mounting Height: **[72 inches (1829 mm)]** **<Insert dimension>** above finished floor to top of markerboard.

3.12 CLEANING AND PROTECTION

A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display surfaces after installation and cleaning.

3.13 DEMONSTRATION

- A. **[Engage a factory-authorized service representative to train] [Train]** Owner's maintenance personnel to adjust, operate, and maintain motor-operated, sliding visual display units.
1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 101100

SECTION 101200 - DISPLAY CASES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. **[Illuminated] [Nonilluminated]** bulletin boards.
- 2. **[Illuminated] [Nonilluminated]** display cases.

- B. Related Sections:

- 1. Section 057000 "Decorative Metal" for custom enclosures for **[bulletin boards] [and] [display cases]**.
- 2. **[Section 062000 "Finish Carpentry"] [Section 064023 "Interior Architectural Woodwork"]** for custom cabinets for **[bulletin boards] [and] [display cases]**.
- 3. Section 097723 "Fabric-Wrapped Panels" for tackable, fabric-covered wall panels.
- 4. Section 101100 "Visual Display Surfaces" for tackboards.
- 5. Section 101300 "Directories" for boards with changeable messages or changeable letters.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. Bulletin Board: Tackable visual display surface or tackboard enclosed in a display case.
- B. Display Case: Glazed cabinet with **[adjustable shelves] [visual display surface background and adjustable shelves]**.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Display cases shall withstand the effects of earthquake motions according to **[ASCE/SEI 7] <Insert requirement>**.

1. Component Importance Factor is 1.0.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): [120 deg F (67 deg C), **ambient**; 180 deg F (100 deg C)] <Insert temperature range>, material surfaces.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for display cases.
1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
1. Product Data for Credit IEQ 4.4: For composite wood products used in display cases, documentation indicating that product contains no urea formaldehyde.
 2. Laboratory Test Reports for Credit IEQ 4: For [**adhesives**] [**and**] [**composite wood products**], documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For display cases. Include plans, elevations, sections, details, and attachments to other work.
1. Show location of seams and joints in visual display surfaces.
 2. Include sections of typical trim members.
 3. Wiring Diagrams: For power, signal, and control wiring.
- D. Samples for Initial Selection: For units with factory-applied color finishes, and as follows:
1. Actual sections of visual display surfaces.
 2. Section of header panel for color selection.
- E. Samples for Verification: For each type of product indicated.
1. Visual Display Surface: Not less than **8-1/2 by 11 inches** (215 by 280 mm), mounted on substrate indicated for final Work. Include one panel for each type, color, and texture required.
 2. Trim: **6-inch-** (152-mm-) long sections of each trim profile[**including corner section**].

- F. Delegated-Design Submittal: For display cases indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Seismic Qualification Certificates: For **<Insert equipment,>** accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of fabrics.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For visual display surfaces, operating hardware[, **and illuminated units**] to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain display cases from single source from single manufacturer.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: **[25] <Insert value>** or less.
 - 2. Smoke-Developed Index: **[50] [450] <Insert value>** or less.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>**.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install display cases until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of openings for display cases by field measurements before fabrication.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Hardboard: ANSI A135.4, tempered.
- B. Particleboard: ANSI A208.1, Grade M-1[.], **made with binder containing no urea formaldehyde.], that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."**
- C. Fiberboard: ASTM C 208.
- D. Hardwood Plywood: HPVA HP-1[.], **made with adhesive containing no urea formaldehyde.], that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."**
- E. Natural Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish.
- F. Plastic-Impregnated Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto burlap backing; with washable vinyl finish and integral color throughout.
- G. Vinyl Fabric: FS CCC-W-408D, Type II, **[burlap weave] <Insert texture and pattern>**; weighing not less than **13 oz./sq. yd.** (440 g/sq. m); with flame-spread index of 25 or less when tested according to ASTM E 84.

- H. Polyester Fabric: Nondirectional weave, 100 percent polyester; weighing not less than **15 oz./sq. yd.** (508 g/sq. m); with flame-spread index of 25 or less when tested according to ASTM E 84.
- I. Extruded-Aluminum Bars and Shapes: **ASTM B 221** (ASTM B 221M), Alloy 6063.
- J. Aluminum Tubing: ASTM B 429, Alloy 6063.
- K. Clear Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering, and 6 mm thick unless otherwise indicated.
- L. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), with Finish 1 (smooth or polished), colorless sheet with visible light transmittance of 92 percent measured per ASTM D 1003.
- M. Opaque Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet).
- N. Translucent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), with Finish 1 (smooth or polished). Provide white-colored sheet unless otherwise indicated, of density required to produce uniform brightness and minimum halation effects.
- O. High-Pressure Plastic Laminate: NEMA LD 3.
- P. Fasteners: Provide screws, bolts, and other fastening devices made from same material as items being fastened, except provide hot-dip galvanized, stainless-steel, or aluminum fasteners for exterior applications. Provide types, sizes, and lengths to suit installation conditions. Use security fasteners where exposed to view.
- Q. Adhesives: Manufacturer's standard product that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 TACKBOARD ASSEMBLIES

- A. Natural-Cork Tackboard **<Insert designation>**: **1/16-inch-** (1.6-mm-) thick, natural cork sheet factory laminated to **3/8-inch-** (9.5-mm-) [**7/16-inch-** (11-mm-)] thick fiberboard backing.
- B. Natural-Cork Tackboard **<Insert designation>**: **1/8-inch-** (3-mm-) thick, natural cork sheet factory laminated to **3/8-inch-** (9.5-mm-) thick fiberboard backing.
- C. Natural-Cork Tackboard **<Insert designation>**: **1/4-inch-** (6-mm-) thick, natural cork sheet factory laminated to **1/4-inch-** (6-mm-) thick [**hardboard**] [**particleboard**] backing.
- D. Plastic-Impregnated-Cork Tackboard **<Insert designation>**: **1/8-inch-** (3-mm-) thick, plastic-impregnated cork sheet factory laminated to **3/8-inch-** (9.5-mm-) thick fiberboard backing.

- E. Plastic-Impregnated-Cork Tackboard <Insert designation>: 1/4-inch- (6-mm-) thick, plastic-impregnated cork sheet factory laminated to 1/4-inch- (6-mm-) thick [hardboard] [particleboard] backing.
- F. Vinyl-Fabric-Faced Tackboard <Insert designation>: Vinyl fabric factory laminated to [3/8-inch- (9.5-mm-)] [7/16-inch- (11-mm-)] [1/2-inch- (13-mm-)] thick fiberboard backing.
- G. Vinyl-Fabric-Faced Tackboard <Insert designation>: 1/16-inch- (1.6-mm-) thick, vinyl-fabric-faced cork sheet factory laminated to 3/8-inch- (9.5-mm-) thick fiberboard backing.
- H. Vinyl-Fabric-Faced Tackboard <Insert designation>: 1/8-inch- (3-mm-) thick, vinyl-fabric-faced cork sheet factory laminated to 3/8-inch- (9.5-mm-) thick fiberboard backing.
- I. Vinyl-Fabric-Faced Tackboard <Insert designation>: 1/4-inch- (6-mm-) thick, vinyl-fabric-faced cork sheet factory laminated to 1/4-inch- (6-mm-) thick [hardboard] [particleboard] backing.
- J. Polyester-Fabric-Faced Tackboard <Insert designation>: Polyester fabric factory laminated to [3/8-inch- (9.5-mm-)] [1/2-inch- (13-mm-)] thick fiberboard backing.
- K. Polyester-Fabric-Faced Tackboard <Insert designation>: 1/16-inch- (1.6-mm-) thick, polyester-fabric-faced cork sheet factory laminated to 3/8-inch- (9.5-mm-) thick fiberboard backing.
- L. Polyester-Fabric-Faced Tackboard <Insert designation>: 1/8-inch- (3-mm-) thick, polyester-fabric-faced cork sheet factory laminated to 3/8-inch- (9.5-mm-) thick fiberboard backing.
- M. Polyester-Fabric-Faced Tackboard <Insert designation>: 1/4-inch- (6-mm-) thick, polyester-fabric-faced cork sheet factory laminated to 1/4-inch- (6-mm-) thick [hardboard] [particleboard] backing.

2.3 BULLETIN BOARD <Insert drawing designation>

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Nonilluminated Bulletin Boards:
 - a. A-1 Visual Systems.
 - b. AARCO Products, Inc.
 - c. ADP Lemco, Inc.
 - d. APCO Graphics, Inc.
 - e. Aywon.
 - f. Best-Rite Manufacturing.
 - g. Claridge Products and Equipment, Inc.
 - h. Ghent Manufacturing, Inc.
 - i. Marsh Industries, Inc.; Visual Products Group.

- j. Nelson-Harkins Industries.
 - k. Peter Pepper Products, Inc.
 - l. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 - m. Poblocki Sign Company.
 - n. PolyVision Corporation; a Steelcase company.
 - o. Tablet & Ticket Co. (The).
 - p. Tri-Best Visual Display Products.
 - q. **<Insert manufacturer's name>**.
 - r. or approved equal.
2. Illuminated Bulletin Boards:
- a. A-1 Visual Systems.
 - b. AARCO Products, Inc.
 - c. ADP Lemco Inc.
 - d. APCO Graphics, Inc.
 - e. Claridge Products and Equipment, Inc.
 - f. Nelson-Harkins Industries.
 - g. Poblocki Sign Company.
 - h. Tablet & Ticket Co. (The).
 - i. Tri-Best Visual Display Products.
 - j. **<Insert manufacturer's name>**.
 - k. or approved equal.
- B. General: Factory-fabricated [**weather-resistant**] unit consisting of manufacturer's standard wall-mounted cabinet with tackboard assembly on back inside surface and operable glazed doors at front.
- C. Aluminum-Framed Cabinet: Extruded aluminum[, **with weather-resistant backing for exterior use**]; with [**clear anodic**] [**color anodic**] [**baked-enamel**] [**powder-coat**] finish.
- 1. Color and Gloss: [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] **<Insert color and gloss>**.
- D. Wood-Framed Cabinet: [**Red oak**] [**Walnut**] [**Manufacturer's standard species**] **<Insert species>** with [**natural lacquered**] [**oiled**] [**stained**] finish.
- E. Cabinet Corners: [**Square**] [**Rounded**].
- F. Glazed Sliding Doors: [**Tempered glass**] [**Clear acrylic sheet**] **<Insert glazing>**; unframed; with extruded-aluminum top and bottom track; supported on nylon or ball-bearing rollers; with plastic top guide and rubber bumpers. Equip each door with ground finger pull and adjustable cylinder lock with two keys.
- 1. Thickness: Not less than [**6 mm**] **<Insert dimension>** thick.
 - 2. Number of Doors: [**One**] [**Two**] [**Three**] [**As indicated on Drawings**] **<Insert number>**.

- G. Glazed Hinged Doors: **[Tempered glass] [Clear acrylic sheet] <Insert glazing>**; set in frame matching cabinet material and finish. Equip each door with full-height continuous hinge and cylinder lock with two keys. **[Provide factory-applied weather stripping on doors for exterior use.]**
1. Thickness: Not less than **[6 mm] <Insert dimension>** thick.
 2. Number of Doors: **[One] [Two] [Three] [As indicated on Drawings] <Insert number>**.
- H. Header Panel: **[Nonilluminated; with opaque,] [Illuminated; with translucent,]** acrylic sheet panel set within overall cabinet frame; with matching frame that separates header panel from bulletin board.
1. Graphic Content and Style: Provide header panel copy that complies with requirements indicated on **[Drawings] [artwork supplied on electronic media by DEN Project Manager]** for size, style, spacing, content, height, location, material, and colors of graphics.
 2. Color: **[Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors].**
- I. Illumination System: Concealed top-lighting system consisting of fluorescent-strip fixtures. Include lamps and internal wiring with single, concealed electrical connection to building system. Coordinate electrical characteristics with power supply provided.
1. Ballasts: Low-temperature, high-power-factor, low-energy, fluorescent lamp ballasts that comply with Certified Ballast Manufacturers Association standards and carry its label. **[Provide exterior ballasts for exterior bulletin boards.]**
- J. Tack Surface: Natural-cork tackboard assembly **<Insert designation>**.
- K. Tack Surface: Plastic-impregnated-cork tackboard assembly **<Insert designation>**.
- L. Tack Surface: Vinyl-fabric-faced tackboard assembly **<Insert designation>**.
- M. Tack Surface: Polyester-fabric-faced tackboard assembly **<Insert designation>**.
1. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors].**
- N. Width: **[48 inches (1219 mm)] [As indicated on Drawings] <Insert dimension>**.
- O. Height: **[36 inches (914 mm)] [As indicated on Drawings] <Insert dimension>**.
- P. Depth: **[2 inches (51 mm)] [3 inches (76 mm)] [4 inches (102 mm)] [As indicated on Drawings] <Insert dimension>**.
- Q. Mounting Height: **[As indicated on Drawings] <Insert dimension>**.
- R. Mounting: **[Surface mounted] [Recessed].**

2.4 DISPLAY CASE <Insert drawing designation>

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. A-1 Visual Systems.
2. AARCO Products, Inc.
3. ADP Lemco, Inc.
4. Best-Rite Manufacturing.
5. Claridge Products and Equipment, Inc.
6. Ghent Manufacturing, Inc.
7. Nelson-Harkins Industries.
8. Platinum Visual Systems; a division of ABC School Equipment, Inc.
9. Poblocki Sign Company.
10. PolyVision Corporation; a Steelcase company.
11. Tablet & Ticket Co. (The).
12. <Insert manufacturer's name>.
13. or approved equal.

B. Recessed Cabinet: Factory-fabricated cabinet; with tackboard assembly on back inside surface, operable glazed doors at front, and trim on face to cover edge of recessed opening.

1. Cabinet Box: [Extruded aluminum] [Hardwood veneer plywood].
2. Cabinet Frame and Trim: Aluminum.
3. Cabinet Frame and Trim: [Birch] [Red oak] [Walnut] [Manufacturer's standard hardwood species] <Insert species> with transparent finish.
4. Veneer Species: [Birch] [Red oak] [Walnut] [Manufacturer's standard species] <Insert species> with transparent finish.
5. Aluminum Finish: [Clear anodic] [Color anodic] [Baked enamel] [Powder coat].
 - a. Color and Gloss: [Light bronze] [Medium bronze] [Dark bronze] [Black] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>.

C. Surface-Mounted Cabinet: Factory-fabricated cabinet; with tack assembly on back inside surface, and glazed doors at front.

1. Cabinet Box: Hardwood-veneer-plywood [top and]bottom panels with transparent finish; [top and]glazed side panels.
2. Cabinet Box: Extruded aluminum top, bottom, and side panels.
3. Cabinet Box: Glazed top, bottom, and side panels.
4. Cabinet Box: <Insert construction>.
5. Cabinet Frame: Aluminum.
6. Cabinet Frame: [Maple] [Red oak] [Walnut] [Manufacturer's standard hardwood species] <Insert species> with transparent finish.
7. Aluminum Finish: [Clear anodic] [Color anodic] [Baked enamel] [Powder coat].

- a. Color and Gloss: **[Light bronze] [Medium bronze] [Dark bronze] [Black] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>.**
- D. Glazed Sliding Doors: Tempered glass; unframed; with extruded-aluminum top and bottom track; supported on nylon or ball-bearing rollers; with plastic top guide and rubber bumpers. Equip each door with ground finger pull and adjustable cylinder lock with two keys.
1. Thickness: Not less than **[6 mm] <Insert dimension>** thick.
 2. Number of Doors: **[Two] [Three] [As indicated on Drawings] <Insert number>.**
- E. Glazed Hinged Doors: Tempered glass; set in frame matching cabinet material and finish. Equip each door with full-height continuous hinge and cylinder lock with two keys.
1. Thickness: Not less than **[6 mm] <Insert dimension>** thick.
 2. Number of Doors: **[One] [Two] [Three] [As indicated on Drawings] <Insert number>.**
- F. Shelves: 6-mm-thick tempered glass; supported on adjustable shelf standards and supports.
1. Shelf Width: **[6 inches (150 mm)] [8 inches (200 mm)] [10 inches (250 mm)] [12 inches (300 mm)].**
 2. Number of Shelves: **[Three] [As indicated on Drawings] <Insert number>.**
- G. Adjustable Shelf Standards and Supports: **[BHMA A156.9, B04102; with shelf brackets, B04112; recess mounted in rear surface] [BHMA A156.9, B04071; with shelf rests, B04081; mounted on sides].** Provide standards full height of display case.
- H. Tack Surface: Natural-cork tackboard assembly **<Insert designation>.**
- I. Tack Surface: Plastic-impregnated-cork tackboard assembly **<Insert designation>.**
- J. Tack Surface: Vinyl-fabric-faced tackboard assembly **<Insert designation>.**
- K. Tack Surface: Polyester-fabric-faced tackboard assembly **<Insert designation>.**
1. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>.**
- L. Illumination System: Concealed top-lighting system consisting of fluorescent-strip fixtures. Include lamps and internal wiring with single concealed electrical connection to building system. Coordinate electrical characteristics with power supply provided.

1. Ballasts: Low-temperature, high-power-factor, low-energy, fluorescent lamp ballasts that comply with Certified Ballast Manufacturers Association standards and carry its label.

M. Width: [48 inches (1219 mm)] [As indicated on Drawings] <Insert dimension>.

N. Height: [60 inches (1524 mm)] [As indicated on Drawings] <Insert dimension>.

O. Depth: [8 inches (200 mm)] [16 inches (400 mm)] [24 inches (600 mm)] [As indicated on Drawings] <Insert dimension>.

2.5 FABRICATION

- A. Fabricate [bulletin boards] [and] [display cases] to requirements indicated for dimensions, design, and thickness and finish of materials.
- B. Use metals and shapes of thickness and reinforcing to produce flat surfaces, free of oil-canning, and to impart strength for size, design, and application indicated.
- C. Fabricate cabinets and doorframes with reinforced corners, mitered to a hairline fit, with no exposed fasteners.
- D. Fabricate exterior units with vents to permit evaporation of moisture trapped inside.
- E. Fabricate shelf standards plumb and at heights to align shelf brackets for level shelves.

2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
- B. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power system to verify actual locations of connections before installation of illuminated units.
- C. Examine walls and partitions for proper backing for **[bulletin boards] [and] [display cases]**.
- D. Examine walls and partitions for suitable framing depth if recessed units will be installed.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for display cases as required by type and size of unit.

3.3 INSTALLATION

- A. General: Install units in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
 - 1. Mounting Height: **[72 inches (1829 mm)] <Insert dimension>** above finished floor to top of cabinet.
- B. Bulletin Boards: Attach units to wall surfaces with **[concealed fasteners through back of cabinet] [concealed brackets screwed to wall] [concealed wood cleats screwed to wall] [manufacturer's standard concealed hardware]**.
- C. Recessed Display Cases: Attach units to wall framing with fasteners at not more than **16 inches (400 mm)** o.c. Attach aluminum trim over edges of recessed display cases and conceal grounds and clips. Attach trim with fasteners at not more than **24 inches (600 mm)** o.c.
- D. Surface-Mounted Display Cases: Attach units to wall surfaces with concealed clips, hangers, or grounds fastened at not more than **16 inches (400 mm)** o.c. Secure both top and bottom of display cases to walls.
- E. Comply with requirements specified elsewhere for connecting illuminated **[bulletin boards] [and] [display cases]**.

1. After installation is complete, install new fluorescent lamps.

F. Install display case shelving level and straight.

3.4 ADJUSTING AND CLEANING

A. Adjust doors to operate smoothly without warp or bind and so contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 101200

SECTION 101300 - DIRECTORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. **[Nonilluminated] [Illuminated]**, message-strip directories.
2. **[Nonilluminated] [Illuminated]**, changeable-letter directories.

- B. Related Sections:

1. Section 057000 "Decorative Metal" for custom enclosures for directories.
2. Section 064023 "Interior Architectural Woodwork" for custom enclosures for directories.
3. Section 101100 "Visual Display Surfaces" for tackboards.
4. Section 101200 "Display Cases" for bulletin boards and display cases with tackable surfaces.
5. Section 101400 "Signage" for **[panel-sign-type directories] [dimensional letters] [and] [plaques]**.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Directories shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to **[ASCE/SEI 7] <Insert requirement>**.

1. Seismic Loads: **<Insert loads>**.

- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): **[120 deg F (67 deg C), ambient; 180 deg F (100 deg C)] <Insert temperature range>**, material surfaces.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for directories.
 - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For directories. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Include sections of typical trim members.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes, as follows:
 - 1. Fabric swatches for letterboards.
 - 2. Section of header panel for color selection.
- D. Samples for Verification: For each type of directory indicated, as follows:
 - 1. Letterboards: Not less than **8-1/2 by 11 inches** (215 by 280 mm), mounted on substrate indicated for final Work. Include one panel for each type, color, and texture required.
 - 2. Trim: **6-inch-** (150-mm-) long sections of each trim profile[**including corner section**].
 - 3. Message Strips: Full-size Samples of message strips in color selected with sample of specified typography.
 - 4. Letters: Full-size Samples of changeable letters of each size specified.
- E. Other Action Submittal:
 - 1. Message-Strip Schedule: Layout of each directory and each message strip showing letter size, font, spacing, indents, text copy, and graphics.
- F. Delegated-Design Submittal: For directories indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For illuminated directories to include in maintenance manuals.

- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Message Strips: Full-size, blank strips equal to [10] <Insert number> percent of amount installed for each size indicated, but no fewer than [20] <Insert number> strips.

1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain directories from single source from single manufacturer.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: [25] <Insert value> or less.
 - 2. Smoke-Developed Index: [50] [450] <Insert value> or less.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Preinstallation Conference: Conduct conference at [Project site] [location and time as determined by DEN Project Manager] <Insert location>.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install directories until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
1. Sheet: [ASTM B 209](#) (ASTM B 209M).
 2. Extruded Shapes: [ASTM B 221](#) (ASTM B 221M), Alloy 6063.
- B. Stainless-Steel Sheet: ASTM A 666, Type 304.
- C. Copper-Alloy Brass Sheet: ASTM B 36/B 36M, Alloy UNS No. C26000 (cartridge brass, 70 percent copper).
- D. Copper-Alloy Bronze Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper).
- E. Clear Float Glass: ASTM C 1036, Type I, Class 1, Quality q3, and 6 mm thick unless otherwise indicated.
- F. Gray-Tinted Float Glass: ASTM C 1036; Type I (transparent glass, flat); Class 2 (tinted, heat absorbing, and light reducing); Quality q3 (glazing select); 6-mm-thick, gray-tinted monolithic glass with a maximum luminous transmittance of 14 percent.
- G. Bronze-Tinted Float Glass: ASTM C 1036; Type I (transparent glass, flat); Class 2 (tinted, heat absorbing, and light reducing); Quality q3 (glazing select); 6-mm-thick, bronze-tinted monolithic glass with a maximum luminous transmittance of 44 percent.
- H. Clear Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality q3, with exposed edges seamed before tempering, and 6 mm thick unless otherwise indicated.
- I. Tinted Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 2 (tinted), tint as indicated, Quality q3, with exposed edges seamed before tempering, and 6 mm thick unless otherwise indicated.
- J. Clear Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), with Finish 1 (smooth or polished), and 6 mm thick unless otherwise indicated; colorless sheet with visible light transmittance of 92 percent measured per ASTM D 1003.
- K. Bronze-Tinted Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), with Finish 1 (smooth or polished), and 6 mm thick unless otherwise indicated.
- L. Translucent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), with Finish 1 (smooth or polished), and 6 mm thick unless otherwise indicated; white colored sheet of density required to produce uniform brightness and minimum halation effects.
- M. Opaque Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), with Finish 1 (smooth or polished), and 6 mm thick unless otherwise indicated; colors as indicated.

- N. Fasteners: Provide screws, bolts, and other fastening devices made from same material as items being fastened, except provide hot-dip galvanized, stainless-steel, or aluminum fasteners for exterior applications. Provide types, sizes, and lengths to suit installation conditions. Use security fasteners where exposed to view.

2.2 MESSAGE-STRIP DIRECTORIES

- A. Nonilluminated, Message-Strip Directory **<Insert drawing designation>**: Factory-fabricated[, **weather-resistant**] unit consisting of changeable message strips held in place by retainer frame enclosed in manufacturer's standard [1-1/2-to-2-inch- (38-to-50-mm-)] **<Insert dimension>** deep perimeter frame; with aluminum-sheet rear cover panel and glazed cover.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allenite Signs; division of Allen Marking Products, Inc.
 - b. APCO Graphics, Inc.
 - c. ASI-Modulex.
 - d. Best Sign Systems, Inc.
 - e. Desk & Door Nameplate Co.
 - f. Nelson-Harkins Industries.
 - g. Poblocki Sign Company.
 - h. Tablet & Ticket Co. (The).
 - i. Visiontron Corp.
 - j. Vomar Products, Inc.
 - k. **<Insert manufacturer's name>**.
 - l. or approved equal.
 2. Profiled Frame: Removable, clear acrylic sheet held in place by perimeter frame; with [4-inch- (100-mm-)] **<Insert dimension>** high, molded-opaque-acrylic or molded-fiberglass profiled frame at top and bottom.
 - a. Profiled-Frame Shape: [**Square**] [**Radiused**] [**Beveled**] **<Insert shape>**.
 - b. Profiled-Frame Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors**] **<Insert color>**.
 - c. Header Panel: Provide copy on top profiled frame that complies with requirements indicated on [**Drawings**] [**artwork supplied on electronic media by DEN Project Manager**] for size, style, spacing, content, height, location, material, and colors of graphics.
 - d. Divider Color: [**Same as message strips**] [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors**] **<Insert color>**.
 3. Reveal Frame and Nonsectional Cover: Glazing held in cover frame mounted on full-length, concealed continuous hinge to form reveal between outer edge of cover frame and inner edge of perimeter frame. Provide nonsectional, one-piece

- cover for access to message strips[**and header panel**], equipped with cylinder lock.
- a. Perimeter Frame: [**Extruded aluminum**] [**Brass**] [**Bronze**].
 - b. Perimeter Frame Profile: [**Square**] [**Quarter round**] [**Beveled**] <Insert shape>.
 - c. Perimeter Frame Corners: [**Square**] [**Radius**].
 - d. Cover Frame: Same material and finish as perimeter frame.
 - 1) Hinge Location: [**Side**] [**Top**].
 - e. Glazing: [**Clear float glass**] [**Clear tempered glass**] [**Bronze-tinted tempered glass**] [**Gray-tinted tempered glass**] [**Clear acrylic sheet**].
 - f. Header Panel: Provide copy that complies with requirements indicated on [**Drawings**] [**artwork supplied on electronic media by DEN Project Manager**] for size, style, spacing, content, height, location, material, and colors of graphics.
 - g. Divider Color: [**Same as message strips**] [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors**] <Insert color>.
4. Sectional Frame and Cover: Individual, glazed section covers, each in its own frame, containing single column of message strips. Provide perimeter frame for entire unit[**and separate divider frame between header panel and message-strip columns**]. Mount section covers with concealed pivot hinges or continuous hinges and equip with concealed lock.
- a. Perimeter Frame: [**Extruded aluminum**] [**Brass**] [**Bronze**].
 - b. Perimeter Frame Profile: [**Square**] [**Quarter round**] [**Beveled**].
 - c. Perimeter Frame Corners: [**Square**] [**Radius**].
 - d. Cover Frame: Same material and finish as perimeter frame.
 - e. Glazing: [**Clear float glass**] [**Clear tempered glass**] [**Bronze-tinted tempered glass**] [**Gray-tinted tempered glass**] [**Clear acrylic sheet**].
 - f. Header Panel: Provide copy that complies with requirements indicated on [**Drawings**] [**artwork supplied on electronic media by DEN Project Manager**] for size, style, spacing, content, height, location, material, and colors of graphics.
5. Modular Frame and Cover: Individual modular units containing single column of message strips. Provide each modular unit with its own perimeter frame and lift-off glazed cover that snaps into place, and equipped with concealed lock.
- a. Perimeter Frame: [**Extruded aluminum**] [**Brass**] [**Bronze**].
 - b. Perimeter Frame Profile: [**Square**] [**Quarter round**] [**Beveled**] <Insert shape>.
 - c. Perimeter Frame Corners: [**Square**] [**Radius**].
 - d. Cover Frame: Same material and finish as perimeter frame.
 - e. Glazing: [**Clear float glass**] [**Clear tempered glass**] [**Bronze-tinted tempered glass**] [**Gray-tinted tempered glass**] [**Clear acrylic sheet**].

- f. Header Panel: **[At top of each message-strip column] [Separate modular unit for entire directory]**.
- 1) Provide copy that complies with requirements indicated on **[Drawings] [artwork supplied on electronic media by DEN Project Manager]** for size, style, spacing, content, height, location, material, and colors of graphics.
6. Aluminum Finish: **[Clear anodic] [Color anodic] [Baked enamel] [Powder coat]**.
- a. Color and Gloss: **[Light bronze] [Medium bronze] [Dark bronze] [Black] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors]** <Insert color and gloss>.
7. Brass Finish: **[Buffed] [Medium satin] [Fine matte] [Statuary conversion coating]**.
8. Bronze Finish: **[Buffed] [Medium satin] [Fine matte] [Statuary conversion coating]**.
9. Applied-Copy Changeable Message Strips: Screen-printed copy or vinyl copy applied to **[7-inch- (175-mm-)] [14-inch- (350-mm-)]** <Insert dimension> long, opaque acrylic strips.
10. Engraved Changeable Message Strips: Machine- or laser-engraved copy in **[7-inch- (175-mm-)] [14-inch- (350-mm-)]** <Insert dimension> long, interchangeable, interlocking, acrylic or high-pressure plastic-laminate strips with contrasting core.
11. Magnetic Changeable Message Strips: Screen-printed copy or vinyl copy laminated to **[7-inch- (175-mm-)] [14-inch- (350-mm-)]** <Insert dimension> long, flexible magnetic tape.
12. Film-Insert Changeable Message Strips: Removable message strips fabricated from plastic film with **[vinyl] [screen-printed]** lettering, held in **[7-inch- (175-mm-)] [14-inch- (350-mm-)]** <Insert dimension> long, interchangeable, interlocking plastic carriers.
- a. Message-Strip Color: **[Black] [Gray] [Brown] [White] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range]** <Insert color>.
- b. Message-Strip Height: **[1/2 inch (13 mm)] [1 inch (25 mm)]** [As indicated on Drawings] <Insert dimension>.
- c. Letter Height: **[3/16 inch (5 mm)] [1/4 inch (6 mm)] [3/8 inch (9.5 mm)]** <Insert dimension>.
- d. Letter Style: **[Helvetica Medium] [Clarendon Medium] [Optima Bold] [As selected by DEN Project Manager]** <Insert style>.
- e. Letter Color: **[White] [Black] [Gray] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range]** <Insert color>.
- f. Letter Case: **[All capitals] [Initial capitals] [Capitals and lowercase] [As typed]**.

13. Graphics Panel: Screen-printed graphics or vinyl graphics laminated to opaque acrylic sheet; held in place by interchangeable, interlocking plastic carrier. Provide graphics that comply with requirements indicated on **[Drawings]** **[artwork supplied on electronic media by DEN Project Manager]** for size, style, spacing, content, height, location, material, and colors.
 14. Width: **[24 inches (610 mm)]** **[As indicated on Drawings]** **<Insert dimension>**.
 15. Height: **[36 inches (914 mm)]** **[As indicated on Drawings]** **<Insert dimension>**.
 16. Mounting: **[Recessed]** **[Semirecessed]** **[Surface mounted]** **[As indicated on Drawings]**.
 17. Mounting Height: **[As indicated on Drawings]** **<Insert dimension>**.
- B. Rear-Illuminated, Message-Strip Directory **<Insert drawing designation>**:
Factory-fabricated **[weather-resistant]** unit consisting of changeable message strips held in place by retainer frame enclosed in manufacturer's standard **[4-to-6-inch- (100-to-150-mm-)]** **<Insert dimension>** deep perimeter frame; with glazed cover, aluminum-sheet rear cover panel, and concealed illumination system.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Graphics, Inc.
 - b. ASI-Modulex, Inc.
 - c. Nelson-Harkins Industries.
 - d. Poblocki Sign Company.
 - e. Tablet & Ticket Co. (The).
 - f. Vomar Products, Inc.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
 2. Reveal Frame and Nonsectional Cover: Glazing held in cover frame mounted on full-length, concealed continuous hinge to form reveal between outer edge of cover frame and inner edge of perimeter frame. Provide nonsectional, one-piece cover for access to message strips **[and header panel]**, equipped with concealed lock.
 - a. Perimeter Frame: **[Extruded aluminum]** **[Brass]** **[Bronze]** **[Stainless steel]**.
 - b. Perimeter Frame Profile: **[Square]** **[Quarter round]** **[Beveled]** **<Insert shape>**.
 - c. Perimeter Frame Corners: **[Square]** **[Radius]**.
 - d. Cover Frame: Same material and finish as perimeter frame.
 - 1) Hinge Location: **[Side]** **[Top]**.
 - e. Glazing: **[Gray-tinted float glass]** **[Gray-tinted tempered glass]** **[Bronze-tinted acrylic sheet]**.
 - f. Header Panel: Provide copy that complies with requirements indicated on **[Drawings]** **[artwork supplied on electronic media by DEN Project Manager]** for size, style, spacing, content, height, location, material, and colors of graphics.

- g. Divider Color: Same as message strips.
3. Floating-Glass Cover: Unframed glazing mounted on full-length, concealed continuous hinge **[to form reveal between outer edge of glazing and inner edge]** **[so glazing conceals front]** of perimeter frame. Provide nonsectional, one-piece cover for access to message strips **[and header panel]**, equipped with concealed lock.
 - a. Perimeter Frame: **[Extruded aluminum]** **[Brass]** **[Bronze]** **[Stainless steel]** with square profile and corners.
 - b. Glazing: **[Gray-tinted float glass]** **[Gray-tinted tempered glass]** **[Bronze-tinted acrylic sheet]**.
 - c. Hinge Location: **[Side]** **[Top]**.
 - d. Header Panel: Provide copy that complies with requirements indicated on **[Drawings]** **[artwork supplied on electronic media by DEN Project Manager]** for size, style, spacing, content, height, location, material, and colors of graphics.
 - e. Divider Color: Same as message strips.
4. Aluminum Finish: **[Clear anodic]** **[Color anodic]** **[Plated]** **<Insert finish>**.
 - a. Color and Gloss: **[Light bronze]** **[Medium bronze]** **[Dark bronze]** **[Black]** **[Gold]** **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from manufacturer's full range]** **<Insert color and gloss>**.
 - b. Plating: **[Satin bronze]** **[Mirror bronze]** **[Bright chrome]** **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from manufacturer's full range]** **<Insert finish>**.
5. Brass Finish: **[Buffed]** **[Medium satin]** **[Fine matte]** **[Statuary conversion coating]**.
6. Bronze Finish: **[Buffed]** **[Medium satin]** **[Fine matte]** **[Statuary conversion coating]**.
7. Stainless-Steel Finish: **[No. 4]** **[No. 8]**.
8. Film-Insert Message Strips: Removable, black, negative-film message strips in **[7-inch- (175-mm-)]** **[14-inch- (350-mm-)]** **<Insert dimension>** long, interchangeable, interlocking plastic carriers.
9. Engraved Changeable Message Strips: Machine- or laser-engraved copy in **[7-inch- (175-mm-)]** **[14-inch- (350-mm-)]** **<Insert dimension>** long, interchangeable, interlocking, black, acrylic strips with transparent core.
 - a. Message-Strip Height: **[3/8 inch (9.5 mm)]** **[1/2 inch (13 mm)]** **[5/8 inch (16 mm)]** **[3/4 inch (19 mm)]** **[1 inch (25 mm)]** **[As indicated on Drawings]** **<Insert dimension>**.
 - b. Letter Height: **[3/16 inch (5 mm)]** **[1/4 inch (6 mm)]** **[3/8 inch (9.5 mm)]** **[1/2 inch (13 mm)]** **[5/8 inch (16 mm)]** **<Insert dimension>**.
 - c. Letter Style: **[Helvetica Medium]** **[Clarendon Medium]** **[Optima Bold]** **[As selected by DEN Project Manager]** **<Insert style>**.

- d. Letter Case: **[All capitals] [Initial capitals] [Capitals and lowercase] [As typed]**.
10. Graphics Panel: Same material and color as changeable message strips. Provide graphics that comply with requirements indicated on **[Drawings] [artwork supplied on electronic media by DEN Project Manager]** for size, style, spacing, content, height, location, material, and colors.
11. Header Panel: Same material and color as changeable message strips. Provide copy that complies with requirements indicated on **[Drawings] [artwork supplied on electronic media by DEN Project Manager]** for size, style, spacing, content, height, location, material, and colors.
12. Rear-Illumination System: Provide removable and accessible fluorescent-strip fixture system with reflective interior surfaces for uniform illumination of message strips **[and header panel]** with minimum halation and without light leaks. Include lamps and internal wiring with single concealed electrical connection to building system. Coordinate electrical characteristics with power supply provided.
 - a. Ballasts: Low-temperature, high-power-factor, low-energy, fluorescent lamp ballasts that comply with Certified Ballast Manufacturers Association standards and carry its label. **[Provide exterior ballasts for exterior directories.]**
13. Width: **[As indicated on Drawings] <Insert dimension>**.
14. Height: **[As indicated on Drawings] <Insert dimension>**.
15. Mounting: **[Recessed] [Semirecessed] [Surface mounted] [As indicated on Drawings]**.
16. Mounting Height: **[As indicated on Drawings] <Insert dimension>**.

2.3 CHANGEABLE-LETTER DIRECTORIES

- A. Open-Face, Changeable-Letter Directory **<Insert drawing designation>**:
Factory-fabricated unit consisting of manufacturer's standard, **1-inch-** (25-mm-) deep perimeter frame surrounding **[fixed] [removable]** letterboard with open face.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A-1 Visual Systems.
 - b. ADP Lemco, Inc.
 - c. Claridge Products and Equipment, Inc.
 - d. Ghent Manufacturing, Inc.
 - e. Marsh Industries, Inc.; Visual Products Group.
 - f. Nelson-Harkins Industries.
 - g. Peter Pepper Products, Inc.
 - h. Tablet & Ticket Co. (The).
 - i. Visiontron Corp.
 - j. **<Insert manufacturer's name>**.
 - k. or approved equal.

2. Aluminum Perimeter Frame: Extruded aluminum with **[clear anodic] [color anodic] [baked-enamel] [powder-coat]** finish.
 - a. Perimeter Frame Shape: **[Square] [Half round] [Quarter round]** <Insert shape>.
 - b. Perimeter Frame Corners: **[Square] [Radius]**.
 - c. Color and Gloss: **[Light bronze] [Medium bronze] [Dark bronze] [Black] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range]** <Insert color and gloss>.
3. Wood Perimeter Frame: **[Red oak] [Walnut]** with **[natural lacquered] [oiled] [stained]** finish.
 - a. Perimeter Frame Profile: **[Square] [Half round] [Quarter round]** <Insert shape>.
 - b. Perimeter Frame Corners: **[Square] [Radius]**.
4. Letterboard: Manufacturer's standard **[felt] [vinyl] [rubber]**-covered panel material, with grooves spaced at **1/4 inch** (6 mm) o.c. to receive changeable letters.
 - a. Color: **[Black] [Red] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range]** <Insert color>.
5. Letters: Molded plastic with tabs for engaging grooves in letterboard. Provide manufacturer's standard assortment of not less than **[300]** <Insert number> letters for each size, style, color, and case required; include letters, numbers, and characters. Package letters in compartmentalized carrying box.
 - a. Height: **[3/8 inch (9.5 mm)] [1/2 inch (13 mm)] [3/4 inch (19 mm)] [1 inch (25 mm)] [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]** <Insert dimension> to top of capitals.
 - b. Style: **[Helvetica] [Gothic] [Roman] [As selected by DEN Project Manager]** <Insert style>.
 - c. Color: **[White] [Black] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range]** <Insert color>.
 - d. Case: **[All capitals] [Capitals and lowercase]**.
6. Header Panel: **[Nonilluminated; with opaque,] [Illuminated; with translucent,]** acrylic sheet panel set within overall perimeter frame; with matching frame that separates header panel from letterboard.
 - a. Graphic Content and Style: Provide header panel copy that complies with requirements indicated on **[Drawings] [artwork supplied on electronic media by DEN Project Manager]** for size, style, spacing, content, height, location, material, and colors.

- a. Perimeter Frame Profile: **[Square] [Half round] [Quarter round] <Insert shape>**.
 - b. Perimeter Frame Corners: **[Square] [Radius]**.
4. Glazed, Sliding Doors: Unframed, clear-tempered-glass doors supported on nylon or ball-bearing rollers in extruded-aluminum top and bottom track, with plastic top guide and rubber bumpers. Equip each door with ground finger pull and adjustable cylinder lock with two keys.
 - a. Number of Doors: **[Two] [Three] [As indicated on Drawings] <Insert number>**.
5. Glazed, Hinged Doors: Clear **[acrylic sheet] [tempered glass]** set in door frame equipped with full-height continuous hinge and cylinder lock with two keys.**[Provide factory-applied weather stripping on doors for exterior use.]**
 - a. Door Frame: Same material and finish as perimeter frame.
 - b. Number of Doors: **[One] [Two] [Three] [As indicated on Drawings] <Insert number>**.
6. Lift-off Cover: Clear **[acrylic sheet] [tempered glass]** set in frame that snaps into place. Fabricate frame from same material and finish as perimeter frame.
7. Header Panel: **[Nonilluminated; with opaque,] [Illuminated; with translucent,]** acrylic sheet panel set within overall perimeter frame; with matching frame that separates header panel from letterboard.
 - a. Graphic Content and Style: Provide header panel copy that complies with requirements indicated on **[Drawings] [artwork supplied on electronic media by DEN Project Manager]** for size, style, spacing, content, height, location, material, and colors.
 - b. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
8. Illumination System: Concealed top-lighting system consisting of fluorescent-strip fixtures. Include lamps and internal wiring with single, concealed electrical connection to building system. Coordinate electrical characteristics with power supply provided.
 - a. Ballasts: Low-temperature, high-power-factor, low-energy, fluorescent lamp ballasts that comply with Certified Ballast Manufacturers Association standards and carry its label.**[Provide exterior ballasts for exterior directories.]**
9. Letterboard: Manufacturer's standard **[felt] [vinyl] [rubber]**-covered panel material, with grooves spaced at **1/4 inch** (6 mm) o.c. to receive changeable letters.

- a. Color: **[Black]** **[Red]** **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from manufacturer's full range]** **<Insert color>**.
10. Letters: Molded plastic with tabs for engaging grooves in letterboard. Provide manufacturer's standard assortment of not less than **[300]** **<Insert number>** characters for each size, style, color, and case required; include letters, numbers, and characters. Package letters in compartmentalized carrying box.
- a. Height: **[3/8 inch (9.5 mm)]** **[1/2 inch (13 mm)]** **[3/4 inch (19 mm)]** **[1 inch (25 mm)]** **[1-1/2 inches (38 mm)]** **[2 inches (50 mm)]** **[3 inches (75 mm)]** **<Insert dimension>** to top of capitals.
 - b. Style: **[Helvetica]** **[Gothic]** **[Roman]** **[As selected by DEN Project Manager]** **<Insert style>**.
 - c. Color: **[White]** **[Black]** **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from manufacturer's full range]** **<Insert color>**.
 - d. Case: **[All capitals]** **[Capitals and lowercase]**.
11. Width: **[24 inches (610 mm)]** **[As indicated on Drawings]** **<Insert dimension>**.
12. Height: **[36 inches (914 mm)]** **[As indicated on Drawings]** **<Insert dimension>**.
13. Mounting: **[Recessed]** **[Semirecessed]** **[Surface mounted]**.
14. Mounting Height: **[As indicated on Drawings]** **<Insert dimension>**.

2.4 FABRICATION

- A. Fabricate directories to requirements indicated for dimensions, design, and thickness and finish of materials. Use metals and shapes of thickness and reinforcement to produce flat surfaces, free of oil canning, and to impart strength for size, design, and application indicated.
- B. Fabricate directory cabinets and doorframes with reinforced corners, mitered and welded to a hairline fit, with no exposed fasteners. Provide structural reinforcement to prevent racking and misalignment.
- C. Fabricate exterior directories with vents to permit evaporation of moisture trapped inside.
- D. Message-Strip Directories: Provide blank message strips for each carrier in entire directory.
- E. Message-Strip Directories: Provide message strips with wording and other designations for the locations where wording is indicated. Include blank message strips as needed to fill out remainder of directory.
- F. Provide hold-open arms for doors of top-hinged directories.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
- B. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils** (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.7 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 3. Directional Satin Finish: No. 4.
 - 4. Mirrorlike Reflective, Nondirectional Polish: No. 8.

2.8 COPPER-ALLOY FINISHES

- A. Buffed Finish: M21 (Mechanical Finish: buffed, smooth specular).
- B. Medium-Satin Finish: M32 (Mechanical Finish: directionally textured, medium satin).
- C. Fine-Matte Finish: M42 (Mechanical Finish: nondirectional finish, fine matte).
- D. Statuary Conversion Coating over Satin Finish: M32-C55 (Mechanical Finish: directionally textured, medium satin; Chemical Finish: conversion coating, sulfide).

1. Color: Match DEN Project Manager's sample.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power system to verify actual locations of connections before installation of illuminated directories.
- C. Examine walls and partitions for proper backing for directories.
- D. Examine walls and partitions for suitable framing depth if recessed directories will be installed.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for directories as required by type and size of unit.

3.3 INSTALLATION

- A. General: Install directories in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
 1. Mounting Height: [72 inches (1829 mm)] <Insert dimension> above finished floor to top of directory.
- B. Recessed Directories: Attach directories to wall framing with fasteners at not more than 16 inches (400 mm) o.c. Attach aluminum trim over edges of recessed directories and conceal grounds and clips.
- C. Surface-Mounted Directories: Attach directories to wall surfaces with concealed clips, hangers, or grounds fastened at not more than 16 inches (400 mm) o.c. Secure both top and bottom of directories to walls.
- D. Comply with requirements specified elsewhere for connecting illuminated directories.
 1. After installation is complete, install new fluorescent lamps.

3.4 ADJUSTING AND CLEANING

- A. Adjust directory doors to operate smoothly without warp or bind and so that contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 101300

SECTION 101416 - PLAQUES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes plaques.
- B. Related Requirements:
 - 1. Section 101423 "Panel Signage" for signs, with or without frames that are made of materials other than solid metal.
 - 2. **[Section 142100 "Electric Traction Elevators"] [Section 142400 "Hydraulic Elevators"] [Section 143100 "Escalators"] [Section 143200 "Moving Walks"] [Section 144200 "Wheelchair Lifts"]** for code-required conveying equipment signage.
 - 3. Section 220553 "Identification for Plumbing Piping and Equipment" for labels, tags, and nameplates for plumbing systems and equipment.
 - 4. Section 230553 "Identification for HVAC Piping and Equipment" for labels, tags, and nameplates for HVAC systems and equipment.
 - 5. Section 260553 "Identification for Electrical Systems" for labels, tags, and nameplates for electrical equipment.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ALLOWANCES

- A. Allowances for **[plaques] [plaques used for room identification]** <Insert item **description**> are specified in Section 012100 "Allowances."
- B. <Insert product or material> **[is] [are]** part of <Insert name of allowance>.

1.4 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured materials. Include statement indicating cost for each regionally manufactured material.
 - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
 2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
 3. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For plaques.
1. Include fabrication and installation details and attachments to other work.
 2. Show plaque mounting heights, locations of supplementary supports to be provided by others, and accessories.
 3. Show message list, timesteps, graphic elements[, **including raised characters and Braille**], and layout for each plaque at least [**half size**] <Insert scale>.
- D. Samples for Initial Selection: For each type of plaque, exposed component, and exposed finish.
1. Include representative Samples of available timesteps and graphic symbols.
- E. Samples for Verification: For each type of plaque showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
1. Plaques: [**Full-size Sample**] [**Half-size Sample**] <Insert size>.
 2. Exposed Accessories: [**Full-size Sample**] [**Half-size Sample**] <Insert size> of each accessory type.
- F. Plaque Schedule: Use same designations specified or indicated on Drawings or in a plaque or sign schedule.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For [**Installer**] [**and**] [**manufacturer**].

- B. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For plaques to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: **[Manufacturer of products] [An entity that employs installers and supervisors who are trained and approved by manufacturer].**

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of plaques that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - 2. Warranty Period: Minimum **[five (5)] <Insert number>** years from date of Substantial Completion.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PLAQUES, GENERAL

- A. Regional Materials: Plaques shall be manufactured within **500 miles (800 km)** of Project site.

2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in **[the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities]** **[and] [ICC A117.1]** for signs.

2.3 PLAQUES

- A. Cast Plaque **<Insert drawing designation>**: Plaque with background texture, border, and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Ace Sign Systems, Inc.
- b. Allen Markings International.
- c. APCO Graphics, Inc.
- d. A. R. K. Ramos Signage Systems.
- e. Diskey Sign Company.
- f. Erie Landmark Company; Division of Paul W. Zimmerman Foundries.
- g. Gemini Incorporated.
- h. Matthews International Corporation; Bronze Division.
- i. Metal Arts; Division of L & H Mfg. Co.
- j. Metallic Arts.
- k. Nelson-Harkins Industries.
- l. Southwell Company (The).
- m. **<Insert manufacturer's name>**.
- n. or approved equal.

2. Plaque Material: Cast **[aluminum] [brass] [bronze] [zinc] <Insert material>**.

3. Plaque Thickness: **[0.153 inch (3.89 mm)] [0.25 inch (6.35 mm)] [0.50 inch (12.7 mm)] <Insert dimension>**.

4. Finishes:

- a. Integral Metal Finish: **[Mill] [Antique oxidized] [Mill finish raised surface with dark oxidized background] [As indicated by manufacturer's designation] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry finishes] <Insert finish>**.
- b. Integral Aluminum Finish: **[Clear anodized] [Light bronze anodized] [Medium bronze anodized] [Match DEN Project Manager's sample] [Anodized color as selected by DEN Project Manager from full range of industry colors and color densities] <Insert finish>**.
- c. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color **[as indicated by manufacturer's designation] [matching DEN Project Manager's sample] [as selected by DEN Project Manager from manufacturer's full range] <Insert color>**.

- d. Overcoat: **[Manufacturer's standard baked-on clear coating] [Clear organic coating] <Insert requirement>**.
 5. Background Texture: **[Smooth] [Pebble] [Leatherette] [Matte] [Stipple] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert description>**.
 6. Integrally Cast Border Style: **[As indicated] [Square cut without border] [Square single line, polished] [Square double line, polished] [Plain bevel, brushed] [Plain bevel, polished] [Projected bevel] [Raised flat band] [Double-raised line border] <Insert description>**.
 7. Applied Frame Material, Style, and Finish: **[As indicated] <Insert description>**.
 8. Mounting: **[As indicated] [Concealed studs] [Rosette-head through fasteners] [Countersunk flathead through fasteners] [Adhesive] [Two-face tape] <Insert requirement>**.
 9. Text and Typeface: **[Accessible raised characters and Braille] [Times Roman] [typeface as indicated by manufacturer's designation] [typeface matching DEN Project Manager's sample] [typeface as selected by DEN Project Manager from manufacturer's full range] [and] [variable content as scheduled] <Insert requirement>**. [Finish raised characters to contrast with background color, and finish Braille to match background color.]
- B. Etched Plaque **<Insert drawing designation>**: Chemically etched or photochemically engraved metal sheet or plate with texture, border, and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Ace Sign Systems, Inc.
 - b. Advance Corporation; Braille-Tac Division.
 - c. Allen Markings International.
 - d. APCO Graphics, Inc.
 - e. A. R. K. Ramos Signage Systems.
 - f. Diskey Sign Company.
 - g. Dixie Graphics.
 - h. Erie Landmark Company; Division of Paul W. Zimmerman Foundries.
 - i. Gemini Incorporated.
 - j. Matthews International Corporation; Bronze Division.
 - k. Metal Arts; Division of L & H Mfg. Co.
 - l. Metallic Arts.
 - m. Mohawk Sign Systems.
 - n. Nelson-Harkins Industries.
 - o. Steel Art Company.
 - p. **<Insert manufacturer's name>**.
 - q. or approved equal.
 2. Plaque Material: Sheet or plate **[aluminum] [brass] [bronze] [copper] [stainless steel] [zinc] <Insert material>**.
 3. Plaque Thickness: **[0.064 inch (1.63 mm)] [0.125 inch (3.18 mm)] [0.153 inch (3.89 mm)] [0.250 inch (6.35 mm)] <Insert dimension>**.

4. Finishes:
 - a. Integral Metal Finish: **[Mill] [Antique oxidized] [Mill finish raised surface with dark oxidized background] [As indicated by manufacturer's designation] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry finishes] <Insert finish>**.
 - b. Integral Aluminum Finish: **[Clear anodized] [Light bronze anodized] [Medium bronze anodized] [Match DEN Project Manager's sample] [Anodized color as selected by DEN Project Manager from full range of industry colors and color densities] <Insert finish>**.
 - c. Integral Stainless-Steel Finish: **[No. 4] [No. 8] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry finishes] <Insert description>**.
 - d. Baked-Enamel or Powder-Coat Finish: **Manufacturer's standard, in color [as indicated by manufacturer's designation] [matching DEN Project Manager's sample] [as selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 - e. Overcoat: **[Manufacturer's standard baked-on clear coating] [Clear organic coating] <Insert requirement>**.
5. Integral Edge Style: **[As indicated] [Square cut, polished] [Plain bevel, brushed] <Insert description>**.
6. Applied Frame Material, Style, and Finish: **[As indicated] <Insert description>**.
7. Mounting: **[As indicated] [Concealed studs] [Rosette-head through fasteners] [Countersunk flatheads through fasteners] [Adhesive] [Two-face tape] <Insert requirement>**.
8. Text and Typeface: **[Accessible raised characters and Braille] [Times Roman] [typeface as indicated by manufacturer's designation] [typeface matching DEN Project Manager's sample] [typeface as selected by DEN Project Manager from manufacturer's full range] [and] [variable content as scheduled] <Insert requirement>**. [Finish raised characters to contrast with background color, and finish Braille to match background color.]

2.4 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M, alloy and temper recommended by plaque manufacturer for casting process used and for type of use and finish indicated.
- B. Aluminum Sheet and Plate: [ASTM B 209](#) (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Aluminum Extrusions: [ASTM B 221](#) (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- D. Brass Castings: ASTM B 584, **[alloy recommended by manufacturer and finisher for finish indicated] [lead-free alloy recommended by manufacturer and finisher for finish indicated] [Alloy UNS No. C85200 (high-copper yellow brass)] <Insert requirement>**.

- E. Brass Sheet (Yellow Brass): ASTM B 36/B 36M, [**alloy recommended by manufacturer and finisher for finish indicated**] [**lead-free alloy recommended by manufacturer and finisher for finish indicated**] [**Alloy UNS No. C26000 (yellow brass)**] <Insert requirement>.
- F. Bronze Castings: ASTM B 584, [**alloy recommended by manufacturer and finisher for finish indicated**] [**lead-free alloy recommended by manufacturer and finisher for finish indicated**] [**Alloy UNS No. C86500 (No. 1 manganese bronze)**] <Insert requirement>.
- G. Bronze Plate: ASTM B 36/B 36M, [**alloy recommended by manufacturer and finisher for finish indicated**] [**lead-free alloy recommended by manufacturer and finisher for finish indicated**] [**Alloy UNS No. C22000 (commercial bronze)**] <Insert requirement>.
- H. Copper Sheet: ASTM B 152/B 152M.
- I. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, [**Type 304,**] [**Type 316,**] stretcher-leveled standard of flatness.
- J. Zinc Castings: ASTM B 240, alloy and temper recommended by plaque manufacturer for type of use and finish indicated.
- K. Zinc Sheet: [**ASTM B 69**] <Insert standard>, alloy and temper recommended by plaque manufacturer for type of use and finish indicated.

2.5 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of plaques, noncorrosive and compatible with each material joined, and complying with the following:
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
 - 2. For exterior exposure, furnish [**nonferrous-metal**] [**stainless-steel**] [**or**] [**hot-dip galvanized**] <Insert requirement> devices unless otherwise indicated.
 - 3. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
 - b. Fastener Heads: For nonstructural connections, use [**flathead**] [**or**] [**oval countersunk**] <Insert shape> screws and bolts with tamper-resistant [**Allen-head**] [**spanner-head**] [**or**] [**one-way-head**] <Insert slot design> slots unless otherwise indicated.
 - 4. Plaque Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of plaque, screwed into back of plaque, or screwed into tapped lugs cast integrally into back of plaque, unless otherwise indicated.

- b. Through Fasteners: Exposed metal fasteners matching plaque finish, with type of head indicated, installed in predrilled holes.
- B. Adhesives: As recommended by plaque manufacturer and with a VOC content of [70] <Insert value> g/L or less for adhesives used inside the weatherproofing system and applied on-site when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Adhesives: As recommended by plaque manufacturer and that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.6 FABRICATION

- A. General: Provide manufacturer's standard plaques according to requirements indicated.
 - 1. Preassemble plaques in the shop to greatest extent possible. Disassemble plaques only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 - 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 5. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match plaque finish.
 - 6. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.
- B. Surface-Engraved Graphics: Machine engrave characters and other graphic devices into panel surface indicated to produce precisely formed copy, incised to uniform depth.
 - 1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.

- C. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted plaques to suit plaque construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish **[to match plaque-background color] [to match DEN Project Manager's sample]** <Insert requirement> color unless otherwise indicated.
 2. Stainless-Steel Brackets: Factory finish brackets **[to match plaque background] [to match DEN Project Manager's sample] [with No. 4]** <Insert finish> finish unless otherwise indicated.

2.7 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.
- D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.8 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, **[Class I, 0.018 mm] [Class II, 0.010 mm]** or thicker.
- B. Color Anodic Finish: AAMA 611, **[Class I, 0.018 mm] [Class II, 0.010 mm]** or thicker.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils (0.04 mm)**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.9 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
1. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 2. Directional Satin Finish: No. 4.
 3. Dull Satin Finish: No. 6.

4. Reflective, Directional Polish: No. 7.
5. Mirrorlike Reflective, Nondirectional Polish: No. 8.

2.10 CLEAR ORGANIC COATING FOR COPPER-ALLOY FINISHES

- A. Clear Organic Coating: Clear, waterborne, air-drying, acrylic lacquer called "Incralac"; specially developed for coating copper-alloy products; consisting of a solution of methyl methacrylate copolymer with benzotriazole to prevent breakdown of the film in UV light; shop applied in two uniform coats per manufacturer's written instructions, with interim drying between coats and without runs or other surface imperfections, to a total dry film thickness of **1 mil** (0.025 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of plaque work.
- B. Verify that plaque-support surfaces are within tolerances to accommodate plaques without gaps or irregularities between backs of plaques and support surfaces unless otherwise indicated.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install plaques using mounting methods indicated and according to manufacturer's written instructions.
 1. Install plaques level, plumb, true to line, and at locations and heights indicated, with plaque surfaces free of distortion and other defects in appearance.
 2. Install plaques so they do not protrude or obstruct according to the accessibility standard.
 3. Before installation, verify that plaque surfaces are clean and free of materials or debris that would impair installation.
 4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Plaques Used for Room Identification[**and Other Accessible Plaques**]: Install in locations on walls [**as indicated**] [**and**] [**according to accessibility standard**] <Insert requirement>.
- C. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of plaque. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place plaque in position and push until flush to surface, embedding studs in holes. Temporarily support plaque in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place plaque in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
2. Through Fasteners: Drill holes in substrate using predrilled holes in plaque as template. Countersink holes in plaque if required. Place plaque in position and flush to surface. Install through fasteners and tighten.
3. Brackets: Remove loose debris from substrate surface and install bracket supports in position so that plaque is correctly located and aligned.
4. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of plaque and of suitable quantity to support weight of plaque after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as plaque is applied and to prevent visibility of cured adhesive at plaque edges. Place plaque in position, and push to engage adhesive. Temporarily support plaque in position until adhesive fully sets.
5. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of plaque and of suitable quantity to support weight of plaque without slippage. Keep strips away from edges to prevent visibility at plaque edges. Place plaque in position, and push to engage tape adhesive.
6. Shim-Plate Mounting: Provide **1/8-inch- (3-mm-)** thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other direct mounting methods are impractical. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach plaques to plate using **[method specified above] <Insert requirement>**.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed plaques and plaques that do not comply with specified requirements. Replace plaques with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as plaques are installed.
- C. On completion of installation, clean exposed surfaces of plaques according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain plaques in a clean condition during construction and protect from damage until acceptance by Owner.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 101416

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cast dimensional characters.
 - 2. Cutout dimensional characters.
 - 3. Fabricated channel dimensional characters.
 - 4. Illuminated, fabricated channel dimensional characters.
 - 5. Molded-plastic dimensional characters.
 - 6. Illuminated, molded-plastic dimensional characters.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ALLOWANCES

- A. Allowances for [**signage**] [**illuminated, fabricated channel dimensional characters**] **<Insert item description>** are specified in Section 012100 "Allowances."
- B. **<Insert product or material>** [**is**] [**are**] part of **<Insert name of allowance>**.

1.4 DEFINITIONS

- A. Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

1.5 COORDINATION

- A. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured materials. Include statement indicating cost for each regionally manufactured material.
 - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
 2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
 3. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For dimensional letter signs.
1. Include fabrication and installation details and attachments to other work.
 2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 3. Show message list, typestyles, graphic elements, and layout for each sign at least [**half size**] <Insert scale>.
 4. Show locations of electrical service connections.
 5. Include diagrams for power, signal, and control wiring.
- D. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
1. Include representative Samples of available typestyles and graphic symbols.
- E. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
1. Dimensional Characters: [**Full-size Sample**] [**Half-size Sample**] <Insert size> of [**each type of**] dimensional character.
 2. Exposed Accessories: [**Full-size Sample**] [**Half-size Sample**] <Insert size> of each accessory type.
- F. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.
- G. Delegated-Design Submittal: For [**signs indicated in "Performance Requirements" Article**] <Insert sign designations>.

1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[Installer] [and] [manufacturer]**.
- B. Sample Warranty: For special warranty.

1.8 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: **[Manufacturer of products] [An entity that employs installers and supervisors who are trained and approved by manufacturer]**.

1.10 FIELD CONDITIONS

- A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Separation or delamination of sheet materials and components.
 2. Warranty Period: Minimum **[Five (5)] <Insert number>** years from date of Substantial Completion.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419

"Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 DIMENSIONAL LETTER SIGNS, GENERAL

- A. Regional Materials: Dimensional letter signs shall be manufactured within **500 miles (800 km)** of Project site.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design sign structure and anchorage of **[rooftop]** **[dimensional character]** **<Insert description>** sign type(s) **<Insert drawing designation of sign(s)>** to withstand design loads **[as indicated on Drawings]** **<Insert loads>**.
- B. Thermal Movements: For exterior **[fabricated channel dimensional characters]** **<Insert item>**, allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: **[120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces]** **<Insert temperature change>**.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 DIMENSIONAL CHARACTERS

- A. Cast Characters **<Insert drawing designation>**: Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
- ACE Sign Systems, Inc.
 - Allen Markings International.
 - APCO Graphics, Inc.
 - A. R. K. Ramos Signage Systems.
 - ASI Sign Systems, Inc.
 - Diskey Sign Company.
 - Gemini Incorporated.
 - Matthews International Corporation; Bronze Division.
 - Metal Arts; Division of L & H Mfg. Co.
 - Metallic Arts.

- k. Seton Identification Products.
 - l. Southwell Company (The).
 - m. **<Insert manufacturer's name>**.
 - n. or approved equal.
 2. Character Material: Cast **[aluminum] [brass] [bronze] [zinc] <Insert material>**.
 3. Character Height: **[As indicated] <Insert dimension>**.
 4. Thickness: **[As indicated] [Manufacturer's standard for size of character] <Insert dimension>**.
 5. Finishes:
 - a. Integral Metal Finish: **[Mill] [Antique oxidized] [As indicated by manufacturer's designation] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry finishes] <Insert finish>**.
 - b. Integral Aluminum Finish: **[Clear anodized] [Light bronze anodized] [Medium bronze anodized] [Match DEN Project Manager's sample] [Anodized color as selected by DEN Project Manager from full range of industry colors and color densities] <Insert finish>**.
 - c. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color **[as indicated by manufacturer's designation] [matching DEN Project Manager's sample] [as selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 - d. Overcoat: **[Manufacturer's standard baked-on clear coating] [Clear organic coating] <Insert requirement>**.
 6. Mounting: **[As indicated] [Concealed studs] [Projecting studs] [Rosette-head through fasteners] [Countersunk flathead through fasteners] <Insert requirement>**.
 7. Typeface: **[Times Roman] <Insert requirement>**.
- B. Cutout Characters **<Insert drawing designation>**: Characters with uniform faces; square-cut, smooth[, **eased**] edges; precisely formed lines and profiles; and as follows:
 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. ACE Sign Systems, Inc.
 - b. APCO Graphics, Inc.
 - c. A. R. K. Ramos Signage Systems.
 - d. ASI Sign Systems, Inc.
 - e. Charleston Industries, Inc.
 - f. Diskey Sign Company.
 - g. Gemini Incorporated.
 - h. InPro Corporation.
 - i. Matthews International Corporation; Bronze Division.
 - j. Metal Arts; Division of L & H Mfg. Co.
 - k. Metallic Arts.
 - l. Nelson-Harkins Industries.
 - m. Southwell Company (The).

- n. Steel Art Company.
 - o. **<Insert manufacturer's name>**.
 - p. or approved equal.
2. Character Material: Sheet or plate **[aluminum] [brass] [bronze] [copper] [stainless steel] [zinc] [acrylic] [acrylic with laminated aluminum facing] [acrylic with laminated brass facing] [acrylic with laminated bronze facing] [acrylic with laminated stainless-steel facing] <Insert material>**.
 3. Character Height: **[As indicated] <Insert dimension>**.
 4. Thickness: **[As indicated] [Manufacturer's standard for size of character] [0.125 inch (3.18 mm)] [0.25 inch (6.35 mm)] <Insert dimension>**.
 5. Finishes:
 - a. Integral Metal Finish: **[Mill] [Antique oxidized] [As indicated by manufacturer's designation] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry finishes] <Insert finish>**.
 - b. Integral Aluminum Finish: **[Clear anodized] [Light bronze anodized] [Medium bronze anodized] [Match DEN Project Manager's sample] [Anodized color as selected by DEN Project Manager from full range of industry colors and color densities] <Insert finish>**.
 - c. Integral Stainless-Steel Finish: **[No. 4] [No. 8] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry finishes] <Insert description>**.
 - d. Integral Acrylic Color: **[As indicated by manufacturer's designation] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors] <Insert color>**.
 - e. Baked-Enamel or Powder-Coat Finish: **Manufacturer's standard, in color [as indicated by manufacturer's designation] [matching DEN Project Manager's sample] [as selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 - f. Overcoat: **[Manufacturer's standard baked-on clear coating] [Clear organic coating] <Insert requirement>**.
 - g. Painted Edges: **Paint edges of acrylic characters with laminated metal facing as recommended in writing by manufacturer.**
 6. Mounting: **[As indicated] [Concealed studs] [Projecting studs] [Rosette-head through fasteners] [Countersunk flathead through fasteners] [Concealed, painted aluminum back bar or bracket assembly] [Concealed, stainless-steel back bar or bracket assembly] [Adhesive] <Insert requirement>**.
 7. Typeface: **[Times Roman] <Insert requirement>**.
- C. Fabricated Channel Characters **<Insert drawing designation>**: **[Metal face and side returns] [Open face with metal side returns] [Translucent face with metal side returns]**, formed free from warp and distortion; with uniform faces, sharp corners, and precisely formed lines and profiles; internally braced for stability and for securing fasteners; and as follows.

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. ACE Sign Systems, Inc.
 - b. Allen Industries, Inc.; Architectural Division.
 - c. APCO Graphics, Inc.
 - d. A. R. K. Ramos Signage Systems.
 - e. ASI Sign Systems, Inc.
 - f. Diskey Sign Company.
 - g. Gemini Incorporated.
 - h. Metallic Arts.
 - i. Nelson-Harkins Industries.
 - j. Poblocki Sign Company, LLC.
 - k. Steel Art Company.
 - l. **<Insert manufacturer's name>**.
 - m. or approved equal.

2. **Illuminated Characters: [Backlighted] [Frontlighted] character construction with [fluorescent tube] [fiber-optic] [LED] [neon tube] <Insert requirement> lighting including transformers, insulators, and other accessories for operability, with provision for servicing and concealing connections to building electrical system. Use tight or sealed joint construction to prevent unintentional light leakage. Space lamps apart from each other and away from character surfaces as needed to illuminate evenly.**
 - a. **Power: [As indicated on electrical Drawings] [120 V, 60 Hz, 1 phase, 15 A] <Insert requirement>**.
 - b. **Weeps: Provide weep holes to drain water at lowest part of exterior characters.[Equip weeps with permanent baffles to block light leakage without inhibiting drainage.]**

3. **Character Material: Sheet or plate [aluminum] [brass] [bronze] [copper] [steel] [stainless steel] [zinc] <Insert material>**.
4. **Material Thickness: [As indicated] [Manufacturer's standard for size and design of character] [0.100 inch (2.54 mm)] [0.032 inch (0.81 mm)] [Nominal 0.048 inch (1.21 mm) thick for face and 0.030 inch (0.76 mm) thick for returns] [0.050 inch (1.27 mm) thick for face and 0.031 inch (0.79 mm) thick for returns] <Insert dimension(s)>**.
5. **Translucent Face Sheet: Acrylic sheet, [thickness as indicated] [manufacturer's standard thickness for size of character] [0.125 inch (3.18 mm) thick] [0.25 inch (6.35 mm) thick] <Insert dimension>, and with integral color [matching DEN Project Manager's sample] [as selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
6. **Character Height: [As indicated] <Insert dimension>**.
7. **Character Depth: [As indicated] <Insert dimension>**.
8. **Finishes:**
 - a. **Integral Metal Finish: [Mill] [Antique oxidized] [As indicated by manufacturer's designation] [Match DEN Project Manager's sample]**

- [As selected by DEN Project Manager from full range of industry finishes] <Insert finish>.
- b. Integral Aluminum Finish: [Clear anodized] [Light bronze anodized] [Medium bronze anodized] [Match DEN Project Manager's sample] [Anodized color as selected by DEN Project Manager from full range of industry colors and color densities] <Insert finish>.
 - c. Integral Stainless-Steel Finish: [No. 4] [No. 8] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry finishes] <Insert description>.
 - d. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color [as indicated by manufacturer's designation] [matching DEN Project Manager's sample] [as selected by DEN Project Manager from manufacturer's full range] <Insert color>.
 - e. Overcoat: [Manufacturer's standard baked-on clear coating] [Clear organic coating] <Insert requirement>.
9. Mounting: [As indicated] [Manufacturer's standard for size and design of character] [Projecting studs] [Concealed, painted aluminum back bar or bracket assembly] [Concealed, stainless-steel back bar or bracket assembly] <Insert requirement>.
- a. Hold characters at [2-inch (51-mm) distance] [manufacturer's recommended distance] [distance as selected by DEN Project Manager] <Insert dimension> from wall surface.
10. Typeface: [Times Roman] <Insert requirement>.
- D. Molded-Plastic Characters <Insert drawing designation>: [Injection molded] [or] [thermoformed] characters having uniform faces and profiles, and as follows:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. ACE Sign Systems, Inc.
 - b. ASI Sign Systems, Inc.
 - c. Diskey Sign Company.
 - d. Gemini Incorporated.
 - e. Metallic Arts.
 - f. <Insert manufacturer's name>.
 - g. or approved equal.
 2. **Illuminated Characters:** Characters with concealed [fluorescent tube] [fiber-optic] [LED] [neon tube] lighting including transformers, insulators, and other accessories; with provision for servicing and concealing connections to building electrical system. Space lamps apart from each other and away from character surfaces as needed to illuminate evenly.
 - a. Power: [As indicated on electrical Drawings] [120 V, 60 Hz, 1 phase, 15 A] <Insert requirement>.

- b. Weeps: Provide weep holes to drain water at lowest part of exterior characters. [**Equip weeps with permanent baffles to block light leakage without inhibiting drainage.**]
3. Color: Manufacturer's standard [**integral color**] [**painted finish**] process, in color [**as indicated by manufacturer's designation**] [**matching DEN Project Manager's sample**] [**as selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
4. Typeface: [**Times Roman**] <Insert requirement>.

2.4 DIMENSIONAL CHARACTER MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.
- B. Aluminum Sheet and Plate: [ASTM B 209](#) (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Aluminum Extrusions: [ASTM B 221](#) (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- D. Brass Castings: ASTM B 584, [**alloy recommended by manufacturer and finisher for finish indicated**] [**lead-free alloy recommended by manufacturer and finisher for finish indicated**] [**Alloy UNS No. C85200 (high-copper yellow brass)**] <Insert requirement>.
- E. Brass Sheet (Yellow Brass): ASTM B 36/B 36M, [**alloy recommended by manufacturer and finisher for finish indicated**] [**lead-free alloy recommended by manufacturer and finisher for finish indicated**] [**Alloy UNS No. C26000 (yellow brass)**] <Insert requirement>.
- F. Bronze Castings: ASTM B 584, [**alloy recommended by manufacturer and finisher for finish indicated**] [**lead-free alloy recommended by manufacturer and finisher for finish indicated**] [**Alloy UNS No. C86500 (No. 1 manganese bronze)**] <Insert requirement>.
- G. Bronze Plate: ASTM B 36/B 36M, [**alloy recommended by manufacturer and finisher for finish indicated**] [**lead-free alloy recommended by manufacturer and finisher for finish indicated**] [**Alloy UNS No. C22000 (commercial bronze)**] <Insert requirement>.
- H. Copper Sheet: ASTM B 152/B 152M.
- I. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, [**Type 304,**] [**Type 316,**] stretcher-leveled standard of flatness.
- J. Zinc Castings: ASTM B 240, alloy and temper recommended by sign manufacturer for type of use and finish indicated.

- K. Zinc Sheet: [**ASTM B 69**] <Insert standard>, alloy and temper recommended by sign manufacturer for type of use and finish indicated.
- L. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- M. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.5 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
 - 2. For exterior exposure, furnish [**nonferrous-metal**] [**stainless-steel**] [**or**] [**hot-dip galvanized**] <Insert requirement> devices unless otherwise indicated.
 - 3. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
 - b. Fastener Heads: For nonstructural connections, use [**flathead**] [**or**] [**oval countersunk**] <Insert shape> screws and bolts with tamper-resistant [**Allen-head**] [**spanner-head**] [**or**] [**one-way-head**] <Insert slot design> slots unless otherwise indicated.
 - 4. Sign Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
 - b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
 - c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.
- B. Adhesives: As recommended by sign manufacturer and with a VOC content of [**70**] <Insert value> g/L or less for adhesives used inside the weatherproofing system and applied on-site when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Adhesives: As recommended by sign manufacturer and that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- D. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.6 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 - 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 5. Internally brace signs for stability and for securing fasteners.
 - 6. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
 - 7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.
- B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
 - 1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish **[to match sign-background color] [to match DEN Project Manager's sample] <Insert requirement>** color unless otherwise indicated.
 - 2. Stainless-Steel Brackets: Factory finish brackets **[to match sign background] [to match DEN Project Manager's sample] [with No. 4] <Insert finish>** finish unless otherwise indicated.

2.7 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.
- D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.8 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, [**Class I, 0.018 mm**] [**Class II, 0.010 mm**] or thicker.
- B. Color Anodic Finish: AAMA 611, [**Class I, 0.018 mm**] [**Class II, 0.010 mm**] or thicker.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils** (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.9 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 2. Directional Satin Finish: No. 4.
 - 3. Dull Satin Finish: No. 6.
 - 4. Reflective, Directional Polish: No. 7.
 - 5. Mirrorlike Reflective, Nondirectional Polish: No. 8.

2.10 CLEAR ORGANIC COATING FOR COPPER-ALLOY FINISHES

- A. Clear Organic Coating: Clear, waterborne, air-drying, acrylic lacquer called "Incralac"; specially developed for coating copper-alloy products; consisting of a solution of methyl methacrylate copolymer with benzotriazole to prevent breakdown of the film in UV light; shop applied in two uniform coats per manufacturer's written instructions, with interim drying between coats and without runs or other surface imperfections, to a total dry film thickness of **1 mil** (0.025 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Verify that electrical service is correctly sized and located to accommodate signs.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
 - 3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Mounting Methods:
 - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
 - 2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the

- stud ends in holes. Temporarily support sign in position until adhesive fully sets.
- b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.
3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
 4. Back Bar and Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.
 5. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
 6. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 101419

SECTION 101423 - PANEL SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Panel signs.
2. Illuminated panel signs.
3. Room-identification signs.
4. Field-applied, vinyl-character signs.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary Project identification signs and for temporary information and directional signs.
2. Section 015639 "Temporary Tree and Plant Protection" for temporary protection-zone signage.
3. Section 101300 "Directories" for building directories.
4. Section 101426 "Post and Panel/Pylon Signage" for freestanding signs.
5. **[Section 142100 "Electric Traction Elevators"] [Section 142400 "Hydraulic Elevators"] [Section 143100 "Escalators"] [Section 143200 "Moving Walks"] [Section 144200 "Wheelchair Lifts"]** for code-required conveying equipment signage.
6. Section 220553 "Identification for Plumbing Piping and Equipment" for labels, tags, and nameplates for plumbing systems and equipment.
7. Section 230553 "Identification for HVAC Piping and Equipment" for labels, tags, and nameplates for HVAC systems and equipment.
8. Section 260553 "Identification for Electrical Systems" for labels, tags, and nameplates for electrical equipment.
9. Section 265100 "Interior Lighting" for illuminated, self-luminous, and photoluminescent exit sign units.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ALLOWANCES

- A. Allowances for **[signage] [room-identification signs]** <Insert item description> are specified in Section 012100 "Allowances."
- B. <Insert product or material> **[is] [are]** part of <Insert name of allowance>.

1.4 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.
- B. Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

1.5 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.
- B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured materials. Include statement indicating cost for each regionally manufactured material.
 - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
 - 2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
 - 3. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For panel signs.
 - 1. Include fabrication and installation details and attachments to other work.

2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 3. Show message list, typestyles, graphic elements[, **including raised characters and Braille**], and layout for each sign at least [**half size**] <Insert scale>.
 4. Show locations of electrical service connections.
 5. Include diagrams for power, signal, and control wiring.
- D. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
1. Include representative Samples of available typestyles and graphic symbols.
- E. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
1. Panel Signs: [**Full-size Sample**] [**Not less than 12 inches (300 mm) square, including corner**] <Insert size>.
 2. Room-Identification Signs: [**Full-size Sample**] <Insert size>.
 3. Field-Applied, Vinyl-Character Signs: [**Full-size Sample of characters on glass**] <Insert requirement>.
 4. Variable Component Materials: [**Full-size Sample**] [**8-inch (200-mm) Sample**] <Insert size> of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
 5. Exposed Accessories: [**Full-size Sample**] [**Half-size Sample**] <Insert size> of each accessory type.
- F. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.
- G. Delegated-Design Submittal: For [**signs indicated in "Performance Requirements Article**] <Insert sign designations>.
1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.
- 1.7 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For [**Installer**] [**and**] [**manufacturer**].
 - B. Sample Warranty: For special warranty.
- 1.8 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For signs to include in maintenance manuals.

- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: **[Manufacturer of products] [An entity that employs installers and supervisors who are trained and approved by manufacturer].**

1.10 FIELD CONDITIONS

- A. Field Measurements: Verify locations of **[anchorage devices] [and] [electrical service]** embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
2. Warranty Period: Minimum **[five (5)] <Insert number>** years from date of Substantial Completion.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PANEL SIGNS, GENERAL

- A. Regional Materials: Panel signs shall be manufactured within **500 miles (800 km)** of Project site.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design sign structure and anchorage of **[rooftop illuminated panel]** **<Insert description>** sign type(s) **<Insert drawing designation of sign(s)>** to withstand design loads **[as indicated on Drawings]** **<Insert loads>**.
- B. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: **[120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces]** **<Insert temperature change>**.
- C. Accessibility Standard: Comply with applicable provisions in **[the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities]** **[and]** **[ICC A117.1]** for signs.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 SIGNS

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1. Ace Sign Systems, Inc.
 - 2. Advance Corporation; Braille-Tac Division.
 - 3. Allen Industries, Inc.
 - 4. Allen Markings International.
 - 5. APCO Graphics, Inc.
 - 6. ASE, Inc.
 - 7. ASI Sign Systems, Inc.
 - 8. Best Sign Systems Inc.
 - 9. Bunting Graphics, Inc.
 - 10. Clarke Systems.
 - 11. Diskey Sign Company.
 - 12. Fossil Industries, Inc.
 - 13. InPro Corporation.
 - 14. Mohawk Sign Systems.
 - 15. Nelson-Harkins Industries.
 - 16. Poblocki Sign Company, LLC.
 - 17. Seton Identification Products.
 - 18. Supersine Company (The); Division of Stamp-Rite, Inc.
 - 19. Vista System.
 - 20. Vomar Products, Inc.
 - 21. **<Insert manufacturer's name>**.
 - 22. or approved equal.

- B. Panel Sign **<Insert drawing designation>**: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
1. Basis-of-Design Product: **[Indicated on Drawings] <Insert manufacturer's name; product name or designation>**.
 2. Illuminated Panel Sign: Backlighted construction with **[fluorescent tube] [fiber-optic] [LED] [neon tube] <Insert requirement>** lighting including transformers, insulators, and other accessories for operability, with provision for servicing and concealing connections to building electrical system. Use tight or sealed joint construction to prevent unintentional light leakage. Space lamps apart from each other and away from sign surfaces as needed to illuminate evenly.
 - a. Power: **[As indicated on electrical Drawings] [120 V, 60 Hz, 1 phase, 15 A] <Insert requirement>**.
 - b. Weeps: Provide weep holes to drain water at lowest part of exterior signs.**[Equip weeps with permanent baffles to block light leakage without inhibiting drainage.]**
 3. Solid-Sheet Sign**[and Returns][, Returns, and Back]: [Aluminum] [Brass] [Bronze] [Copper] [Steel] [Stainless-steel] [Acrylic] [Fiberglass] [PVC] <Insert material>** sheet with finish specified in "Surface Finish and Applied Graphics" Subparagraph below and as follows:
 - a. Thickness: **[As indicated] [Manufacturer's standard for size of sign] [0.060 inch (1.52 mm)] [0.080 inch (2.03 mm)] [0.125 inch (3.18 mm)] [0.25 inch (6.35 mm)] <Insert dimension>**.
 - b. Surface-Applied Graphics: Applied **[vinyl film] [baked enamel or powder coat] [paint] [photo image] <Insert requirement>**.
 - c. Etched and Filled Graphics: Sign face etched or routed to receive enamel-paint infill.
 - d. Inset, Cutout Characters: Sign face routed to receive push-through acrylic graphics **[flush with] [slightly projecting from]** the sign panel.
 4. Laminated Aluminum-Sheet Sign: Aluminum sheet laminated to both sides of **[acrylic] [phenolic] <Insert material>** core sheet**[with painted edges]**.
 - a. Composite-Sheet Thickness: **[As indicated] [Manufacturer's standard for size of sign] [0.125 inch (3.18 mm)] [0.25 inch (6.35 mm)] <Insert dimension>**.
 - b. Surface-Applied Graphics: Applied **[vinyl film] [paint] [photo image] <Insert requirement>**.
 5. Laminated-Sheet Sign: **[Photopolymer] [Sandblasted polymer] <Insert material>** face sheet with raised graphics laminated**[over subsurface graphics]** to **[acrylic] [phenolic] <Insert material>** backing sheet to produce composite sheet.

- a. Composite-Sheet Thickness: **[As indicated] [Manufacturer's standard for size of sign]** [0.125 inch (3.18 mm)] [0.25 inch (6.35 mm)] **<Insert dimension>**.
 - b. Surface-Applied Graphics: Applied [vinyl film] [paint] [photo image] **<Insert requirement>**.
 - c. Subsurface Graphics: **[Reverse halftone or dot-screen image] [Reverse etch image] [Snap-in changeable insert beneath removable face sheet] [Slide-in changeable insert]** **<Insert requirement>**.
6. Composite Phenolic-Core Sign: Solid phenolic panel core with integral subsurface graphic image covered with integral, polymeric face layer.
- a. Composite-Sheet Thickness: **[As indicated] [Manufacturer's standard for size of sign]** [0.5 inch (12.7 mm)] [1 inch (25.4 mm)] **<Insert dimension>**.
7. Laminated Polycarbonate-Sheet Sign: Polycarbonate face sheet laminated to each side of [phenolic] **<Insert material>** base sheet to produce composite sheet.
- a. Composite-Sheet Thickness: **[As indicated] [Manufacturer's standard for size of sign]** [0.125 inch (3.18 mm)] [0.25 inch (6.35 mm)] **<Insert dimension>**.
 - b. Surface-Applied Graphics: Applied [vinyl film] [paint] [photo image] **<Insert requirement>**.
 - c. Subsurface Graphics: **[Reverse halftone or dot-screen image] [Reverse etch image]** **<Insert requirement>**.
8. Engraved Plastic-Laminate Sign: Plastic-laminate face laminated to contrasting phenolic core to produce composite sheet.
- a. Composite-Sheet Thickness: **[As indicated] [Manufacturer's standard for size of sign]** [0.125 inch (3.18 mm)] [0.25 inch (6.35 mm)] **<Insert dimension>**.
 - b. Engraved Graphics: Characters engraved through plastic-laminate face sheet to expose contrasting phenolic core.
 - c. Plastic-Laminate Color and Pattern: **[As indicated by manufacturer's designation] [As selected by DEN Project Manager from manufacturer's full range]** **<Insert color and pattern>**.
 - d. Core Color: Manufacturer's standard [dark color] **<Insert color>**.
9. Sign-Panel Perimeter: Finish edges smooth.
- a. Edge Condition[, **Vertical Edges**][, **Horizontal Edges**]: **[As indicated] [Square cut] [Beveled] [Bullnosed]** **<Insert requirement>**.
 - b. Corner Condition in Elevation: **[As indicated] [Square] [Rounded to radius indicated]** **<Insert requirement>**.
10. Frame: **[Entire perimeter] [Horizontal retainers] [Vertical retainers] [to hold changeable sign panel]** **<Insert description>**.

- a. Material: **[Aluminum] [Brass] [Bronze] [Steel] [Stainless steel] [PVC] <Insert material>**.
 - b. Material Thickness: **<Insert dimension>**.
 - c. Frame Depth: **[As indicated] <Insert dimension>**.
 - d. Profile: **[Square] [Beveled] [Rounded] <Insert requirement>**.
 - e. Corner Condition in Elevation: **[Square] [Mitered] [Rounded to radius indicated] <Insert requirement>**.
 - f. Finish and Color: **[Mill] [Painted, matte black color] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert requirement>**.
11. Mounting: **[As indicated] [Manufacturer's standard method for substrates indicated] [Surface mounted to wall] [Projecting from wall] [Suspended] [Aluminum bracket] [Stainless-steel bracket] <Insert requirement> with [concealed anchors] [countersunk flathead through fasteners] [adhesive] [two-face tape] [hook-and-loop tape] [or] [magnetic tape]**.
12. Surface Finish and Applied Graphics:
- a. Integral Metal Finish: **[Mill] [Antique oxidized] [As indicated by manufacturer's designation] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry finishes] <Insert finish>**.
 - b. Integral Aluminum Finish: **[Clear anodized] [Light bronze anodized] [Medium bronze anodized] [Match DEN Project Manager's sample] [Anodized color as selected by DEN Project Manager from full range of industry colors and color densities] <Insert finish>**.
 - c. Integral Stainless-Steel Finish: **[No. 4] [No. 8] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry finishes] <Insert description>**.
 - d. Integral **[Acrylic] [Fiberglass] [PVC] Sheet Color: [As indicated by manufacturer's designation] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors] <Insert color>**.
 - e. Baked-Enamel or Powder-Coat Finish and Graphics: Manufacturer's standard, in color **[as indicated by manufacturer's designation] [matching DEN Project Manager's sample] [as selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 - f. Painted Finish and Graphics: Manufacturer's standard, factory-applied **[exterior-grade sign paint] [acrylic polyurethane] <Insert requirement>**, in color **[as indicated by manufacturer's designation] [matching DEN Project Manager's sample] [as selected by DEN Project manager from manufacturer's full range] <Insert color>**.
 - g. Photo-Image Graphics: Manufacturer's standard **[black-and-white] [multicolor], [600-dpi] <Insert value> halftone or dot-screen image**.
 - h. Overcoat: **[Manufacturer's standard baked-on clear coating] <Insert requirement>**.
13. Text and Typeface: **[Accessible raised characters and Braille] [Times Roman] [typeface as indicated by manufacturer's designation] [typeface matching DEN Project Manager's sample] [typeface as selected by DEN Project**

- Manager from manufacturer's full range] [and] [variable content as scheduled] <Insert requirement>.[Finish raised characters to contrast with background color, and finish Braille to match background color.]**
14. Flatness Tolerance: Sign panel shall remain flat or uniformly curved under installed conditions as indicated and within a tolerance of plus or minus [1/16 inch (1.5 mm)] <Insert dimension> measured diagonally from corner to corner.
- C. Room-Identification Sign <Insert drawing designation>: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
1. Basis-of-Design Product: [Indicated on Drawings] <Insert manufacturer's name; product name or designation>.
 2. Laminated-Sheet Sign: [Photopolymer] [Sandblasted polymer] <Insert material> face sheet with raised graphics laminated[over subsurface graphics] to [acrylic] [phenolic] <Insert material> backing sheet to produce composite sheet.
 - a. Composite-Sheet Thickness: [As indicated] [Manufacturer's standard for size of sign] [0.125 inch (3.18 mm)] [0.25 inch (6.35 mm)] <Insert dimension>.
 - b. Surface-Applied Graphics: Applied [vinyl film] [paint] [photo image] <Insert requirement>.
 - c. Subsurface Graphics: [Reverse halftone or dot-screen image] [Reverse etch image] [Snap-in changeable insert beneath removable face sheet] [Slide-in changeable insert] <Insert requirement>.
 - d. Color(s): [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert requirement>.
 3. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition: [As indicated] [Square cut] [Beveled] [Bullnosed] <Insert requirement>.
 - b. Corner Condition in Elevation: [As indicated] [Square] [Rounded to radius indicated] <Insert requirement>.
 4. Frame: [Aluminum] <Insert material>.
 - a. Material Thickness: <Insert dimension>.
 - b. Frame Depth: [As indicated] [Convex-curved frame to receive removable face sheet and changeable subsurface graphics] <Insert dimension>.
 - c. Profile: [Square] [Beveled] [Rounded] <Insert requirement>.
 - d. Corner Condition in Elevation: [Square] [Mitered] [Rounded to radius indicated] <Insert requirement>.
 - e. Finish and Color: [Mill] [Painted, matte black color] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert requirement>.

5. Mounting: [**Manufacturer's standard method for substrates indicated**] [**Surface mounted to wall**] with [**concealed anchors**] [**countersunk flathead through fasteners**] [**adhesive**] [**two-face tape**] [**hook-and-loop tape**] [**or**] [**magnetic tape**].
6. Text and Typeface: [**Accessible raised characters and Braille**] [**Times Roman**] [**typeface as indicated by manufacturer's designation**] [**typeface matching DEN Project Manager's sample**] [**typeface as selected by DEN Project Manager from manufacturer's full range**] [**and**] [**variable content as scheduled**] <Insert requirement>.[**Finish raised characters to contrast with background color, and finish Braille to match background color.**]

2.4 FIELD-APPLIED, VINYL-CHARACTER SIGNS

- A. Field-Applied, Vinyl-Character Sign <Insert drawing designation>: Prespaced characters die cut from [**3- to 3.5-mil (0.076- to 0.089-mm)**] <Insert dimensions> thick, weather-resistant vinyl film with release liner on the back and carrier film on the front for on-site alignment and application.

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Allen Markings International.
 - b. APCO Graphics, Inc.
 - c. ASI Sign Systems, Inc.
 - d. Best Sign Systems Inc.
 - e. Mohawk Sign Systems.
 - f. Nelson-Harkins Industries.
 - g. Seton Identification Products.
 - h. <Insert manufacturer's name>.
 - i. or approved equal.
2. Size: [**As indicated**] [**As scheduled**] <Insert requirement>.
3. Substrate: [**As indicated**] [**As scheduled**] [**Glass**] [**Doors**] [**Walls**] <Insert substrate>.
4. Text and Font: [**As indicated**] [**As scheduled**] <Insert requirement>.

2.5 PANEL-SIGN MATERIALS

- A. Aluminum Sheet and Plate: **ASTM B 209** (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Aluminum Extrusions: **ASTM B 221** (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Brass Sheet (Yellow Brass): ASTM B 36/B 36M, [**alloy recommended by manufacturer and finisher for finish indicated**] [**lead-free alloy recommended by manufacturer and finisher for finish indicated**] [**Alloy UNS No. C26000 (yellow brass)**] <Insert requirement>.

- D. Bronze Plate: ASTM B 36/B 36M, [**alloy recommended by manufacturer and finisher for finish indicated**] [**lead-free alloy recommended by manufacturer and finisher for finish indicated**] [**Alloy UNS No. C22000 (commercial bronze)**] <Insert requirement>.
- E. Copper Sheet: ASTM B 152/B 152M.
- F. Steel Materials:
1. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, [**G90 (Z275)**] <Insert coating **designation**> coating, either commercial or forming steel.
 2. Steel Sheet: [**Uncoated, cold-rolled, ASTM A 1008/A 1008M, commercial steel, Type B, exposed**] [or] [**electrolytic zinc-coated, ASTM A 879/A 879M, Coating Designation 08Z (24G), with steel-sheet substrate according to ASTM A 1008/A 1008M, commercial steel, exposed**].
 3. Steel Members Fabricated from Plate or Bar Stock: ASTM A 529/A 529M or ASTM A 572/A 572M, **42,000-psi (290-MPa)** minimum yield strength.
 4. For steel exposed to view on completion, provide materials having flat, smooth surfaces without blemishes. Do not use materials whose surfaces exhibit pitting, seam marks, roller marks, rolled trade names, or roughness.
- G. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, [**Type 304,**] [**Type 316,**] stretcher-leveled standard of flatness.
- H. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- I. Polycarbonate Sheet: ASTM C 1349, Appendix X1, Type II (coated, mar-resistant, UV-stabilized polycarbonate), with coating on both sides.
- J. Fiberglass Sheet: Multiple laminations of glass-fiber-reinforced polyester resin with UV-light stable, colorfast, nonfading, weather- and stain-resistant, colored polyester gel coat, and with manufacturer's standard finish.
- K. PVC Sheet: Manufacturer's standard, UV-light stable, PVC plastic.
- L. Plastic-Laminate Sheet: NEMA LD 3, general-purpose HGS grade, **0.048-inch (1.2-mm)** nominal thickness.
- M. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated and suitable for exterior applications.
- N. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.6 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
1. Use concealed fasteners and anchors unless indicated to be exposed.
 2. For exterior exposure, furnish [**nonferrous-metal**] [**stainless-steel**] [**or**] [**hot-dip galvanized**] <Insert requirement> devices unless otherwise indicated.
 3. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
 - b. Fastener Heads: For nonstructural connections, use [**flathead**] [**or**] [**oval countersunk**] <Insert shape> screws and bolts with tamper-resistant [**Allen-head**] [**spanner-head**] [**or**] [**one-way-head**] <Insert slot design> slots unless otherwise indicated.
 4. Sign Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.
 - b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.
 - c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.
 5. Inserts: Furnish inserts to be set by other trades into concrete or masonry work.
- B. Adhesives: As recommended by sign manufacturer and with a VOC content of [**70**] <Insert value> g/L or less for adhesives used inside the weatherproofing system and applied on-site when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Adhesives: As recommended by sign manufacturer and that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, **0.045 inch** (1.14 mm) thick, with adhesive on both sides.
- E. Hook-and-Loop Tape: Manufacturer's standard two-part tape consisting of hooked part on sign back and looped side on mounting surface.
- F. Magnetic Tape: Manufacturer's standard magnetic tape with adhesive on one side.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.7 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 5. Internally brace signs for stability and for securing fasteners.
 6. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
- B. Surface-Engraved Graphics: Machine engrave characters and other graphic devices into panel surface indicated to produce precisely formed copy, incised to uniform depth.
1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.
 2. Engraved Opaque Acrylic Sheet: Fill engraved graphics with manufacturer's standard enamel.
 3. Face-Engraved Clear Acrylic Sheet: Fill engraved copy with manufacturer's standard enamel. Apply manufacturer's standard opaque background color coating to back face of acrylic sheet.
 4. Engraved Plastic Laminate: Engrave through exposed face ply of plastic-laminate sheet to expose contrasting core ply.
- C. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.
- D. Subsurface-Engraved Graphics: Reverse engrave back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.
- E. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.
- F. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:

1. For snap-in changeable inserts beneath removable face sheet, furnish one suction or other device to assist in removing face sheet. Furnish initial changeable insert. **[Subsequent changeable inserts are by Owner] [Furnish two blank inserts for each sign for Owner's use] <Insert requirement>**.
 2. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. **[Subsequent changeable inserts are by Owner] [Furnish two blank inserts for each sign for Owner's use] <Insert requirement>**.
 3. For frame to hold changeable sign panel, fabricate frame without burrs or constrictions that inhibit function. Furnish initial sign panel. **[Subsequent changeable sign panels are by Owner] <Insert requirement>**.
- G. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish **[to match sign-background color] [to match DEN Project Manager's sample] <Insert requirement>** color unless otherwise indicated.
 2. Stainless-Steel Brackets: Factory finish brackets **[to match sign background] [to match DEN Project Manager's sample] [with No. 4] <Insert finish>** finish unless otherwise indicated.

2.8 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.
- D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.9 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, **[Class I, 0.018 mm] [Class II, 0.010 mm]** or thicker.
- B. Color Anodic Finish: AAMA 611, **[Class I, 0.018 mm] [Class II, 0.010 mm]** or thicker.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils (0.04 mm)**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.10 METALLIC-COATED STEEL FINISHES

- A. Surface Preparation: Clean surfaces of oil and other contaminants. Use cleaning methods that do not leave residue. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A 780/A 780M.
- B. Factory Prime Finish: After cleaning and pretreating, apply an air-dried primer compatible with the organic coating to be applied over it.
- C. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).

2.11 STEEL FINISHES

- A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, and prepare for coating according to coating manufacturer's written instructions.
 - 1. For Baked-Enamel or Powder-Coat Finish: After cleaning, apply a conversion coating compatible with the organic coating to be applied over it.
- B. Factory Prime Finish: After surface preparation and pretreatment, apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer.
- C. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).

2.12 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 2. Directional Satin Finish: No. 4.
 - 3. Dull Satin Finish: No. 6.
 - 4. Reflective, Directional Polish: No. 7.
 - 5. Mirrorlike Reflective, Nondirectional Polish: No. 8.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Verify that anchor inserts are correctly sized and located to accommodate signs.
- D. Verify that electrical service is correctly sized and located to accommodate signs.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
 - 4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Room-Identification Signs[**and Other Accessible Signage**]: Install in locations on walls **[as indicated] [and] [according to accessibility standard] <Insert requirement>**.
- C. Mounting Methods:
 - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.
 3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
 4. Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.
 5. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
 6. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
 7. Hook-and-Loop Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply sign component of two-part tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage; push to engage tape adhesive. Keep tape strips [0.250 inch (6.35 mm)] <Insert dimension> away from edges to prevent visibility at sign edges when sign is initially installed or reinstalled. Apply substrate component of tape to substrate in locations aligning with tape on back of sign; push and rub well to fully engage tape adhesive to substrate.
 8. Magnetic Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position.
 9. Shim-Plate Mounting: Provide 1/8-inch- (3-mm-) thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other direct mounting methods are impractical. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach signs to plate using <Insert mounting method> method specified above.
- D. Field-Applied, Vinyl-Character Signs: Clean and dry substrate. Align sign characters in final position before removing release liner. Remove release liner in stages, and apply and firmly press characters into final position. Press from the middle outward to obtain

good bond without blisters or fishmouths. Remove carrier film without disturbing applied vinyl film.

- E. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 101423

SECTION 101426 - POST AND PANEL/PYLON SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Nonilluminated post and panel signs.
2. Internally illuminated post and panel signs.
3. Nonilluminated pylon signs.
4. Internally illuminated pylon signs.

- B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary Project identification signs and for temporary informational and directional signs.
2. Section 033000 "Cast-in-Place Concrete" for concrete foundations, concrete fill in postholes, and setting anchor bolts in concrete foundations for signs.
3. Section 101416 "Plaques" for one-piece, solid-metal signs, with or without frames.
4. Section 101419 "Dimensional Letter Signage" for wall-mounted dimensional characters.
5. Section 101423 "Panel Signage" for wall-mounted sign panels.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ALLOWANCES

- A. Allowances for **[post and panel/pylon signage] [post and panel signs] [pylon signs]** <Insert item description> are specified in Section 012100 "Allowances."

- B. <Insert product or material> [is] [are] part of <Insert name of allowance>.

1.4 COORDINATION

- A. Furnish templates and tolerance information for placement of sign-anchorage devices embedded in permanent construction by other installers.

- B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For post and panel/pylon signage.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 - 3. Show message list, typestyles, graphic elements, and layout for each sign at least [**half size**] <Insert scale>.
 - 4. Show locations of electrical service connections.
 - 5. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
 - 1. Include representative Samples of available typestyles and graphic symbols.
- D. Samples for Verification: For each type of sign assembly, showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 - 1. Post and Panel Signs: [**Full-size Sample**] [**Not less than 12 inches** (300 mm) **square, including corner and post**] <Insert size>.
 - 2. Pylon Signs: [**Full-size Sample**] [**Not less than 12 inches** (300 mm) **square, including corner**] <Insert size>.
 - 3. Variable Component Materials: [**Full-size Sample**] [**8-inch** (200-mm) **Sample**] <Insert size> of each base material, character or graphic element, in each exposed color and finish not included in other Samples.
 - 4. Exposed Accessories: [**Full-size Sample**] [**Half-size Sample**] <Insert size> of each accessory type.
- E. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.
- F. Delegated-Design Submittal: For [**signs indicated in "Performance Requirements Article**] <Insert sign designations>.
 - 1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[Installer] [and] [manufacturer]**.
- B. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: **[Manufacturer of products] [An entity that employs installers and supervisors who are trained and approved by manufacturer]**.

1.9 FIELD CONDITIONS

- A. Field Measurements: Verify locations of **[anchorage devices] [and] [electrical service]** embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Minimum **[five (5)] <Insert number>** years from date of Substantial Completion.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design sign structure and anchorage of **[post and panel] [pylon]** <Insert description> sign type(s) <Insert drawing designation of sign(s)> to withstand design loads <Insert loads>.
- B. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: [120 deg F (67 deg C), **ambient**; 180 deg F (100 deg C), **material surfaces**] <Insert temperature change>.
- C. Accessibility Standard: Comply with applicable provisions in [**the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities**] [and] [ICC A117.1] for signs.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 POST AND PANEL/PYLON SIGNS

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1. Ace Sign Systems, Inc.
 - 2. Allen Industries, Inc.
 - 3. APCO Graphics, Inc.
 - 4. ASI Sign Systems, Inc.
 - 5. Bunting Graphics, Inc.
 - 6. Charleston Industries, Inc.
 - 7. Clarke Systems.
 - 8. Diskey Sign Company.
 - 9. Fossil Industries, Inc.
 - 10. Nelson-Harkins Industries.
 - 11. Poblocki Sign Company, LLC.
 - 12. Supersine Company (The); Division of Stamp-Rite, Inc.
 - 13. Vista System.
 - 14. Vomar Products, Inc.
 - 15. <Insert manufacturer's name>.
 - 16. or approved equal.
- B. Post and Panel Sign <Insert drawing designation>: Sign of [**single-panel**] [**hollow-box**] <Insert description> configuration; with smooth, uniform surfaces and

support assembly; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Basis-of-Design Product: **[Indicated on Drawings] <Insert manufacturer's name; product name or designation>**.
2. Illuminated Sign: Backlighted construction with **[fluorescent tube] [fiber-optic] [LED] [neon tube] <Insert requirement>** lighting including transformers, insulators, and other accessories for operability, with provision for servicing and concealing connections to building electrical system. Use tight or sealed joint construction to prevent unintentional light leakage. Space lamps apart from each other and away from sign surfaces as needed to illuminate evenly.
 - a. Power: **[As indicated on electrical Drawings] [120 V, 60 Hz, 1 phase, 15 A] <Insert requirement>**.
 - b. Weeps: Provide weep holes to drain water at lowest part of exterior signs. **Equip weeps with permanent baffles to block light leakage without inhibiting drainage.**
3. Solid-Sheet Sign Panels[and Returns][, Returns, and Back]: **[Aluminum] [Brass] [Bronze] [Copper] [Stainless-steel] [Acrylic] [Fiberglass] [Polycarbonate] <Insert material>** sheet with finish specified in "Sign-Panel-Face Finish and Applied Graphics" Subparagraph below and as follows:
 - a. Thickness: **[As indicated] [Manufacturer's standard for size of sign] [0.060 inch (1.52 mm)] [0.080 inch (2.03 mm)] [0.125 inch (3.18 mm)] [0.25 inch (6.35 mm)] <Insert dimension>**.
 - b. Surface-Applied Graphics: Applied **[vinyl film] [baked enamel or powder coat] [paint] [photo image] <Insert requirement>**.
 - c. Etched and Filled Graphics: Sign face etched or routed to receive enamel-paint infill.
 - d. Inset, Cutout Characters: Sign face routed to receive push-through acrylic graphics **[flush with] [slightly projecting from]** the sign panel.
4. Laminated, Aluminum-Sheet Sign Panels: Aluminum sheet laminated to both sides of **[acrylic] [phenolic] <Insert material>** core sheet **[with painted edges]**.
 - a. Composite-Sheet Thickness: **[As indicated] [Manufacturer's standard for size of sign] [0.125 inch (3.18 mm)] [0.25 inch (6.35 mm)] <Insert dimension>**.
 - b. Surface-Applied Graphics: Applied **[vinyl film] [paint] [photo image] <Insert requirement>**.
5. Composite, Phenolic-Core Sign Panels: Solid phenolic panel core with integral subsurface graphic image covered with integral, polymeric face layer.
 - a. Composite-Sheet Thickness: **[As indicated] [Manufacturer's standard for size of sign] [0.125 inch (3.18 mm)] [0.25 inch (6.35 mm)] <Insert dimension>**.

6. Single-Panel Sign Frame: [Entire perimeter] [Horizontal retainers] [Vertical retainers] <Insert description>.
 - a. Material: [Aluminum] [Brass] [Bronze] [Steel] [Stainless steel] <Insert material>.
 - b. Material Thickness: <Insert dimension>.
 - c. Frame Depth: [As indicated] <Insert dimension>.
 - d. Profile: [Square] [Beveled] [Rounded] <Insert requirement>.
 - e. Corner Condition in Elevation: [Square] [Mitered] [Rounded to radius indicated] <Insert requirement>.
 - f. Finish and Color: [Mill] [Black baked enamel or powder coat] [Match sign-panel face] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert requirement>.

7. Hollow-Box Sign Frame: Entire perimeter framed with formed-aluminum sheet or extruded-aluminum, hollow-box-type frame with vertical edges attached to supports with aluminum fittings. Close top and bottom edges of panels with manufacturer's standard welded seams or extrusions.
 - a. Hollow-Box Depth: [2 inches (50 mm)] [6 inches (150 mm)] [Same depth as posts] <Insert requirement>.
 - b. Profile: [Square] [Beveled] [Rounded] <Insert requirement>.
 - c. Corner Condition in Elevation: [Square] [Mitered] [Rounded to radius indicated] <Insert requirement>.
 - d. Finish and Color: [Mill] [Black baked enamel or powder coat] [Match sign-panel face] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert requirement>.

8. Sign-Frame Mounting: [Between posts] [Over posts] [As indicated] <Insert description>.
9. Multiple-Message Bars and Inserts: Fixed message bars capable of receiving changeable messages in the form of slide-in, [aluminum] [acrylic-sheet] <Insert material> changeable inserts. [Provide initial messages as indicated.]
10. Posts: [Aluminum] [Steel] <Insert material>.
 - a. Shape: [Round] [Square] [Rectangular] [Semicircular].
 - b. Size: [2-inch (50-mm) diameter] [3-inch (75-mm) diameter] [4-inch (100-mm) diameter] [2 by 2 inches (50 by 50 mm)] [3 by 3 inches (75 by 75 mm)] [4 by 4 inches (100 by 100 mm)] [2 by 4 inches (50 by 100 mm)] [1-3/4 by 3 inches (44 by 75 mm)] <Insert dimension(s)>.
 - c. Installation Method: [Direct burial] [Baseplate] [Sleeve] [Reverse sleeve] <Insert requirement>.
 - d. Finish and Color: [Mill] [Black baked enamel or powder coat] [Match sign-panel face] [Match sign-panel frame] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert requirement>.

11. Sign-Panel-Face Finish and Applied Graphics:

- a. Integral Metal Finish: **[Mill] [Antique oxidized] [Mill finish raised surface with dark oxidized background] [As indicated by manufacturer's designation] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry finishes] <Insert finish>**.
 - b. Integral Aluminum Finish: **[Clear anodized] [Light bronze anodized] [Medium bronze anodized] [Match DEN Project Manager's sample] [Anodized color as selected by DEN Project Manager from full range of industry colors and color densities] <Insert finish>**.
 - c. Integral Stainless-Steel Finish: **[No. 4] [No. 8] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry finishes] <Insert description>**.
 - d. Integral **[Acrylic] [Fiberglass] [Polycarbonate]** Sheet Color: **[As indicated by manufacturer's designation] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors] <Insert color>**.
 - e. Baked-Enamel or Powder-Coat Finish and Graphics: Manufacturer's standard, in color **[as indicated by manufacturer's designation] [match DEN Project Manager's sample] [as selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 - f. Painted Finish and Graphics: Manufacturer's standard, factory-applied **[exterior-grade sign paint] [acrylic polyurethane] <Insert requirement>**, in color **[as indicated by manufacturer's designation] [matching DEN Project Manager's sample] [as selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 - g. Photo-Image Graphics: Manufacturer's standard **[black-and-white] [multicolor], [600-dpi] <Insert value>** halftone or dot-screen image.
 - h. Overcoat: **[Manufacturer's standard baked-on clear coating] <Insert requirement>**.
12. Text and Typeface: **[Times Roman] [typeface as indicated by manufacturer's designation] [typeface matching DEN Project Manager's sample] [typeface as selected by DEN Project Manager from manufacturer's full range] [and] [variable content as scheduled] <Insert requirement>**.
- C. Pylon Sign **<Insert drawing designation>**: Sign with smooth, uniform surfaces and support assembly; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
1. Basis-of-Design Product: **[Indicated on Drawings] <Insert manufacturer's name; product name or designation>**.
 2. Illuminated Sign: Backlighted construction with **[fluorescent tube] [fiber-optic] [LED] [neon tube] <Insert requirement>** lighting including transformers, insulators, and other accessories for operability, with provision for servicing and concealing connections to building electrical system. Use tight or sealed joint construction to prevent unintentional light leakage. Space lamps apart from each other and away from sign surfaces as needed to illuminate evenly.
 - a. Power: **[As indicated on electrical Drawings] [120 V, 60 Hz, 1 phase, 15 A] <Insert requirement>**.

- b. Weeps: Provide weep holes to drain water at lowest part of exterior signs.
3. Solid-Sheet Sign Panels[**and Returns**][, **Returns, and Back**]: [**Aluminum**] [**Brass**] [**Bronze**] [**Copper**] [**Stainless-steel**] [**Acrylic**] [**Fiberglass**] [**Polycarbonate**] <Insert material> sheet with finish specified in "Sign-Panel-Face Finish and Applied Graphics" Subparagraph below and as follows:
 - a. Thickness: [**As indicated**] [**Manufacturer's standard for size of sign**] [**0.060 inch (1.52 mm)**] [**0.080 inch (2.03 mm)**] [**0.125 inch (3.18 mm)**] [**0.25 inch (6.35 mm)**] <Insert dimension>.
 - b. Surface-Applied Graphics: Applied [**vinyl film**] [**baked enamel or powder coat**] [**paint**] [**photo image**] <Insert requirement>.
 - c. Etched and Filled Graphics: Sign face etched or routed to receive enamel-paint infill.
 - d. Inset, Cutout Characters: Sign face routed to receive push-through acrylic graphics [**flush with**] [**slightly projecting from**] the sign panel.
4. Laminated, Aluminum-Sheet Sign Panels: Aluminum sheet laminated to both sides of [**acrylic**] [**phenolic**] <Insert material> core sheet[**with painted edges**].
 - a. Composite-Sheet Thickness: [**As indicated**] [**Manufacturer's standard for size of sign**] [**0.125 inch (3.18 mm)**] [**0.25 inch (6.35 mm)**] <Insert dimension>.
 - b. Surface-Applied Graphics: Applied [**vinyl film**] [**paint**] [**photo image**] <Insert requirement>.
5. Composite, Phenolic-Core Sign Panels: Solid phenolic panel core with integral subsurface graphic image covered with integral, polymeric face layer.
 - a. Composite-Sheet Thickness: [**As indicated**] [**Manufacturer's standard for size of sign**] [**0.125 inch (3.18 mm)**] [**0.25 inch (6.35 mm)**] <Insert dimension>.
6. Single-Panel Sign Frame: [**Entire perimeter**] [**Horizontal retainers**] [**Vertical retainers**] <Insert description>.
 - a. Material: [**Aluminum**] [**Brass**] [**Bronze**] [**Steel**] [**Stainless steel**] <Insert material>.
 - b. Material Thickness: <Insert dimension>.
 - c. Frame Depth: [**As indicated**] <Insert dimension>.
 - d. Profile: [**Square**] [**Beveled**] [**Rounded**] <Insert requirement>.
 - e. Corner Condition in Elevation: [**Square**] [**Mitered**] [**Rounded to radius indicated**] <Insert requirement>.
 - f. Finish and Color: [**Mill**] [**Black baked enamel or powder coat**] [**Match sign-panel face**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert requirement>.

7. Hollow-Box Sign Frame: Entire perimeter framed with formed-aluminum sheet or extruded-aluminum, hollow-box-type frame with vertical edges attached to supports with aluminum fittings. Close top and bottom edges of panels with manufacturer's standard welded seams or extrusions.
 - a. Hollow-Box Depth: [2 inches (50 mm)] [6 inches (150 mm)] [**Same depth as external pylon frame**] <Insert requirement>.
 - b. Profile: [**Square**] [**Beveled**] [**Rounded**] <Insert requirement>.
 - c. Corner Condition in Elevation: [**Square**] [**Mitered**] [**Rounded to radius indicated**] <Insert requirement>.
 - d. Finish and Color: [**Mill**] [**Black baked enamel or powder coat**] [**Match sign-panel face**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert requirement>.
8. Sign-Frame Mounting: [**Between pylon supports**] [**Over pylon supports**] [**As indicated**] <Insert description>.
9. Multiple-Message Bars and Inserts: Fixed message bars capable of receiving changeable messages in the form of slide-in, [aluminum] [acrylic-sheet] <Insert material> changeable inserts. [Provide initial messages as indicated.]
10. Pylon Structure: [**Internal**] [**External**] frame.
 - a. Pylon Shape: [**Rectangular**] [**Square**] [**Triangular**] [**Circular**] <Insert requirement>.
 - b. External-Frame Finish and Color: [**Mill**] [**Black baked enamel or powder coat**] [**Match sign-panel face**] [**Match sign-panel frame**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert requirement>.
11. Sign-Panel-Face Finish and Applied Graphics:
 - a. Integral Metal Finish: [**Mill**] [**Antique oxidized**] [**Mill finish raised surface with dark oxidized background**] [**As indicated by manufacturer's designation**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry finishes**] <Insert finish>.
 - b. Integral Aluminum Finish: [**Clear anodized**] [**Light bronze anodized**] [**Medium bronze anodized**] [**Match DEN Project Manager's sample**] [**Anodized color as selected by DEN Project Manager from full range of industry colors and color densities**] <Insert finish>.
 - c. Integral Stainless-Steel Finish: [**No. 4**] [**No. 8**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry finishes**] <Insert description>.
 - d. Integral [**Acrylic**] [**Fiberglass**] [**Polycarbonate**] Sheet Color: [**As indicated by manufacturer's designation**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors**] <Insert color>.
 - e. Baked-Enamel or Powder-Coat Finish and Graphics: Manufacturer's standard, in color [**as indicated by manufacturer's designation**] [**match**

- DEN Project Manager's sample] [as selected by DEN Project Manager from manufacturer's full range] <Insert color>.**
- f. Painted Finish and Graphics: Manufacturer's standard, factory-applied **[exterior-grade sign paint] [acrylic polyurethane] <Insert requirement>**, in color **[as indicated by manufacturer's designation] [matching DEN Project Manager's sample] [as selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 - g. Photo-Image Graphics: Manufacturer's standard **[black-and-white] [multicolor], [600-dpi] <Insert value>** halftone or dot-screen image.
 - h. Overcoat: **[Manufacturer's standard baked-on clear coating] <Insert requirement>**.
12. Text and Typeface: **[Times Roman] [typeface as indicated by manufacturer's designation] [typeface matching DEN Project Manager's sample] [typeface as selected by DEN Project Manager from manufacturer's full range] [and] [variable content as scheduled] <Insert requirement>**.

2.3 MATERIALS

- A. Aluminum Sheet and Plate: **ASTM B 209 (ASTM B 209M)**, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Aluminum Extrusions: **ASTM B 221 (ASTM B 221M)**, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Brass Sheet (Yellow Brass): **ASTM B 36/B 36M, [alloy recommended by manufacturer and finisher for finish indicated] [lead-free alloy recommended by manufacturer and finisher for finish indicated] [Alloy UNS No. C26000 (yellow brass)] <Insert requirement>**.
- D. Bronze Plate: **ASTM B 36/B 36M, [alloy recommended by manufacturer and finisher for finish indicated] [lead-free alloy recommended by manufacturer and finisher for finish indicated] [Alloy UNS No. C22000 (commercial bronze)] <Insert requirement>**.
- E. Copper Sheet: **ASTM B 152/B 152M**.
- F. Steel Materials:
 - 1. Metallic-Coated Steel Sheet: **ASTM A 653/A 653M, [G90 (Z275)] <Insert coating designation>** coating, either commercial or forming steel.
 - 2. Steel Sheet: **[Uncoated, cold-rolled, ASTM A 1008/A 1008M, commercial steel, Type B, exposed] [or] [electrolytic zinc-coated, ASTM A 879/A 879M, Coating Designation 08Z (24G), with steel sheet substrate according to ASTM A 1008/A 1008M, commercial steel, exposed]**.
 - 3. Hot-Rolled, Structural-Steel Shapes: **ASTM A 36/A 36M or ASTM A 529/A 529M**.
 - 4. Steel Members Fabricated from Plate or Bar Stock: **ASTM A 529/A 529M or ASTM A 572/A 572M, 42,000-psi (290-MPa) minimum yield strength**.
 - 5. Steel Tubing or Pipe: **ASTM A 500, Grade B**.

6. Bolts for Steel Framing: ASTM A 307 or **ASTM A 325** (ASTM A 325M) as necessary for design loads and connection details.
 7. For steel exposed to view on completion, provide materials having flat, smooth surfaces without blemishes. Do not use materials whose surfaces exhibit pitting, seam marks, roller marks, rolled trade names, or roughness.
- G. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, [**Type 304,**] [**Type 316,**] stretcher-leveled standard of flatness.
- H. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- I. Fiberglass Sheet: Multiple laminations of glass-fiber-reinforced polyester resin with UV-light stable, colorfast, nonfading, weather- and stain-resistant, colored polyester gel coat, and with manufacturer's standard finish.
- J. Polycarbonate Sheet: ASTM C 1349, Appendix X1, Type II (coated, mar-resistant, UV-stabilized polycarbonate), with coating on both sides.
- K. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated and suitable for exterior applications.
- L. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
1. Use concealed fasteners and anchors unless indicated to be exposed.
 2. For exterior exposure, furnish [**nonferrous-metal**] [**stainless-steel**] [**or**] [**hot-dip galvanized**] <Insert requirement> devices unless otherwise indicated.
 3. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
 - b. Fastener Heads: For nonstructural connections, use [**flathead**] [**or**] [**oval countersunk**] <Insert shape> screws and bolts with tamper-resistant, [**Allen-head**] [**spanner-head**] [**or**] [**one-way-head**] <Insert slot design> slots unless otherwise indicated.
 4. Inserts: Furnish inserts to be set by other trades into concrete or masonry work.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- C. Anchoring Materials:

1. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
2. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - a. Water-Resistant Product: At exterior locations, provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 1. Preassemble signs in the shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in locations concealed from view after final assembly.
 2. Mill joints to tight, hairline fit. Form joints exposed to weather to resist water penetration and retention.
 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed joints of flux, and dress exposed and contact surfaces.
 4. Conceal fasteners and anchors unless indicated to be exposed; locate exposed fasteners where they will be inconspicuous.
 5. Internally brace signs for stability and for securing fasteners.
- B. Sign Message Panels: Construct sign-panel surfaces to be smooth and to remain flat under installed conditions within a tolerance of plus or minus $1/16$ inch (1.5 mm) measured diagonally from corner to corner.
 1. Coordinate dimensions and attachment methods to produce message panels with closely fitting joints. Align edges and surfaces with one another in the relationship indicated.
 2. Increase panel thickness or reinforce with concealed stiffeners or backing materials as needed to produce surfaces without distortion, buckles, warp, or other surface deformations.
 3. Continuously weld joints and seams unless other methods are indicated; grind, fill, and dress welds to produce smooth, flush, exposed surfaces with welds invisible after final finishing.
- C. Post Fabrication: Fabricate posts designed to withstand wind pressure indicated for Project location and of lengths required for installation method indicated for each sign.

1. Aluminum Posts: Manufacturer's standard **0.125-inch- (3.18-mm-)** thick, extruded-aluminum tubing unless otherwise indicated, with brackets or slots to engage sign panels. Include post caps, fillers, spacers, junction boxes, access panels, reinforcement where required for loading conditions, and related accessories required for complete installation.
 2. Steel Posts: Fabricate from minimum **[0.120-inch- (3.05-mm-)] <Insert dimension>** thick steel tubing unless otherwise indicated. Include post caps, fillers, spacers, junction boxes, access panels, reinforcement where required for loading conditions, and related accessories required for complete installation.
 - a. Hot-dip galvanize post assemblies after fabrication according to ASTM A 123/A 123M.
 3. Direct Burial: Fabricate posts **36 inches (910 mm)** longer than height of sign to permit direct burial or embedment in concrete foundations or concrete-filled postholes.
 4. Baseplates: Fabricate posts with baseplates welded to bottom of posts. Drill holes in baseplate for anchor-bolt connection.
 - a. Provide **[preset] [drilled-in-place]** anchor bolts of size required for connecting posts to concrete foundations.
 5. Sleeves: Fabricate posts **[12 inches (300 mm)] <Insert dimension>** longer than height of sign to permit embedment in sleeves cast in concrete foundations or concrete-filled postholes. Provide sleeves by manufacturer, sized to receive outside diameter of posts. Size sleeves for direct embedment in concrete foundations or concrete-filled postholes and to prevent sign movement, but not less than **[24 inches (610 mm)] [36 inches (910 mm)] <Insert dimension>** for embedment.
 6. Reverse Sleeves: Provide inserts by sign manufacturer, sized for close fit inside posts. Size inserts for direct embedment in concrete foundations and to attach signposts securely and prevent sign movement, but of a height not less than one-third of post height plus **36 inches (910 mm)** for embedment.
 - a. Provide through bolts to fasten posts to inserts.
- D. Pylon Fabrication: Fabricate pylon signs with integral base consisting of channels, angles, plates, or other fittings. Design and fabricate pylon and anchorage to withstand wind pressure indicated for Project location. Detail anchorage so that water can drain out of assembly without obstruction. Drill holes in members for anchor-bolt connection. Provide anchor bolts of size required for connecting base to concrete foundations.
1. Internal Frames: Manufacturer's standard internal steel framing system and anchorage, modified as required for Project requirements. Provide welded construction. Cut, drill, and tap units to receive hardware, bolts, and similar items.
 - a. Hot-dip galvanize steel framing system after fabrication according to ASTM A 123/A 123M.

2. External Frames: Manufacturer's standard external [**aluminum**] [**steel**] framing system and anchorage for direct attachment of sign message panels, modified as required for Project requirements. Provide welded construction using mitered joints. Cut, drill, and tap units to receive hardware, bolts, and similar items.
 - a. Hot-dip galvanize steel framing system after fabrication according to ASTM A 123/A 123M.

2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.
- D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, [**Class I, 0.018 mm**] [**Class II, 0.010 mm**] or thicker.
- B. Color Anodic Finish: AAMA 611, [**Class I, 0.018 mm**] [**Class II, 0.010 mm**] or thicker.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils** (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.8 METALLIC-COATED STEEL FINISHES

- A. Surface Preparation: Clean surfaces of oil and other contaminants. Use cleaning methods that do not leave residue. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A 780/A 780M.
- B. Factory Prime Finish: After cleaning and pretreating, apply an air-dried primer compatible with the organic coating to be applied over it.
- C. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of **2 mils** (0.05 mm).

2.9 STEEL FINISHES

- A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, and prepare for coating according to coating manufacturer's written instructions.
 - 1. For Baked-Enamel or Powder-Coat Finish: After cleaning, apply a conversion coating compatible with the organic coating to be applied over it.
- B. Factory Prime Finish: After surface preparation and pretreatment, apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer.
- C. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of **2 mils** (0.05 mm).

2.10 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 2. Directional Satin Finish: No. 4.
 - 3. Dull Satin Finish: No. 6.
 - 4. Reflective, Directional Polish: No. 7.
 - 5. Mirrorlike Reflective, Nondirectional Polish: No. 8.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs.
- C. Verify that anchor inserts are correctly sized and located to accommodate signs.
- D. Verify that electrical service is correctly sized and located to accommodate signs.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install signs using installation methods indicated and according to manufacturer's written instructions.
1. Install signs level, plumb, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 2. Install signs so they do not protrude or obstruct according to accessibility standard.
 3. Before installation, verify that sign components are clean and free of materials or debris that would impair installation.
 4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.3 INSTALLING POSTS

- A. Vertical Tolerance: Set posts plumb within a tolerance of [1/16 inch in 3 feet (2 mm in 1 m)] <Insert dimensions>.
- B. Direct-Burial Method:
1. Excavation: Excavate posthole to dimensions indicated. Reconstruct subgrade that is not firm, undisturbed, or compacted soil, or that is damaged by freezing temperatures, frost, rain, accumulated water, or construction activities by excavating an additional [12 inches (300 mm)] <Insert dimension>, backfilling with satisfactory soil or well-graded aggregate, and compacting to original subgrade elevation.
 2. Setting in Earth: Set post in position, support to prevent movement, and backfill with satisfactory soil or well-graded aggregate as recommended in writing by manufacturer. Place and compact backfill in 6-inch (150-mm) lifts, compacting each lift.
 3. Setting in Cast-in-Place Concrete: Set post in position, support to prevent movement, and place concrete [in posthole] [or] [for concrete foundation] as indicated.
 4. Setting in Preformed Hole in Concrete Foundation: Form or core drill holes in concrete foundation not less than 3/4 inch (20 mm) larger than outside dimension of post for installing posts in concrete. Set post in position, shim to prevent movement, and fill annular space between post and hole with [nonshrink, nonmetallic grout] [or] [anchoring cement], mixed and placed to comply with manufacturer's written instructions.
 - a. Cover anchorage joint in concrete foundations with flange of same metal and finish as post, [welded to post after placing anchoring material] [attached to post with set screws].
 - b. Leave anchorage joint exposed with [1/8-inch (3-mm) anchoring material sloped away from post] [anchoring material flush with adjacent surface].

C. Baseplate Method:

1. Preset Anchor Bolts: Set post baseplate in position over anchor bolts projecting from concrete foundation, shim and support post to prevent movement, place washers and nuts, and tighten. Fill shim space with nonshrink, nonmetallic grout, mixed and placed to comply with manufacturer's written instructions.
2. Drilled-in-Place Anchor Bolts: Set post baseplate in position over concrete foundation, locate and drill anchor holes, shim and support post to prevent movement, place washers and anchor bolts, and tighten. Fill shim space with nonshrink, nonmetallic grout, mixed and placed to comply with manufacturer's written instructions.

D. Sleeve Method: Set post in position in sleeve and support post to prevent movement, fill annular space between post and sleeve with **[nonshrink, nonmetallic grout] [or] [anchoring cement]**, mixed and placed to comply with manufacturer's written instructions.

1. Cover anchorage joint with flange of same metal and finish as post, **[welded to post after placing anchoring material] [attached to post with set screws]**.
2. Leave anchorage joint exposed with **[1/8-inch (3-mm) anchoring material sloped away from post] [anchoring material flush with adjacent surface]**.

E. Reverse-Sleeve Method: Set post in position over the projecting insert and support post to prevent movement, drill posts and inserts for through bolts, and install and tighten through bolts.

3.4 INSTALLING PYLONS

A. Vertical Tolerance: Install pylons plumb within a tolerance of **[1/16 inch in 3 feet (2 mm in 1 m)] <Insert dimensions>**.

B. Attachment with Preset Anchor Bolts: Set pylon base in position over anchor bolts projecting from concrete foundation, shim and support pylon to prevent movement, place washers and nuts, and tighten. Fill shim space with nonshrink, nonmetallic grout, mixed and placed to comply with manufacturer's written instructions.

C. Attachment with Drilled-in-Place Anchor Bolts: Set pylon base in position over concrete foundation, locate and drill anchor holes, shim and support pylon to prevent movement, place washers and anchor bolts, and tighten. Fill shim space with nonshrink, nonmetallic grout, mixed and placed to comply with manufacturer's written instructions.

3.5 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 101426

SECTION 102113 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel toilet compartments configured as **[toilet enclosures] [entrance screens] [and] [urinal screens]**.
2. Stainless-steel toilet compartments configured as **[toilet enclosures] [entrance screens] [and] [urinal screens]**.
3. Plastic-laminate-faced toilet compartments configured as **[toilet enclosures] [entrance screens] [and] [urinal screens]**.
4. Phenolic-core toilet compartments configured as **[toilet enclosures] [entrance screens] [and] [urinal screens]**.
5. Solid-polymer toilet compartments configured as **[toilet enclosures] [entrance screens] [and] [urinal screens]**.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for supports that attach **[ceiling-hung compartments] [floor-and-ceiling-anchored compartments] [and] [post-to-ceiling screens]** to overhead structural system.
2. **[Section 061000 "Rough Carpentry"] [Section 061035 "Miscellaneous Rough Carpentry"]** for **[blocking] [overhead support of floor-and-ceiling-anchored compartments] [and] [overhead support of post-to-ceiling screens]**.
3. Section 102800 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.4: For particleboard, documentation indicating that product contains no urea formaldehyde.
2. Laboratory Test Reports for Credit IEQ 4: For **[adhesives] [and] [composite wood products]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.

1. Show locations of cutouts for compartment-mounted toilet accessories.
2. Show locations of reinforcements for compartment-mounted grab bars.
3. Show locations of centerlines of toilet fixtures.
4. Show **[ceiling grid and]** overhead support or bracing locations.

D. Samples for Initial Selection: For each type of unit indicated. Include Samples of hardware and accessories involving material and color selection.

E. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

1. Each type of material, color, and finish required for units, prepared on **6-inch-** (152-mm-) square Samples of same thickness and material indicated for Work.
2. Each type of hardware and accessory.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of toilet compartment, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.

B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

A. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete."

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: [25] [75] [200] or less.
2. Smoke-Developed Index: 450 or less.

- C. Regulatory Requirements: Comply with applicable provisions in [the U.S. **Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities"**] [and] [ICC/ANSI A117.1] for toilet compartments designated as accessible.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

1.8 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M.
- B. Aluminum Extrusions: [ASTM B 221](#) (ASTM B 221M).
- C. Brass Castings: ASTM B 584.
- D. Brass Extrusions: ASTM B 455.
- E. Steel Sheet: Commercial steel sheet for exposed applications; mill phosphatized and selected for smoothness.
1. Electrolytically Zinc Coated: ASTM A 879/A 879M, [01Z](#) (03G).
 2. Hot-Dip Galvanized: ASTM A 653/A 653M, either hot-dip galvanized or galvanized.
- F. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- G. Stainless-Steel Castings: ASTM A 743/A 743M.
- H. Zamac: ASTM B 86, commercial zinc-alloy die castings.

2.2 STEEL UNITS <Insert drawing designation>

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Accurate Partitions Corporation.
 2. All American Metal Corp.
 3. American Sanitary Partition Corporation.
 4. Ampco, Inc.
 5. Bradley Corporation; Mills Partitions.
 6. Flush Metal Partition Corp.
 7. General Partitions Mfg. Corp.
 8. Global Steel Products Corp.
 9. Hadrian Manufacturing Inc.
 10. Knickerbocker Partition Corporation.
 11. Metpar Corp.
 12. Rockville Partitions Incorporated.
 13. Sanymetal; a Crane Plumbing company.
 14. Shanahan's Limited.
 15. <Insert manufacturer's name>.
 16. or approved equal.
- B. Toilet-Enclosure Style: [**Overhead braced**] [**Floor anchored**] [**Ceiling hung**] [**Floor and ceiling anchored**].
- C. Entrance-Screen Style: [**Overhead braced**] [**Floor anchored**] [**Ceiling hung**] [**Floor and ceiling anchored**].
- D. Urinal-Screen Style: [**Wall hung, flat panel**] [**Wall hung with integral flanges**] [**Wall hung, wedge shaped**] [**Floor anchored**] [**Overhead braced**] [**Post to ceiling**].
- E. Door, Panel, and Pilaster Construction: Seamless, metal facing sheets pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures; corners secured by welding or clips and exposed welds ground smooth. [**Provide with no-sightline system.**] Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.
1. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of **1 inch** (25 mm) for doors and panels and **1-1/4 inches** (32 mm) for pilasters.
 2. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units.
 3. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.
- F. Urinal-Screen Construction:
1. Flat-Panel Urinal Screen: Matching panel construction.

2. Integral-Flange, Wall-Hung Urinal Screen: Similar to panel construction, with integral full-height flanges for wall attachment, and maximum **1-1/4 inches** (32 mm) thick.
 3. Wedge-Shaped, Wall-Hung Urinal Screen: Similar to panels, V-shaped, fabricated for concealed wall attachment, and maximum **6 inches** (152 mm) wide at wall and minimum **1 inch** (25 mm) wide at protruding end.
- G. Facing Sheets and Closures: **[Electrolytically coated steel] [Hot-dip galvanized-steel] [Electrolytically coated or hot-dip galvanized-steel]** sheet with nominal base-metal (uncoated) thicknesses as follows:
1. Pilasters, Braced at Both Ends: Manufacturer's standard thickness, but not less than **0.036 inch** (0.91 mm).
 2. Pilasters, Unbraced at One End: Manufacturer's standard thickness, but not less than **0.048 inch** (1.21 mm).
 3. Panels: **[Manufacturer's standard thickness, but not less than 0.030 inch (0.76 mm)] [0.036 inch (0.91 mm)]**.
 4. Doors: Manufacturer's standard thickness, but not less than **0.030 inch** (0.76 mm).
 5. Flat-Panel Urinal Screens: Thickness matching the panels.
 6. Integral-Flange, Wall-Hung Urinal Screens: Manufacturer's standard thickness, but not less than **0.030 inch** (0.76 mm).
 7. Wedge-Shaped, Wall-Hung Urinal Screens: Manufacturer's standard thickness, but not less than **0.036 inch** (0.91 mm).
- H. Pilaster **[Shoes] [and] [Sleeves (Caps)]**: Stainless-steel sheet, not less than **0.031-inch** (0.79-mm) nominal thickness and **3 inches** (76 mm) high, finished to match hardware.
- I. Urinal-Screen Post: Manufacturer's standard post design of **[material matching the thickness and construction of pilasters] [or] [1-3/4-inch- (44-mm-) square, aluminum tube with satin finish] <Insert requirement>**; with shoe **[and sleeve (cap)]** matching that on the pilaster.
- J. Brackets (Fittings):
1. Stirrup Type: Ear or U-brackets; **[chrome-plated zamac] [clear-anodized aluminum] [stainless steel] [chrome-plated brass]**.
 2. Full-Height (Continuous) Type: Manufacturer's standard design; **[stainless steel] [aluminum]**.
- K. Steel-Sheet Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-on finish, including thermosetting, electrostatically applied, and powder coatings. Comply with coating manufacturer's written instructions for applying and baking. Apply **[one color] [two colors]** in each room.
1. Color: **[As indicated by manufacturer's designations] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.

2.3 STAINLESS-STEEL UNITS <Insert drawing designation>

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Accurate Partitions Corporation.
 2. All American Metal Corp.
 3. American Sanitary Partition Corporation.
 4. Ampco, Inc.
 5. Bradley Corporation; Mills Partitions.
 6. Flush Metal Partition Corp.
 7. General Partitions Mfg. Corp.
 8. Global Steel Products Corp.
 9. Hadrian Manufacturing Inc.
 10. Knickerbocker Partition Corporation.
 11. Metpar Corp.
 12. Rockville Partitions Incorporated.
 13. Sanymetal; a Crane Plumbing company.
 14. Shanahan's Limited.
 15. Weis-Robart Partitions, Inc.
 16. <Insert manufacturer's name>.
 17. or approved equal.
- B. Toilet-Enclosure Style: [**Overhead braced**] [**Floor anchored**] [**Ceiling hung**] [**Floor and ceiling anchored**].
- C. Entrance-Screen Style: [**Overhead braced**] [**Floor anchored**] [**Ceiling hung**] [**Floor and ceiling anchored**].
- D. Urinal-Screen Style: [**Wall hung flat panel**] [**Wall hung with integral flanges**] [**Wall hung, wedge shaped**] [**Floor anchored**] [**Overhead braced**] [**Post to ceiling**].
- E. Door, Panel, and Pilaster Construction: Seamless, metal facing sheets pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures; corners secured by welding or clips and exposed welds ground smooth. [**Provide with no-sightline system.**] Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.
1. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of **1 inch** (25 mm) for doors and panels and **1-1/4 inches** (32 mm) for pilasters.
 2. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units.
 3. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.
- F. Urinal-Screen Construction:
1. Flat-Panel Urinal Screen: Matching panel construction.

2. Integral-Flange, Wall-Hung Urinal Screen: Similar to panel construction, with integral full-height flanges for wall attachment, and maximum **1-1/4 inches** (32 mm) thick.
 3. Wedge-Shaped, Wall-Hung Urinal Screen: Similar to panels, V-shaped, fabricated for concealed wall attachment, and maximum **6 inches** (152 mm) wide at wall and minimum **1 inch** (25 mm) wide at protruding end.
- G. Facing Sheets and Closures: Stainless-steel sheet of nominal thicknesses as follows:
1. Pilasters, Braced at Both Ends: Manufacturer's standard thickness, but not less than **0.038 inch** (0.95 mm).
 2. Pilasters, Unbraced at One End: Manufacturer's standard thickness, but not less than **0.050 inch** (1.27 mm).
 3. Panels: **[Manufacturer's standard thickness, but not less than 0.031 inch (0.79 mm)] [0.038 inch (0.95 mm)]**.
 4. Doors: Manufacturer's standard thickness, but not less than **0.031 inch** (0.79 mm).
 5. Flat-Panel Urinal Screens: Thickness matching the panels.
 6. Integral-Flange, Wall-Hung Urinal Screens: Manufacturer's standard thickness, but not less than **0.031 inch** (0.79 mm).
 7. Wedge-Shaped, Wall-Hung Urinal Screens: Manufacturer's standard thickness, but not less than **0.038 inch** (0.95 mm).
- H. Pilaster **[Shoes] [and] [Sleeves (Caps)]**: Stainless-steel sheet, not less than **0.031-inch** (0.79-mm) nominal thickness and **3 inches** (76 mm) high, finished to match hardware.
- I. Urinal-Screen Post: Manufacturer's standard post design of **[material matching the thickness and construction of pilasters] [or] [1-3/4-inch- (44-mm-) square, aluminum tube with satin finish] <Insert requirement>**; with shoe**[and sleeve (cap)]** matching that on the pilaster.
- J. Brackets (Fittings):
1. Stirrup Type: Ear or U-brackets; **[chrome-plated zamac] [clear-anodized aluminum] [stainless steel] [chrome-plated brass]**.
 2. Full-Height (Continuous) Type: Manufacturer's standard design; **[stainless steel] [aluminum]**.
- K. Stainless-Steel Finish: **[No. 4 bright, directional polish] [Manufacturer's standard textured finish] <Insert finish>** on exposed faces. Protect exposed surfaces from damage by application of strippable, temporary protective covering before shipment.
- 2.4 PHENOLIC-CORE UNITS **<Insert drawing designation>**
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Accurate Partitions Corporation.
 2. American Sanitary Partition Corporation.

3. Ampco, Inc.
 4. Bobrick Washroom Equipment, Inc.
 5. Bradley Corporation; Mills Partitions.
 6. Flush Metal Partition Corp.
 7. General Partitions Mfg. Corp.
 8. Global Steel Products Corp.
 9. Knickerbocker Partition Corporation.
 10. Metpar Corp.
 11. Partition Systems Incorporated of South Carolina.
 12. Rockville Partitions Incorporated.
 13. Sanymetal; a Crane Plumbing company.
 14. Shanahan's Limited.
 15. Tex-Lam Manufacturing, Inc.
 16. Weis-Robart Partitions, Inc.
 17. Young Group Ltd. (The); Fabricated Products Division; DesignRite Partitions.
 18. <Insert manufacturer's name>.
 19. or approved equal.
- B. Toilet-Enclosure Style: [**Overhead braced**] [**Floor anchored**] [**Ceiling hung**] [**Floor and ceiling anchored**].
- C. Entrance-Screen Style: [**Overhead braced**] [**Floor anchored**] [**Ceiling hung**] [**Floor and ceiling anchored**].
- D. Urinal-Screen Style: [**Wall hung**] [**Floor anchored**] [**Overhead braced**] [**Post to ceiling**].
- E. Door, Panel[, **Screen**], and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges[**and no-sightline system**]. Provide minimum **3/4-inch-** (19-mm-) thick doors and pilasters and minimum **1/2-inch-** (13-mm-) thick panels.
- F. Pilaster [**Shoes**] [**and**] [**Sleeves (Caps)**]: Fabricated from stainless-steel sheet, not less than **0.031-inch** (0.79-mm) nominal thickness and **3 inches** (76 mm) high, finished to match hardware.
- G. Urinal-Screen Post: Manufacturer's standard post design of [**monolithic phenolic urinal screen cut out at bottom to form a post**] [**material matching the thickness and construction of pilasters**] [**or**] [**1-3/4-inch-** (44-mm-) **square, aluminum tube with satin finish**] <Insert requirement>; with shoe[**and sleeve (cap)**] matching that on the pilaster.
- H. Brackets (Fittings):
1. Stirrup Type: Ear or U-brackets, [**chrome-plated zamac**] [**clear-anodized aluminum**] [**stainless steel**] [**chrome-plated brass**].
 2. Full-Height (Continuous) Type: Manufacturer's standard design; [**stainless steel**] [**aluminum**].

- I. Phenolic-Panel Finish:
 1. Facing Sheet Finish: [**One color and pattern**] [**Two colors and patterns**] in each room.
 2. Color and Pattern: [**As indicated by manufacturer's designations**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and pattern>, with manufacturer's standard [**dark color core**] [**through-color core matching face sheet**].

2.5 SOLID-POLYMER UNITS <Insert drawing designation>

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Accurate Partitions Corporation.
 2. Ampco, Inc.
 3. Bradley Corporation; Mills Partitions.
 4. Comtec Industries/Capitol Partitions.
 5. General Partitions Mfg. Corp.
 6. Global Steel Products Corp.
 7. Hadrian Manufacturing Inc.
 8. Knickerbocker Partition Corporation.
 9. Metpar Corp.
 10. Partition Systems Incorporated of South Carolina.
 11. Rockville Partitions Incorporated.
 12. Santana Products, Inc.
 13. Sanymetal; a Crane Plumbing company.
 14. Weis-Robart Partitions, Inc.
 15. <Insert manufacturer's name>.
 16. or approved equal.
- B. Toilet-Enclosure Style: [**Overhead braced**] [**Floor anchored**] [**Ceiling hung**] [**Floor and ceiling anchored**].
- C. Entrance-Screen Style: [**Overhead braced**] [**Floor anchored**] [**Ceiling hung**] [**Floor and ceiling anchored**].
- D. Urinal-Screen Style: [**Wall hung**] [**Floor anchored**] [**Overhead braced**] [**Post to ceiling**].
- E. Door, Panel[, **Screen**], and Pilaster Construction: Solid, [**high-density polyethylene (HDPE)**] [**or**] [**polypropylene (PP)**] panel material, not less than **1 inch** (25 mm) thick, seamless, with eased edges, [**no-sightline system**,] and with homogenous color and pattern throughout thickness of material.
 1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
 2. Heat-Sink Strip: Manufacturer's standard continuous, [**extruded-aluminum**] [**or**] [**stainless-steel**] strip fastened to exposed bottom edges of solid-polymer components to prevent burning.

3. Color and Pattern: [**One color and pattern**] [**Two colors and patterns**] in each room [**as indicated by manufacturer's designations**] [**as selected by DEN Project Manager from manufacturer's full range**] <Insert color and pattern>.
- F. Pilaster [**Shoes**] [**and**] [**Sleeves (Caps)**]: Manufacturer's standard design; [**polymer**] [**or**] [**stainless steel**].
1. Polymer Color and Pattern: [**Matching pilaster**] [**Contrasting with pilaster, as indicated by manufacturer's designations**] [**Contrasting with pilaster, as selected by DEN Project Manager from manufacturer's full range**] <Insert color and pattern>.
- G. Urinal-Screen Post: Manufacturer's standard post design of [**material matching the thickness and construction of pilasters**] [**or**] [**1-3/4-inch- (44-mm-) square, aluminum tube with satin finish**] <Insert requirement>; with shoe[**and sleeve (cap)**] matching that on the pilaster.
- H. Brackets (Fittings):
1. Stirrup Type: Ear or U-brackets, [**chrome-plated zamac**] [**clear-anodized aluminum**] [**stainless steel**] [**chrome-plated brass**].
 2. Full-Height (Continuous) Type: Manufacturer's standard design; [**polymer or extruded aluminum**] [**polymer**] [**extruded aluminum**] [**stainless steel**].
 - a. Polymer Color and Pattern: [**Matching panel**] [**Contrasting with panel, as indicated by manufacturer's designations**] [**Contrasting with panel, as selected by DEN Project Manager from manufacturer's full range**] <Insert color and pattern>.
- I. Overhead Cross Bracing for Ceiling-Hung Units: As recommended by manufacturer and fabricated from solid polymer.

2.6 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
1. Material: [**Chrome-plated zamac**] [**Clear-anodized aluminum**] [**Stainless steel**] [**Chrome-plated brass**].
 2. Hinges: Manufacturer's standard [**paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees**] [**continuous, cam type that swings to a closed or partially open position**] [**continuous, spring-loaded type**] [**integral hinge for solid-polymer doors**] <Insert requirement>.
 3. Latch and Keeper: Manufacturer's standard [**recessed**] [**surface-mounted**] latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.

4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
 5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors[**and entrance-screen doors**].
 6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.7 FABRICATION

- A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- B. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- C. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.
- D. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.
- E. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment at[**tops and**] bottoms of posts. Provide shoes[**and sleeves (caps)**] at posts to conceal anchorage.
- F. Door Size and Swings: Unless otherwise indicated, provide **24-inch-** (610-mm-) wide, in-swinging doors for standard toilet compartments and **36-inch-** (914-mm-) wide, out-swinging doors with a minimum **32-inch-** (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
1. Maximum Clearances:
 - a. Pilasters and Panels: **1/2 inch** (13 mm).
 - b. Panels and Walls: **1 inch** (25 mm).
 2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than **[two brackets attached] [three brackets attached at midpoint and]** near top and bottom of panel.
 - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than **1-3/4 inches** (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than **2 inches** (51 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.
- D. Ceiling-Hung Units: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust so bottoms of doors are level with bottoms of pilasters when doors are in closed position.
- E. Floor-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels when doors are in closed position.
- F. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when

unlatched. Set hinges on out-swinging doors[**and doors in entrance screens**] to return doors to fully closed position.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 102113

SECTION 102226.13 - ACCORDION FOLDING PARTITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Manually operated, accordion folding partitions.
2. Manually operated, fire-rated accordion folding partitions.
3. Electrically operated, accordion folding partitions.
4. Electrically operated, fire-rated accordion folding partitions.

- B. Related Sections:

1. Section 055000 "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.
2. Section 083513 "Folding Doors" for small-size, non-acoustically rated, fire-rated, and non-fire-rated accordion folding doors.
3. Section 087100 "Door Hardware" for hardware to the extent not specified in this Section.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. NIC: Noise Isolation Class.
- B. NRC: Noise Reduction Coefficient.
- C. SAA: Sound Absorption Average.
- D. STC: Sound Transmission Class.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design accordion folding partitions, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Retain first paragraph below with "Seismic Qualification Certificates" Paragraph in "Informational Submittals" Article for projects requiring seismic design. IBC and ASCE/SEI 7 establish criteria for buildings subject to earthquake motions. Verify requirements of authorities having jurisdiction. Seismic Performance: Accordion folding partitions shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7] <Insert requirement>**.
- C. Acoustical Performance: Provide accordion folding partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:
 - 1. Sound-Transmission Requirements: Accordion folding partition assembly tested in a laboratory for sound transmission loss performance according to ASTM E 90, calculated according to ASTM E 413, and rated for not less than the STC value indicated.
 - 2. Noise Reduction Requirements: Accordion folding partition assembly, identical to partition tested for STC, tested for sound-absorption performance according to ASTM C 423, and rated for not less than the **[NRC] [or] [SAA]** value indicated.
 - 3. Acoustical Performance Requirements: Installed accordion folding partition assembly, identical to partition tested for STC, tested for NIC according to ASTM E 336, determined by ASTM E 413, and rated for **[not less than the NIC value indicated] [10 dB less than STC value indicated] <Insert value>**.
- D. Fire Resistance: Provide fire-rated accordion folding partition assemblies with fire-resistance ratings indicated.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Certificates for **[Credit MR 6] [Credit MR 7]**: Chain-of-custody certificates certifying that accordion folding partitions comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
 - 2. Product Data for Credit IEQ 4.4: For composite wood and agrifiber products used in accordion folding partitions, documentation indicating that products contain no urea formaldehyde.

3. Laboratory Test Reports for Credit IEQ 4: For [**composite wood and agrifiber products**] [**and**] [**accordion folding partitions**], documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
1. Indicate storage and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
 2. Indicate facing-material seam locations if any.
 3. Wiring Diagrams: For power, signal, and control wiring.
- D. Samples for Initial Selection: For each type of exposed material, facing material, and finish indicated.
1. Include similar Samples of accessories involving color selection.
- E. Samples for Verification: For each type of exposed material, facing material, and finish indicated, prepared on Samples of size indicated below:
1. Textile: Full width by not less than **36-inch-** (914-mm-) long section of [**fabric**] [**carpet**] from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat.
 2. Facing Material: Manufacturer's standard-size unit, not less than **3 inches** (75 mm) square.
 3. Edge Material: Not less than full width by **3 inches** (75 mm) long.
 4. Hardware: Manufacturer's standard exposed door-operating device.
- F. Delegated-Design Submittal: For accordion folding partitions indicated to comply with performance requirements and design criteria, including analysis data and calculations signed and sealed by the qualified professional engineer responsible for their preparation.
1. Design Calculations: Calculate requirements for seismic restraints.
- 1.6 INFORMATIONAL SUBMITTALS
- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Suspended ceiling components.
 2. Structural members to which suspension systems will be attached.
 3. Size and location of initial access modules for acoustical tile.
 4. Items penetrating finished ceiling, including the following:
 - a. HVAC ductwork, outlets, and inlets.

- b. Speakers.
- c. Sprinklers.
- d. Smoke detectors.
- e. Access panels.
- f. <Insert item>.

5. Plenum [fire] [smoke] [and] [acoustical] barriers.

B. Setting Drawings: For embedded items and cutouts required in other work[, **including support-beam, mounting-hole template**].

C. Qualification Data: For [manufacturer] [Installer] [and] [testing agency].
Retain first paragraph below if required by seismic criteria applicable to Project. Coordinate with Sections specifying seismic controls. See SEI/ASCE 7 for certification requirements for equipment and components.

D. Seismic Qualification Certificates: For accordion folding partitions, accessories, and components, from manufacturer.

E. Product Certificates: For each type of accordion folding partition, from manufacturer.

F. Material Certificates: For each textile dye lot, signed by manufacturers.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each accordion folding partition.

H. Field quality-control reports.

I. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For accordion folding partitions to include in maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

- 1. Facing materials and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
- 2. Seals, hardware, track, carriers, and other operating components.
- 3. Electric operator.

B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- C. Fire-Test-Response Characteristics: Provide partitions with finishes meeting the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. Surface-Burning Characteristics: As determined by testing per ASTM E 84.
 - a. Flame-Spread Index: **[25 or less]**
 - b. Smoke-Developed Index: 450 or less.
 - 2. Fire Growth Contribution: Meeting acceptance criteria of local code and authorities having jurisdiction when tested according to **[NFPA 265]** **[or]** **[NFPA 286]**.
- D. Fire-Rated Assemblies: Provide fire-rated accordion folding partitions with the following characteristics as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. Fire-Rated Door Assemblies: Comply with NFPA 80, based on testing according to UL 10B.
 - 2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification or label certification by a testing agency acceptable to authorities having jurisdiction that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Preinstallation Conference: Conduct conference at **[Project site]** **[location and time as determined by DEN Project Manager]** **<Insert location>**.

1.9 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of accordion folding partition openings by field measurements before fabrication.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of accordion folding partitions that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Faulty operation of accordion folding partitions.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal wear.
2. Warranty Period: Minimum **[two (2)] [five (5)] <Insert number>** years from date of Substantial Completion.
3. Warranty Period for Pantographic Frames, Trolleys, and Tracks: Minimum **[Ten (10)] <Insert number>** years from date of Substantial Completion.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GENERAL

- A. General Requirements for Accordion Folding Partitions: Partitions shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 ACCORDION FOLDING PARTITION <Insert drawing designation>

- A. Accordion Folding Partition: Accordion folding frame with **[pantograph] [or] [hinged]** sections designed for horizontal extension and retraction, covered with decorative facing material, reinforced for hardware attachment, supported by overhead suspension system, and equipped with manufacturer's standard air-release method to prevent billowing.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Cornell Iron Works, Inc.](#)
 - b. [Curtition](#); a division of T&C Industries, Inc.
 - c. [Holcomb & Hoke Mfg. Co., Inc.](#)
 - d. [Hufcor, Inc.](#)
 - e. [KWIK-WALL Company.](#)
 - f. [Moderco Inc.](#)
 - g. [Modernfold, Inc.](#); a DORMA Group company.
 - h. [Panelfold Inc.](#)
 - i. [Won-Door Corporation.](#)
 - j. [Woodfold Mfg., Inc.](#)

- k. **<Insert manufacturer's name>**.
 - l. or approved equal.

- B. Partition Type: **[Single fixed jamb partition] [Single sliding jamb partition] [Bi-parting partition with fixed jambs] [Bi-parting partition with sliding jambs] [Double-end-post partition in one accordion section] [Double-end-post partition in two accordion sections] [As indicated on Drawings] <Insert description>** with the following hardware:
 - 1. Lead Post Latching Hardware: **[Latch on one side] [Latch on one side with coin-slot release on opposite side] [Latch on both sides] <Insert requirement>** secured to **[recessed jamb striker] [surface jamb striker] [meeting post striker] <Insert requirement>**.
 - 2. Lead Post Locking Hardware: Key-operated lock cylinder[, **keyed to master key system,**] operable from **[latch side] [both sides]** of post.
 - 3. Lead Post Locking Hardware: Deadlock to receive cylinder, operable from **[latch side] [both sides]** of post. See Section 087100 "Door Hardware" and Section 087111 "Door Hardware (Descriptive Specification)" for lock cylinder and keying requirements.
 - 4. Meeting Post: **[Attached] [Floating]**, with meeting/closing arrangement as indicated on Drawings.
 - 5. Intermediate Post: For intersecting partition on **[one side] [both sides]** of partition.
 - 6. Storage-End Hardware: **[Anchor post, secured to opening jamb] [Sliding jamb within storage pocket] [Same as lead post, secured to recessed jamb striker] [Same as lead post, secured to surface jamb striker] [Same as lead post, secured to fixed jamb on pocket door] <Insert requirement>**.
 - 7. Pendant Pull: Near top of lead post in addition to standard pull handle/latch **[for units more than 10 feet (3 m) high or 20 feet (6 m) wide, or both] <Insert requirement>**.
 - 8. Foot Bolt: On **[lead] [attached meeting] [and] [intermediate]** post(s) where indicated; secured to post without interference with seals.

- C. STC Rating: **[30] [35] [40] [45] <Insert STC rating>**.

- D. Sound Absorption: **[NRC] [or] [SAA]** not less than **<Insert NRC or SAA rating>**.

- E. Dimensions:
 - 1. Stack Width (Stored): Maximum **[8-1/2 inches (216 mm)] [12-1/2 inches (318 mm)] <Insert dimension>**.
 - 2. Width When Extended: Maximum **[5 inches (127 mm)] [7 inches (178 mm)] <Insert dimension>**.
 - 3. Total Stack Depth (Stored): Maximum **[38 inches (965 mm)] <Insert dimension>**.

- F. Electric Controls: **[Remote-control station] [two remote-control stations] [obstruction-detection device] [and] [emergency release mechanism] <Insert item>**.

- G. Facing Material: [**Carpet wall covering**] [**Woven fabric**] [**Vinyl-coated fabric**] [**Vinyl film**] [**Plastic-laminate**] [**Wood-veneer**] [**Paint**] [**Owner-furnished material**] <Insert material or requirement>.
1. Color/Pattern: [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert manufacturer's name and designation for color and pattern>.

2.3 FIRE-RATED ACCORDION FOLDING PARTITION <Insert drawing designation>

- A. Fire-Rated Accordion Folding Partition: Accordion folding frame with pantograph sections designed for horizontal extension and retraction, covered with decorative facing material, reinforced for hardware attachment, supported by overhead suspension system, and equipped with manufacturer's standard air-release method to prevent billowing.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. [Cornell Iron Works, Inc.](#)
- b. [Modernfold, Inc.](#); a DORMA Group company.
- c. [Won-Door Corporation](#).
- d. <Insert manufacturer's name>.
- e. or approved equal.

- B. Partition Type: [**Single sliding jamb partition**] [**Bi-parting partition with sliding jambs**] [**As indicated on Drawings**] <Insert description> with the following hardware:

1. Lead Post Latching Hardware: [**Latch on one side**] [**Latch on one side with coin-slot release on opposite side**] [**Latch on both sides**] <Insert requirement> secured to [**recessed jamb striker**] <Insert requirement>.
2. Lead Post Locking Hardware: Key-operated lock cylinder[, **keyed to master key system,**] operable from [**latch side**] [**both sides**] of post.
3. Lead Post Locking Hardware: Deadlock to receive cylinder, operable from [**latch side**] [**both sides**] of post. See Section 087100 "Door Hardware" and Section 087111 "Door Hardware (Descriptive Specification)" for lock cylinder and keying requirements.
4. Storage-End Hardware: [**Sliding jamb within storage pocket**] <Insert requirement>.
5. Pendant Pull: Near top of lead post in addition to standard pull handle/latch [**for units more than 10 feet (3 m) high or 20 feet (6 m) wide, or both**] <Insert requirement>.
6. Foot Bolt: On lead post; secured to post to avoid interference with seals.

- C. Fire Rating: [**3/4 hour**] [**1 hour**] [**1-1/2 hours**] [**3 hours**] <Insert fire rating>.

- D. STC Rating: [**30**] [**40**] [**44**] <Insert STC rating>.

- E. Sound Absorption: **[NRC] [or] [SAA]** not less than **<Insert NRC or SAA rating>**.
- F. Dimensions:
 - 1. Stack Width (Stored): Maximum **[11-1/2 inches (292 mm)] <Insert dimension>**.
 - 2. Width When Extended: Maximum **[13-3/4 inches (349 mm)] <Insert dimension>**.
 - 3. Total Stack Depth (Stored): Maximum **[38 inches (965 mm)] <Insert dimension>**.
- G. Electric Controls: **[Remote-control station] [two remote-control stations] [obstruction-detection device] [and] [emergency release mechanism] <Insert item>**.
- H. Facing Material: **[Vinyl film] [Paint] <Insert material or requirement>**.
 - 1. Color/Pattern: **[Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] <Insert manufacturer's name and designation for color and pattern>**.

2.4 COMPONENTS

- A. Posts and Seals: Provide types of posts and seals that produce accordion folding partitions complying with performance requirements.
 - 1. Posts: Steel or aluminum; formed with deep-nesting and interlocking interfaces and fabricated to ensure rigidity of accordion folding partition.
 - 2. Perimeter Seals: Manufacturer's standard vinyl, neoprene, or woven silica vertical seals, horizontal top and bottom seals, and closures for lead posts and jambs. **[Seals and closures at fire-rated partitions shall be identical to products tested for fire rating indicated and shall form an effective smoke and draft seal.]**
- B. Hardware: Manufacturer's standard manually operated pulls, latches, locks, and bolts as required to operate accordion folding partitions; with decorative, protective finish.
- C. Trim: Manufacturer's standard with decorative, protective finish.
- D. Tiebacks: As required to maintain accordion folding partitions in stacked position; with manufacturer's standard finish.

2.5 SUSPENSION SYSTEMS

- A. Suspension Tracks: Steel or aluminum **[mounted directly to overhead structural support,] [with adjustable steel hanger rods for overhead support,]** designed for type of operation, size, and weight of accordion folding partition indicated. Size track to support partition operation and storage without damage to suspension system, accordion folding partitions, or adjacent construction. Limit track deflection to no more than **0.10 inch (2.54 mm)** between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.

1. Track: **[Surface mounted] [Recessed]**.
 - a. Head Closure Trim: Integral with track for protecting overhead surfaces; **[with factory-applied, decorative, protective finish] [primed for field finish]**.
 - b. Head Closure Trim and Track Channel Pocket: For protecting overhead surfaces and enclosing overhead track opening; **[with factory-applied, decorative, protective finish] [primed for field finish]**.
 - B. Carriers: Trolley system as required for size and weight of partition and for easy, quiet operation; with **[four-wheel] [six-wheel] [12-wheel] [manufacturer's standard]** ball-bearing carriers at lead post and **[two-wheel] [manufacturer's standard]** ball-bearing carriers at intermediate panel supports.
 1. Wheels: **[Nylon] [Steel] [Manufacturer's standard]**.
 - C. Track Switches and Accessories: Manufacturer's standard switches as required for type of operation, storage, track configuration, and layout indicated.
 - D. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.
 - E. Steel Finish: Factory-applied, corrosion-resistant, protective coating unless otherwise indicated.
- 2.6 ELECTRIC OPERATORS
- A. General: Factory-assembled electric operation system of size and capacity recommended and provided by accordion folding partition manufacturer for partition specified; with electric motor and factory-rewired motor controls, speed reducer, chain drive, remote-control stations, control devices, and accessories required for proper operation. Include wiring from motor control to motor. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
 - B. Comply with NFPA 70.
 - C. Motor Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, within installed environment, with indicated operating sequence, and without exceeding nameplate rating or considering service factor; complying with NEMA MG 1. **[Also comply with the following:]**
 1. Voltage: **[120 V] [208-220 V] [NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected] <Insert voltage>**.
 2. Horsepower: **[1/4] [1/3] [3/4] [Manufacturer's standard] <Insert number>**.
 3. Efficiency: **[Standard] [Premium]**.
 4. Enclosure: **[Open dripproof] [Totally enclosed] [Manufacturer's standard]**.
 5. Duty: Continuous duty at ambient temperature of **105 deg F (40 deg C)** and at altitude of **3300 feet (1005 m)** above sea level.
 6. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.

7. Phase: **[Single] [Polyphase]**.

D. Control Equipment: Complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.

1. Remote-Control Station: For partitions indicated, provide manufacturer's standard key-operated, constant-pressure, three-position control station labeled "Open," "Close," and "**[Off] [Stop]**." Provide two keys per station.
2. Obstruction-Detection Device: For partitions indicated, provide automatic safety sensor indicated, that causes operator to immediately **[shut off motor] [stop and reverse direction]**.
 - a. Sensor Edge: Contact-pressure-sensitive safety edge along partition's leading edge.
3. Limit Switches: Provide each partition with adjustable switches, interlocked with motor controls and set to automatically stop accordion folding partition at fully extended and fully stacked positions.
4. Safety Interlocks: Provide each partition with safety interlocks to prevent operation of accordion folding partition under the following conditions:
 - a. On partition, to prevent operation when partition is extended and locked.
 - b. On storage pocket door, to prevent partition operation if door is not in fully open position.
 - c. On partition, at location of convergence by another partition, to prevent operation if crossing partitions are in place.
5. Emergency Release Mechanism: For partitions indicated, provide quick disconnect-release of electric-motor drive system, permitting manual operation in event of operating failure.

2.7 WOOD MATERIALS, GENERAL

- A. Certified Wood: Fabricate products with wood-based components produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- B. Composite Wood and Agrifiber Products: Fabricate products with composite wood and agrifiber products that do not contain urea formaldehyde.
- C. Composite Wood and Agrifiber Products: Fabricate products with composite wood and agrifiber products that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.8 FACING MATERIALS

- A. General: Provide facing materials with appropriate backing that comply with indicated fire-test-response characteristics, and that are factory attached to accordion folding partitions with concealed fasteners.
1. Factory-apply facing material free of air bubbles, wrinkles, blisters, and other defects; **[in one-piece, seamless;] [with vertical invisible seams complying with Shop Drawings for location;]** and with no gaps or overlaps. Tightly secure and conceal raw and selvage edges of facing material for finished appearance. Horizontal butted edges or seams are not permitted.
 2. Where facing material with directional or repeating pattern, directional weave, or matching grain is indicated, mark facing-material top and attach facing material in same direction.
- B. Carpet Wall Covering: Manufacturer's standard **[nonwoven, needle-punched carpet with fibers fused to backing]**, from same dye lot, treated to resist stains.
- C. Woven Fabric: Manufacturer's standard **[100 percent polyolefin]** woven fabric, from same dye lot, treated to resist stains.
- D. Vinyl-Coated Fabric: Manufacturer's standard mildew-resistant, washable, vinyl-coated fabric wall covering; complying with CFFA-W-101-D for **[Type II] [or] [Type III]**; Class A.
1. Total Weight: **<Insert weight>**.
 2. Antimicrobial Treatment: Additives capable of inhibiting growth of bacteria, fungi, and yeasts.
- E. Vinyl Film: Manufacturer's standard vinyl film laminated to partition substrate.
- F. Plastic Laminate: High-pressure decorative laminate; NEMA LD 3, Grade HGS.
- G. Wood Veneer: Genuine wood veneer; clear, vertical grain, straight, and kiln dried; of wood species indicated, laminated to **[noncombustible] [fire-retardant-treated wood]** core with moisture-resistant adhesive.
1. Wood Species and Finish: **[Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] [Cherry] [Maple] [Poplar] [Red oak] <Insert species> with [transparent finish] [transparent finish over stain] [wood finish as specified in Section 099300 "Staining and Transparent Finishing."] <Insert finish>**.
- H. Paint: Manufacturer's standard baked enamel.
- I. Owner-Furnished Material: **<Insert description or requirement>**.

2.9 STORAGE POCKET DOORS

- A. Storage Pocket Door **<Insert drawing designation>**: Full height at end of partition runs to conceal stacked partition[; **of same materials, finish, construction, thickness, and acoustical qualities as partition**] **<Insert requirement>**; complete with operating hardware[**and acoustical seals at soffit, floor, and jambs**]. Hinges in finish to match other exposed hardware.
1. Pocket-door manufacturer's standard method to secure storage pocket door in closed position.
 2. Rim Lock: Key-operated lock cylinder[, **keyed to master key system,**] to secure storage pocket door in closed position. Include two keys per lock.
 3. Rim Lock: Deadlock to receive cylinder, to secure storage pocket door in closed position. See Section 087100 "Door Hardware" and Section 087111 "Door Hardware (Descriptive Specification)" for lock cylinder and keying requirements.
- B. Electric Interlock: Provide each pocket door for an electrically operated, accordion folding partition with electric interlocks to prevent operation of accordion folding partition if pocket door is not in fully open position.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of accordion folding partitions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with ASTM E 557 except as otherwise required by accordion folding partition manufacturer's written installation instructions. Install accordion folding partitions level and plumb, with tight joints and uniform appearance, and free of deformation and surface and finish irregularities.
- B. Install accordion folding partitions and accessories after other finishing operations, including painting, have been completed.

3.3 ADJUSTING

- A. Adjust accordion folding partitions to operate smoothly, without warping or binding. Lubricate hardware and other moving parts.
1. Fire-Rated Accordion Folding Partitions: Verify that operations are functional and comply with requirements of authorities having jurisdiction.

- B. Adjust storage pocket doors to operate smoothly and easily, without binding or warping. Check and readjust operating hardware. Confirm that latches and locks engage accurately and securely without forcing or binding.
- C. Adjust electric interlocks to properly control operation of electrically operated, accordion folding partitions.

3.4 FIELD QUALITY CONTROL

- A. NIC Testing: **[Owner will engage] [Engage]** a qualified testing agency to perform tests and inspections.
- B. Testing Methodology: Perform testing of installed accordion folding partition for noise isolation according to ASTM E 336, determined by ASTM E 413, and rated for not less than NIC indicated. Adjust and fit partitions to comply with NIC test method requirements.
- C. Testing Extent: Testing agency shall randomly select **[one] <Insert number>** accordion folding partition installation(s) for testing.
- D. Accordion folding partitions will be considered defective if they do not pass tests and inspections.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of repaired, replaced, or additional work with specified requirements.
- F. Prepare test and inspection reports.

3.5 CLEANING

- A. Clean soiled surfaces of accordion folding partitions, to remove dust, loose fibers, fingerprints, adhesives, and other foreign materials according to manufacturer's written instructions.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain accordion folding partitions.
 - 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 102226.13

SECTION 102238.13 - OPERABLE GLASS-PANEL PARTITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes manually operated, glass-panel partitions.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.\
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. STC: Sound Transmission Class.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>**.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

2. Certificates for Credit MR 7: Chain-of-custody certificates certifying that operable glass-panel partitions comply with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.
- C. Shop Drawings: For operable glass-panel partitions.
1. Include plans, elevations, sections, details, [**numbered panel installation sequence,**] and attachments to other work.
 2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
- D. Samples for Initial Selection: For each type of exposed material, finish, covering, or facing.
1. Include Samples of accessories involving color selection.
- E. Samples for Verification: For each type of exposed material, finish, covering, or facing, prepared on Samples of size indicated below:
1. Panel Edge Material: Not less than **3 inches** (75 mm) long.
 2. Glass: Units **12 inches** (300 mm) square.
 3. Hardware: One of each exposed door-operating device.
- F. Delegated-Design Submittal: For operable glass-panel partitions.
1. Include design calculations for seismic restraints.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Partition track, track supports and bracing, switches, turning space, and storage layout.
 2. Suspended ceiling components.
 3. Structural members to which suspension systems are attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.
 - b. HVAC ductwork, outlets, and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Smoke detectors.
 - f. Access panels.
 - g. **<Insert item>**.
 6. Plenum acoustical barriers.

- B. Setting Drawings: For embedded items and cutouts required in other work[, **including support-beam, mounting-hole template**].
- C. Qualification Data: For qualified [**Installer**] [**manufacturer**] [**and**] [**vendor**].
- D. Retain "Seismic Qualification Certificates" Paragraph below if required by seismic criteria applicable to Project. See ASCE/SEI 7 for certification requirements for equipment and components. Seismic Qualification Certificates: For operable glass-panel partitions, tracks, accessories, and components, from manufacturer. Include seismic capacity of partition assemblies to remain in vertical position during a seismic event and the following:
 - 1. Basis for Certification: Indicate whether certification is based on analysis, testing, or experience data, according to ASCE/SEI 7.
 - 2. Detailed description of partition anchorage devices on which the certification is based and their installation requirements.
- E. Product Certificates: For each type of operable glass-panel partition.
- F. Product Test Reports: For each operable glass-panel partition, for tests performed by a qualified testing agency.
- G. Sample Warranty: For manufacturer's special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For operable glass-panel partitions to include in maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Panel finish and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
 - b. Seals, hardware, track, track switches, carriers, and other operating components.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

- C. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of operable glass-panel partitions that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Faulty operation of operable glass-panel partitions.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Period: Minimum [**two (2)**] <Insert number> years from date of Substantial Completion.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic bracing of tracks to structure above.
- B. Seismic Performance: Operable glass-panel partitions shall withstand the effects of earthquake motions determined according to [**ASCE/SEI 7**] <Insert requirement>.
 - 1. The term "withstand" means "the partition panels will remain in place without separation of any parts from the system when subjected to the seismic forces specified."

- C. Acoustical Performance: Provide operable glass-panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:
1. Sound-Transmission Requirements: Operable glass-panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.
- D. Fire-Test-Response Characteristics: Provide wood-framed panels complying with one of the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: **[25]** <Insert value> or less.
 - b. Smoke-Developed Index: **[450]** <Insert value> or less.

2.2 OPERABLE GLASS PANELS

- A. Operable Glass Panels: [**Frameless aluminum**] [**Aluminum-framed**] [**Wood-framed**] glass-panel partition system, including panels, [**seals**,]suspension system, operators, and accessories.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Hufcor, Inc.](#)
 - b. [KWIK-WALL Company.](#)
 - c. [Moderco Inc.](#)
 - d. [Modernfold, Inc.; a DORMA Group company.](#)
 - e. [NanaWall Systems, Inc.](#)
 - f. <Insert manufacturer's name>.
 - g. or approved equal.
- B. Panel Operation: Manually operated, [**individual**] [**paired**] [**continuously hinged**] panels.
- C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
1. Factory-Glazed Fabrication: Glaze operable glass panels in the factory where practical and possible for applications indicated. Comply with manufacturer's written instructions and with requirements in Section 088000 "Glazing."

- D. Glass and Glazing: Glass type <Insert description> as specified in Section 088000 "Glazing."
- E. Glass and Glazing: As follows:
1. Safety Glass Standard for Partition Panels: Provide glass products complying with testing requirements in 16 CFR 1201, Category II, or ANSI Z97.1, Class A.
 2. Safety Glass Standard for Pass Doors: Provide glass products complying with testing requirements in 16 CFR 1201, Category II.
 3. Glass: **[Manufacturer's standard] [Custom]** safety glass and glass assemblies as indicated and complying with **[the following] [requirements in Section 088000 "Glazing" and as follows]**:
 - a. Tempered Glass: ASTM C 1048, Kind FT (fully tempered), Type I (transparent flat glass), **[Class 1 (clear)] [Class 2 (tinted)]**, Quality-Q3.
 - b. Tempered Patterned Glass: ASTM C 1048, Kind FT (fully tempered), Type II (patterned flat glass), Class 1 (clear), Form 3 (patterned); and of quality, finish, and pattern specified.
 - c. Laminated Glass: ASTM C 1172, with **[clear] [colored] [patterned] [graphic]** <Insert requirement> interlayer.
 - 1) Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), **[Class 1 (clear)] [Class 2 (tinted)]**, Quality-Q3.
 - 2) Patterned Glass: ASTM C 1036, Type II (patterned and wired flat glass), Class 1 (clear), Form 3 (patterned); and of quality, finish, and pattern specified.
 - d. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass as indicated, separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
 - 1) Spacer: **[Manufacturer's standard spacer construction and material] [Aluminum with mill or clear anodic finish] [Aluminum with black, color anodic finish] [Aluminum with bronze, color anodic finish] [Aluminum with powdered-metal paint finish in color selected by DEN Project Engineer] [Galvanized steel] [Stainless steel]** <Insert material>.
 - e. Glass Thickness: **[Manufacturer's standard thickness for indicated requirements] [As indicated]** <Insert dimension>.
 - f. Glass Vertical Edge: **[Polished] [Manufacturer's standard, permanently adhered edge trim]** <Insert description>.
 4. Glazing System: **[Manufacturer's standard factory-glazing system] [Manufacturer's standard factory-glazing system that produces acoustical seal] [Manufacturer's standard factory-glazing system as indicated]** <Insert requirements>.

- F. Dimensions: Fabricate operable glass-panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
1. Panel Width: [**Standard widths**] [**Equal widths**] [**As indicated**].
- G. STC: Not less than [**36**] [**44**] <Insert number>.
- H. Panel Weight: [**6 lb/sq. ft. (29.3 kg/sq. m)**] [**8 lb/sq. ft. (40 kg/sq. m)**] <Insert value> maximum.
- I. Panel Frame Thickness: Maximum [**1-7/8 inches (48 mm)**] [**3 inches (76 mm)**] <Insert dimension>.
- J. Panel Frame Materials:
1. Certified Wood: Wood for operable glass-panel partitions shall be certified as "FSC Pure"[or "**FSC Mixed Credit**"] according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and to FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
 2. Recycled Content of Operable Glass-Panel Partitions:
 - a. Recycled Content of Aluminum: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent by weight.
 - b. Recycled Content of Glass: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent by weight.
 3. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; **ASTM B 221** (ASTM B 221M) for extrusions; manufacturer's standard strengths and thicknesses for type of use.
 - a. Frame Reinforcement: Manufacturer's standard steel or aluminum.
 4. Wood Frame: Clear, vertical-grain, straight, kiln-dried[, **fire-retardant-treated**] wood as follows:
 - a. Species: [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] [**Cherry**] [**Hemlock**] [**Maple**] [**Meranti**] [**Poplar**] [**Red oak**] <Insert species>.
- K. Panel Closure: [**Manufacturer's standard unless otherwise indicated**] <Insert requirement>.
- L. Hardware: Manufacturer's standard as required to operate operable glass-panel partition and accessories; with decorative, protective finish.
1. Hinges: [**Manufacturer's standard**] [**Concealed (invisible)**] <Insert type>.
 2. Floor Lock: [**Thumb-turn**] [**Key**] actuated.

M. Panel Frame Finishes:

1. Exposed Metal: **[Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range]** as follows:
 - a. Aluminum: **[Clear anodized] [Light bronze anodized] [Medium bronze anodized] [Dark bronze anodized] [Black anodized] [Baked powder coating, black color] <Insert finish and color>**.
 - b. Metal-Clad Aluminum: **[Satin stainless steel] [Polished stainless steel] [Satin brass] [Polished brass] [Satin bronze] [Polished bronze] <Insert finish>**.
2. Wood Finish: **[Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range]**, as follows:
 - a. Type: **[Transparent finish] [Transparent finish over stain] <Insert finish>** over wood variety indicated.
3. Wood Finish: **[As specified in Section 099300 "Staining and Transparent Finishing."]** **<Insert description.>**

2.3 SEALS

- A. General: Provide seals that produce operable glass-panel partitions complying with performance requirements and the following:
1. Manufacturer's standard seals unless otherwise indicated.
 2. Seals made from materials and in profiles that minimize sound leakage.
 3. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable glass-panel partition perimeter and adjacent surfaces, when operable glass-panel partition is extended and closed.

2.4 SUSPENSION SYSTEMS

- A. Tracks: Steel or aluminum **[mounted directly to overhead structural support,] [with adjustable steel hanger rods for overhead support,]** designed for operation, size, and weight of operable glass-panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable glass-panel partitions, or adjacent construction. Limit track deflection to no more than **0.10 inch (2.54 mm)** between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
1. Panel Guide: Aluminum guide on both sides of the track to facilitate straightening of the panels; finished with factory-applied, decorative, protective finish.
 2. Head Closure Trim: As required for acoustical performance; **[with factory-applied, decorative, protective finish] [primed for field finish]**.

- B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.
1. Multidirectional Carriers: Capable of negotiating intersections without track switches.
- C. Track Intersections, Switches, and Accessories: As required for operation, storage, track configuration, and layout indicated for operable glass-panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.
1. Curve-and-Diverter Switches: Allow radius turns to divert panels to an auxiliary track.
 2. L Intersections: Allow panels to change 90 degrees in direction of travel.
 3. T Intersections: Allow panels to pass through or change 90 degrees to another direction of travel.
 4. X Intersections: Allow panels to pass through or change travel direction full circle in 90-degree increments, and allow one partition to cross track of another.
 5. Multidirectional Switches: Adjustable switch configuring track into L, T, or X intersections and allowing panels to be moved in all pass-through, 90-degree change, and crossover travel direction combinations.
 6. Center carrier stop.
- D. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.
- E. Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

2.5 ACCESSORIES

- A. Pass Doors: Swinging door built into and matching panel **[materials,] [construction,] [acoustical qualities,]** finish and thickness, complete with frames and operating hardware. Hinges finished to match other exposed hardware.
1. Accessibility Standard: Fabricate doors to comply with applicable provisions in **[ICC A117.1] [and] [the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities] <Insert requirements of authorities having jurisdiction>**.
 2. Single Pass Door: **[36 by 80 inches (914 by 2032 mm)] [36 by 84 inches (914 by 2134 mm)] <Insert dimensions>**.
 3. Double Pass Door: **[72 by 80 inches (1829 by 2032 mm)] [72 by 84 inches (1829 by 2134 mm)] <Insert dimensions>**.
 4. Pass-Door Hardware: Equip pass door with the following:
 - a. Door Seals: **[Mechanically operated floor seal on panels containing pass doors] [Sweep floor seals]**.
 - b. Panic hardware.
 - c. Concealed door closer.

- d. Latchset: Passage set.
 - e. Lock: Key-operated lock with cylinder[, **keyed to master key system,**] operable from both sides of door. Include two keys per lock.
 - f. Lock: Deadlock to receive cylinder, operable from both sides of door. See [**Section 087100 "Door Hardware"**] [**Section 087111 "Door Hardware (Descriptive Specification)"**] for lock cylinder and keying requirements.
- B. Storage Pocket Door: Full height at end of partition runs to conceal stacked partition; of same frame material, finish, thickness, and acoustical qualities as panels; complete with operating hardware[**and acoustical seals at soffit, floor, and jambs**]. Hinges in finish to match other exposed hardware.
- 1. Manufacturer's standard method to secure storage pocket door in closed position.
 - 2. Rim Lock: Key-operated lock cylinder[, **keyed to master key system,**] to secure storage pocket door in closed position. Include two keys per lock.
 - 3. Rim Lock: Deadlock to receive cylinder, to secure storage pocket door in closed position. See [**Section 087100 "Door Hardware"**] [**Section 087111 "Door Hardware (Descriptive Specification)"**] for lock cylinder and keying requirements.
- C. Vertical Edge Trim: Manufacturer's standard [**transparent**] [**thin aluminum astragal**] trim to protect vertical edges of glass in frameless panels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable glass-panel partitions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with ASTM E 557 except as otherwise required by operable glass-panel partition manufacturer's written installation instructions.
- B. Install operable glass-panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.
- C. Install panels from marked packages in numbered sequence indicated on Shop Drawings.
- D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

- E. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.
- F. Light-Leakage Test: Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids. Adjust partitions for alignment and full closure of vertical joints and full closure along top and bottom seals.

3.3 ADJUSTING

- A. Adjust operable glass-panel partitions, hardware, and other moving parts to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust [**pass doors**] [**and**] [**storage pocket doors**] to operate smoothly and easily, without binding or warping.
- C. Verify that safety devices are properly functioning.

3.4 MAINTENANCE SERVICE

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include [**three**] [**six**] [**nine**] [**12**] months' full maintenance by manufacturer's authorized service representative. Include quarterly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operable-partition operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable glass-panel partitions.
 - 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 102238.13

SECTION 102238.13 - OPERABLE GLASS-PANEL PARTITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes manually operated, glass-panel partitions.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.\
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. STC: Sound Transmission Class.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>**.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

2. Certificates for Credit MR 7: Chain-of-custody certificates certifying that operable glass-panel partitions comply with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.
- C. Shop Drawings: For operable glass-panel partitions.
1. Include plans, elevations, sections, details, [**numbered panel installation sequence,**] and attachments to other work.
 2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
- D. Samples for Initial Selection: For each type of exposed material, finish, covering, or facing.
1. Include Samples of accessories involving color selection.
- E. Samples for Verification: For each type of exposed material, finish, covering, or facing, prepared on Samples of size indicated below:
1. Panel Edge Material: Not less than **3 inches** (75 mm) long.
 2. Glass: Units **12 inches** (300 mm) square.
 3. Hardware: One of each exposed door-operating device.
- F. Delegated-Design Submittal: For operable glass-panel partitions.
1. Include design calculations for seismic restraints.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Partition track, track supports and bracing, switches, turning space, and storage layout.
 2. Suspended ceiling components.
 3. Structural members to which suspension systems are attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.
 - b. HVAC ductwork, outlets, and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Smoke detectors.
 - f. Access panels.
 - g. **<Insert item>**.
 6. Plenum acoustical barriers.

- B. Setting Drawings: For embedded items and cutouts required in other work[, **including support-beam, mounting-hole template**].
- C. Qualification Data: For qualified [**Installer**] [**manufacturer**] [**and**] [**vendor**].
- D. Retain "Seismic Qualification Certificates" Paragraph below if required by seismic criteria applicable to Project. See ASCE/SEI 7 for certification requirements for equipment and components. Seismic Qualification Certificates: For operable glass-panel partitions, tracks, accessories, and components, from manufacturer. Include seismic capacity of partition assemblies to remain in vertical position during a seismic event and the following:
 - 1. Basis for Certification: Indicate whether certification is based on analysis, testing, or experience data, according to ASCE/SEI 7.
 - 2. Detailed description of partition anchorage devices on which the certification is based and their installation requirements.
- E. Product Certificates: For each type of operable glass-panel partition.
- F. Product Test Reports: For each operable glass-panel partition, for tests performed by a qualified testing agency.
- G. Sample Warranty: For manufacturer's special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For operable glass-panel partitions to include in maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Panel finish and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
 - b. Seals, hardware, track, track switches, carriers, and other operating components.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

- C. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of operable glass-panel partitions that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Faulty operation of operable glass-panel partitions.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Period: Minimum [**two (2)**] <Insert number> years from date of Substantial Completion.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic bracing of tracks to structure above.
- B. Seismic Performance: Operable glass-panel partitions shall withstand the effects of earthquake motions determined according to [**ASCE/SEI 7**] <Insert requirement>.
 - 1. The term "withstand" means "the partition panels will remain in place without separation of any parts from the system when subjected to the seismic forces specified."

- C. Acoustical Performance: Provide operable glass-panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:
1. Sound-Transmission Requirements: Operable glass-panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.
- D. Fire-Test-Response Characteristics: Provide wood-framed panels complying with one of the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: **[25]** <Insert value> or less.
 - b. Smoke-Developed Index: **[450]** <Insert value> or less.

2.2 OPERABLE GLASS PANELS

- A. Operable Glass Panels: [**Frameless aluminum**] [**Aluminum-framed**] [**Wood-framed**] glass-panel partition system, including panels, [**seals**], suspension system, operators, and accessories.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Hufcor, Inc.](#)
 - b. [KWIK-WALL Company.](#)
 - c. [Moderco Inc.](#)
 - d. [Modernfold, Inc.; a DORMA Group company.](#)
 - e. [NanaWall Systems, Inc.](#)
 - f. <Insert manufacturer's name>.
 - g. or approved equal.
- B. Panel Operation: Manually operated, [**individual**] [**paired**] [**continuously hinged**] panels.
- C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
1. Factory-Glazed Fabrication: Glaze operable glass panels in the factory where practical and possible for applications indicated. Comply with manufacturer's written instructions and with requirements in Section 088000 "Glazing."

- D. Glass and Glazing: Glass type <Insert description> as specified in Section 088000 "Glazing."
- E. Glass and Glazing: As follows:
1. Safety Glass Standard for Partition Panels: Provide glass products complying with testing requirements in 16 CFR 1201, Category II, or ANSI Z97.1, Class A.
 2. Safety Glass Standard for Pass Doors: Provide glass products complying with testing requirements in 16 CFR 1201, Category II.
 3. Glass: **[Manufacturer's standard] [Custom]** safety glass and glass assemblies as indicated and complying with **[the following] [requirements in Section 088000 "Glazing" and as follows]**:
 - a. Tempered Glass: ASTM C 1048, Kind FT (fully tempered), Type I (transparent flat glass), **[Class 1 (clear)] [Class 2 (tinted)]**, Quality-Q3.
 - b. Tempered Patterned Glass: ASTM C 1048, Kind FT (fully tempered), Type II (patterned flat glass), Class 1 (clear), Form 3 (patterned); and of quality, finish, and pattern specified.
 - c. Laminated Glass: ASTM C 1172, with **[clear] [colored] [patterned] [graphic]** <Insert requirement> interlayer.
 - 1) Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), **[Class 1 (clear)] [Class 2 (tinted)]**, Quality-Q3.
 - 2) Patterned Glass: ASTM C 1036, Type II (patterned and wired flat glass), Class 1 (clear), Form 3 (patterned); and of quality, finish, and pattern specified.
 - d. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass as indicated, separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
 - 1) Spacer: **[Manufacturer's standard spacer construction and material] [Aluminum with mill or clear anodic finish] [Aluminum with black, color anodic finish] [Aluminum with bronze, color anodic finish] [Aluminum with powdered-metal paint finish in color selected by DEN Project Engineer] [Galvanized steel] [Stainless steel]** <Insert material>.
 - e. Glass Thickness: **[Manufacturer's standard thickness for indicated requirements] [As indicated]** <Insert dimension>.
 - f. Glass Vertical Edge: **[Polished] [Manufacturer's standard, permanently adhered edge trim]** <Insert description>.
 4. Glazing System: **[Manufacturer's standard factory-glazing system] [Manufacturer's standard factory-glazing system that produces acoustical seal] [Manufacturer's standard factory-glazing system as indicated]** <Insert requirements>.

- F. Dimensions: Fabricate operable glass-panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
1. Panel Width: **[Standard widths]** **[Equal widths]** **[As indicated]**.
- G. STC: Not less than **[36]** **[44]** **<Insert number>**.
- H. Panel Weight: **[6 lb/sq. ft. (29.3 kg/sq. m)]** **[8 lb/sq. ft. (40 kg/sq. m)]** **<Insert value>** maximum.
- I. Panel Frame Thickness: Maximum **[1-7/8 inches (48 mm)]** **[3 inches (76 mm)]** **<Insert dimension>**.
- J. Panel Frame Materials:
1. Certified Wood: Wood for operable glass-panel partitions shall be certified as "FSC Pure"[or "**FSC Mixed Credit**"] according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and to FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
 2. Recycled Content of Operable Glass-Panel Partitions:
 - a. Recycled Content of Aluminum: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent by weight.
 - b. Recycled Content of Glass: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent by weight.
 3. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; **ASTM B 221 (ASTM B 221M)** for extrusions; manufacturer's standard strengths and thicknesses for type of use.
 - a. Frame Reinforcement: Manufacturer's standard steel or aluminum.
 4. Wood Frame: Clear, vertical-grain, straight, kiln-dried[, **fire-retardant-treated**] wood as follows:
 - a. Species: **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from manufacturer's full range]** **[Cherry]** **[Hemlock]** **[Maple]** **[Meranti]** **[Poplar]** **[Red oak]** **<Insert species>**.
- K. Panel Closure: **[Manufacturer's standard unless otherwise indicated]** **<Insert requirement>**.
- L. Hardware: Manufacturer's standard as required to operate operable glass-panel partition and accessories; with decorative, protective finish.
1. Hinges: **[Manufacturer's standard]** **[Concealed (invisible)]** **<Insert type>**.
 2. Floor Lock: **[Thumb-turn]** **[Key]** actuated.

M. Panel Frame Finishes:

1. Exposed Metal: **[Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range]** as follows:
 - a. Aluminum: **[Clear anodized] [Light bronze anodized] [Medium bronze anodized] [Dark bronze anodized] [Black anodized] [Baked powder coating, black color] <Insert finish and color>**.
 - b. Metal-Clad Aluminum: **[Satin stainless steel] [Polished stainless steel] [Satin brass] [Polished brass] [Satin bronze] [Polished bronze] <Insert finish>**.
2. Wood Finish: **[Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range]**, as follows:
 - a. Type: **[Transparent finish] [Transparent finish over stain] <Insert finish>** over wood variety indicated.
3. Wood Finish: **[As specified in Section 099300 "Staining and Transparent Finishing."]** <Insert description.>

2.3 SEALS

- A. General: Provide seals that produce operable glass-panel partitions complying with performance requirements and the following:
1. Manufacturer's standard seals unless otherwise indicated.
 2. Seals made from materials and in profiles that minimize sound leakage.
 3. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable glass-panel partition perimeter and adjacent surfaces, when operable glass-panel partition is extended and closed.

2.4 SUSPENSION SYSTEMS

- A. Tracks: Steel or aluminum **[mounted directly to overhead structural support,] [with adjustable steel hanger rods for overhead support,]** designed for operation, size, and weight of operable glass-panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable glass-panel partitions, or adjacent construction. Limit track deflection to no more than **0.10 inch (2.54 mm)** between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
1. Panel Guide: Aluminum guide on both sides of the track to facilitate straightening of the panels; finished with factory-applied, decorative, protective finish.
 2. Head Closure Trim: As required for acoustical performance; **[with factory-applied, decorative, protective finish] [primed for field finish]**.

- B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.
1. Multidirectional Carriers: Capable of negotiating intersections without track switches.
- C. Track Intersections, Switches, and Accessories: As required for operation, storage, track configuration, and layout indicated for operable glass-panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.
1. Curve-and-Diverter Switches: Allow radius turns to divert panels to an auxiliary track.
 2. L Intersections: Allow panels to change 90 degrees in direction of travel.
 3. T Intersections: Allow panels to pass through or change 90 degrees to another direction of travel.
 4. X Intersections: Allow panels to pass through or change travel direction full circle in 90-degree increments, and allow one partition to cross track of another.
 5. Multidirectional Switches: Adjustable switch configuring track into L, T, or X intersections and allowing panels to be moved in all pass-through, 90-degree change, and crossover travel direction combinations.
 6. Center carrier stop.
- D. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.
- E. Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

2.5 ACCESSORIES

- A. Pass Doors: Swinging door built into and matching panel **[materials,] [construction,] [acoustical qualities,]** finish and thickness, complete with frames and operating hardware. Hinges finished to match other exposed hardware.
1. Accessibility Standard: Fabricate doors to comply with applicable provisions in **[ICC A117.1] [and] [the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities] <Insert requirements of authorities having jurisdiction>**.
 2. Single Pass Door: **[36 by 80 inches (914 by 2032 mm)] [36 by 84 inches (914 by 2134 mm)] <Insert dimensions>**.
 3. Double Pass Door: **[72 by 80 inches (1829 by 2032 mm)] [72 by 84 inches (1829 by 2134 mm)] <Insert dimensions>**.
 4. Pass-Door Hardware: Equip pass door with the following:
 - a. Door Seals: **[Mechanically operated floor seal on panels containing pass doors] [Sweep floor seals]**.
 - b. Panic hardware.
 - c. Concealed door closer.

- d. Latchset: Passage set.
 - e. Lock: Key-operated lock with cylinder[, **keyed to master key system,**] operable from both sides of door. Include two keys per lock.
 - f. Lock: Deadlock to receive cylinder, operable from both sides of door. See [**Section 087100 "Door Hardware"**] [**Section 087111 "Door Hardware (Descriptive Specification)"**] for lock cylinder and keying requirements.
- B. Storage Pocket Door: Full height at end of partition runs to conceal stacked partition; of same frame material, finish, thickness, and acoustical qualities as panels; complete with operating hardware[**and acoustical seals at soffit, floor, and jambs**]. Hinges in finish to match other exposed hardware.
- 1. Manufacturer's standard method to secure storage pocket door in closed position.
 - 2. Rim Lock: Key-operated lock cylinder[, **keyed to master key system,**] to secure storage pocket door in closed position. Include two keys per lock.
 - 3. Rim Lock: Deadlock to receive cylinder, to secure storage pocket door in closed position. See [**Section 087100 "Door Hardware"**] [**Section 087111 "Door Hardware (Descriptive Specification)"**] for lock cylinder and keying requirements.
- C. Vertical Edge Trim: Manufacturer's standard [**transparent**] [**thin aluminum astragal**] trim to protect vertical edges of glass in frameless panels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable glass-panel partitions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with ASTM E 557 except as otherwise required by operable glass-panel partition manufacturer's written installation instructions.
- B. Install operable glass-panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.
- C. Install panels from marked packages in numbered sequence indicated on Shop Drawings.
- D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

- E. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.
- F. Light-Leakage Test: Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids. Adjust partitions for alignment and full closure of vertical joints and full closure along top and bottom seals.

3.3 ADJUSTING

- A. Adjust operable glass-panel partitions, hardware, and other moving parts to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust [**pass doors**] [**and**] [**storage pocket doors**] to operate smoothly and easily, without binding or warping.
- C. Verify that safety devices are properly functioning.

3.4 MAINTENANCE SERVICE

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include [**three**] [**six**] [**nine**] [**12**] months' full maintenance by manufacturer's authorized service representative. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operable-partition operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable glass-panel partitions.
 - 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 102238.13

SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Wall guards.
2. Impact-resistant handrails.
3. Bed locators.
4. Corner guards.
5. Impact-resistant wall coverings.
6. Door protection systems.

- B. Related Sections:

1. Section 055000 "Metal Fabrications" for [metal angle corner guards] [pipe guards] [wheel guards].
2. Section 087100 "Door Hardware" for metal armor, kick, mop, and push plates.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide handrails capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
2. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
3. Uniform and concentrated loads need not be assumed to act concurrently.

1.4 ACTION SUBMITTALS

- A. Product Data: Include construction details, material descriptions, impact strength[, **fire-test-response characteristics**], dimensions of individual components and profiles, and finishes for each impact-resistant wall protection unit.

1. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Certificates for **[Credit MR 6] [Credit MR 7]**: Chain-of-custody certificates certifying that wood rails comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
3. Product Data for Credit IEQ 4.4: For particleboard, documentation indicating that products contain no urea formaldehyde.
4. Laboratory Test Reports for Credit IEQ 4: For **[adhesives] [and] [composite wood products]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: For each impact-resistant wall protection unit showing locations and extent. Include sections, details, and attachments to other work.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Samples for Initial Selection: For each type of impact-resistant wall protection unit indicated.

1. Include similar Samples of accent strips and accessories involving color selection.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below. **[Include Samples of accent strips to verify color selected.]**

1. **[Wall] [and] [Corner] Guards: 12 inches** (300 mm) long. Include examples of joinery, corners, **[end caps,] [top caps,]** and field splices.
2. Handrails: **12 inches** (300 mm) long. Include examples of joinery, corners, and field splices.
3. Impact-Resistant Wall Covering: **6 by 6 inches** (150 by 150 mm) square.
4. Door-Surface Protection: **6 by 6 inches** (150 by 150 mm) square.
5. Door**[-Edge] [and] [-Frame] Protectors: 12 inches** (300 mm) long.
6. Door-Knob and -Lever Protectors: Full-size unit of each type.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified **[Installer] [testing agency]**.

- B. Material Certificates: For each impact-resistant plastic material, from manufacturer.
- C. Material Test Reports: For each impact-resistant plastic material.
- D. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each impact-resistant wall protection unit to include in maintenance manuals.
 - 1. Include recommended methods and frequency of maintenance for maintaining optimum condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to plastic finishes and performance.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. **[Wall-Guard] [and] [Handrail] Covers:** Full-size plastic covers of maximum length equal to **[2] <Insert number>** percent of each type, color, and texture of units installed, but no fewer than **[two, 8-foot- (2.4-m-)] <Insert number and size>** long units.
 - 2. **Bed-Locator Covers:** Full-size plastic covers equal to **[2] <Insert number>** percent of each type, color, and texture of units installed, but no fewer than **[two] <Insert number>** units.
 - 3. **Corner-Guard Covers:** Full-size plastic covers of maximum length equal to **[2] <Insert number>** percent of each type, color, and texture of units installed, but no fewer than **[two, 4-foot- (1.2-m-)] <Insert number and size>** long units.
- B. Include mounting and accessory components. Replacement materials shall be from same production run as installed units.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain impact-resistant wall protection units from single source from single manufacturer.

- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection units and are based on the specific system indicated. Refer to Section 014000 "Quality Requirements."
- D. Revise subparagraph below to suit Project.
 - 1. Do not modify intended aesthetic effects, as judged solely by DEN Project Manager, except with DEN Project Manager's approval. If modifications are proposed, submit comprehensive explanatory data to DEN Project Manager for review.
- E. Surface-Burning Characteristics: Provide impact-resistant, plastic wall protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.
- F. Regulatory Requirements: Comply with applicable provisions in **[the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines]** [and] [ICC/ANSI A117.1].
- G. Preinstallation Conference: Conduct conference at **[Project site]** [location and time as determined by DEN Project Manager] <Insert location>.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store impact-resistant wall protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
 - 1. Maintain room temperature within storage area at not less than 70 deg F (21 deg C) during the period, plastic materials are stored.
 - 2. Keep plastic sheet material out of direct sunlight.
 - 3. Store plastic wall protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F (21 deg C).
 - a. Store corner-guard covers in a vertical position.
 - b. Store **[wall-guard]** **[bed-locator]** [and] **[handrail]** covers in a horizontal position.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install impact-resistant wall protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg F (21 deg C) for not less than 72 hours before beginning installation and for the remainder of the construction period.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall protection units that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Deterioration of plastic and other materials beyond normal use.
 2. Warranty Period: Minimum **[five (5)] <Insert number>** years from date of Substantial Completion.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. PVC Plastic: ASTM D 1784, Class 1, textured, chemical- and stain-resistant, high-impact-resistant PVC or acrylic-modified vinyl plastic with integral color throughout; **[extruded] [and] [sheet]** material, thickness as indicated.
1. Impact Resistance: Minimum **[25.4 ft-lbf/in. (1356 J/m)] <Insert value>** of notch when tested according to ASTM D 256, Test Method A.
 2. Chemical and Stain Resistance: Tested according to **[ASTM D 543] [ASTM D 1308] <Insert test standard>**.
 3. Self-extinguishing when tested according to ASTM D 635.
 4. Flame-Spread Index: 25 or less.
 5. Smoke-Developed Index: 450 or less.
- B. Polycarbonate Plastic Sheet: ASTM D 6098, S-PC01, Class 1 or 2, abrasion resistant; with a minimum impact-resistance rating of **15 ft-lbf/in. (800 J/m)** of notch when tested according to ASTM D 256, Test Method A.
- C. Aluminum Extrusions: Alloy and temper recommended by manufacturer for type of use and finish indicated, but with not less than strength and durability properties specified in **ASTM B 221 (ASTM B 221M)** for Alloy 6063-T5.
- D. Stainless-Steel Sheet: ASTM A 240/A 240M.
- E. Brass: ASTM B 249/B 249M for extruded shapes and ASTM B 36/B 36 M for sheet.

- F. Solid Wood: Clear hardwood lumber of species indicated, free of appearance defects, and selected for compatible grain and color.
 - 1. Certified Wood: Fabricate products from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- G. Particleboard: ANSI A208.1, Grade M-2[.], **made with binder containing no urea formaldehyde.], that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."**
- H. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- I. Adhesive: As recommended by impact-resistant plastic wall protection manufacturer and with a VOC content of [70] **<Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- J. Adhesive: As recommended by impact-resistant plastic wall protection manufacturer and that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 WALL GUARDS

- A. Crash Rail **<Insert drawing designation>**: Heavy-duty assembly consisting of continuous snap-on plastic cover installed over concealed retainer system; designed to withstand impacts.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Arden Architectural Specialties, Inc.
 - c. Balco, Inc.
 - d. Construction Specialties, Inc.
 - e. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - f. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - g. Musson Rubber Company.
 - h. Pawling Corporation.
 - i. Tepromark International, Inc.
 - j. WallGuard.com.
 - k. **<Insert manufacturer's name>**.
 - l. or approved equal.

2. Cover: Extruded rigid plastic, minimum **0.100-inch** (2.5-mm) wall thickness; **[as follows:] [in dimensions and profiles indicated on Drawings.]**
 - a. Profile: **[Flat] [Convex] <Insert description>**.
 - 1) Dimensions: Nominal **[6 inches high by 1 inch deep** (150 mm high by 25 mm deep)] **[8 inches high by 1 inch deep** (200 mm high by 25 mm deep)] **<Insert dimensions>**.
 - 2) Surface: **[Uniform] [Uniform with coextruded accent inlay strip in contrasting color] [Grooved] <Insert description>**.
 - a) Accent Inlay Strip: Nominal **[2 inches** (50 mm)] **<Insert dimension>** high by length of rail.
 - b. Color and Texture: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>**.
 3. Continuous Retainer: Minimum **0.080-inch-** (2.0-mm-) thick, one-piece, extruded aluminum.
 4. Retainer Clips: Manufacturer's standard impact-absorbing clips designed for heavy-duty performance.
 5. Bumper: Continuous rubber or vinyl bumper cushion(s).
 6. End Caps and Corners: Prefabricated, injection-molded plastic; **[matching color] [contrasting with color] <Insert color>** cover; field adjustable for close alignment with snap-on cover.
 7. Accessories: Concealed splices and mounting hardware.
 8. Mounting: **[Surface mounted directly to wall] [Reveal mounted on bumper cushion(s)] [Extended mounting on injection-molded plastic mounting brackets]**.
- B. Bumper Rail **<Insert drawing designation>**: Assembly consisting of continuous snap-on plastic cover installed over concealed, continuous retainer; designed to withstand impacts.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Arden Architectural Specialties, Inc.
 - c. Balco, Inc.
 - d. Boston Retail Products.
 - e. Construction Specialties, Inc.
 - f. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - g. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - h. Musson Rubber Company.
 - i. Pawling Corporation.
 - j. WallGuard.com.
 - k. **<Insert manufacturer's name>**.

- a. Profile: [**Half-round profile, nominal 1-1/8 inches high by 1-1/8 inches deep** (30 mm high by 30 mm deep)] [**Rounded bullnose profile, nominal 2 inches high by 1 inch deep** (50 mm high by 25 mm deep)] <Insert profile and dimensions>.
 - b. Color and Texture: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and texture>.
3. Retainer: Minimum **0.0625-inch-** (1.6-mm-) thick, one-piece, extruded aluminum.
 4. End Caps and Corners: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.
 5. Accessories: Concealed splices and mounting hardware.
 6. Mounting: [**Surface mounted directly to wall**] [**Reveal mounted on bumper cushions**].
- D. Wood Chair Rail with Bumper <Insert drawing designation>: Assembly consisting of continuous sculpted, solid-wood rail, with continuous bumper insert installed in continuous recessed retainer.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Arden Architectural Specialties, Inc.
 - c. Construction Specialties, Inc.
 - d. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - e. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - f. Pawling Corporation.
 - g. <Insert manufacturer's name>.
 - h. or approved equal.
 2. Wood Rail: [**3-1/2 inches high by 7/8 inch deep** (89 mm high by 22 mm deep)] [**5-1/2 inches high by 1-1/2 inches deep** (140 mm high by 38 mm deep)] [**Size and profile indicated on Drawings**] <Insert dimensions>.
 - a. Wood Species: [**Red oak**] [**Maple**] [**Ash**] [**Beech**] <Insert species>.
 - b. Finish: [**Clear**] [**Stained**].
 - c. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 3. Bumper: Extruded [**rigid plastic**] [**flexible vinyl**], minimum **0.078-inch** (2.0-mm) wall thickness; [**as follows:**] [**in dimensions and profiles indicated on Drawings.**].
 - a. Profile: [**Half-round profile, nominal 2 inches high by 1 inch deep** (50 mm high by 25 mm deep)] [**Small rounded profile, nominal 1-1/8 inches high by 1-1/8 inches deep** (30 mm high by 30 mm deep)] <Insert profile and dimensions>.

- b. Color and Texture: **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from manufacturer's full range]** **<Insert color and texture>**.
 - c. End Caps and Corners: Prefabricated, injection-molded plastic; color matching bumper; field adjustable for close alignment with snap-on bumper.
 4. Retainer: Minimum **0.0625-inch-** (1.6-mm-) thick, one-piece, extruded aluminum.
 - a. Finish: **[Mill]** **[Brass colored]**.
 5. Accessories: Concealed splices and mounting hardware.
 6. Mounting: Surface mounted directly to wall.
 - E. Wood Chair Rail **<Insert drawing designation>**: Assembly consisting of continuous sculpted, solid-wood rail.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Construction Specialties, Inc.
 - b. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - c. Pawling Corporation.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
 2. Rail: **[3-1/2 inches high by 7/8 inch deep]** (89 mm high by 22 mm deep) **[5-1/2 inches high by 1-1/2 inches deep]** (140 mm high by 38 mm deep) **[As indicated on Drawings]** **<Insert dimensions>**.
 - a. Wood Species: **[Red oak]** **[Maple]** **[Ash]** **[Bamboo]** **<Insert species>**.
 - b. Finish: **[Clear]** **[Stained]**.
 - c. Color: **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from manufacturer's full range]** **<Insert color>**.
 3. Accessories: Concealed splices and mounting hardware.
 4. Mounting: Surface mounted directly to wall.
 - F. Opaque-Plastic Chair Rail **<Insert drawing designation>**: Assembly consisting of continuous snap-on cover installed over continuous retainer.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Construction Specialties, Inc.
 - b. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - c. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.

2. Cover: Extruded rigid plastic, minimum **0.070-inch** (1.8-mm) wall thickness; **[as follows:] [in dimensions and profiles indicated on Drawings.]**
 - a. Profile: **[Rounded bullnose profile, nominal 2 inches high by 1 inch deep** (50 mm high by 25 mm deep)] **[Half-round profile, nominal 1-1/8 inches high by 1-1/8 inches deep** (30 mm high by 30 mm deep)] **<Insert profile and dimensions>**.
 - b. Color and Texture: **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from manufacturer's full range]** **<Insert color and texture>**.
 3. Retainer: Minimum **0.060-inch-** (1.5-mm-) thick, one-piece, extruded aluminum.
 4. Bumper: Continuous rubber or vinyl bumper cushion(s).
 5. End Caps and Corners: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.
 6. Accessories: Concealed splices and mounting hardware.
 7. Mounting: **[Surface mounted directly to wall]** **[Reveal mounted on bumper cushions]**.
- G. Transparent-Plastic Chair Rail **<Insert drawing designation>**: Consisting of clear polycarbonate plastic sheet.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - c. wallProtex.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
 2. Height: **[3 inches** (75 mm) **nominal]** **[4 inches** (100 mm) **nominal]** **[As indicated on Drawings]** **<Insert dimension>**.
 3. Mounting: Surface mounted using flat-head countersunk screws through factory-drilled mounting holes.
- H. Rub Strip **<Insert drawing designation>**: Consisting of minimum **[0.040-inch-** (1.0-mm-)] **[0.060-inch-** (1.5-mm-)] **<Insert dimension>** thick, plastic sheet wall-covering material.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Construction Specialties, Inc.
 - c. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - d. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - e. Pawling Corporation.
 - f. Tepromark International, Inc.

- g. <Insert manufacturer's name>.
 - h. or approved equal.
- 2. Height: [8 inches (200 mm) nominal] <Insert dimension>.
 - 3. Color and Texture: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>.
 - 4. Mounting: Surface mounted with adhesive or double-faced adhesive tape.

2.3 HANDRAILS

- A. Impact-Resistant Plastic Handrails <Insert drawing designation>: Assembly consisting of snap-on plastic cover installed over continuous retainer.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Arden Architectural Specialties, Inc.
 - c. Balco, Inc.
 - d. Construction Specialties, Inc.
 - e. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - f. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - g. Kwalu, LLC.
 - h. Musson Rubber Company.
 - i. Pawling Corporation.
 - j. Tepromark International, Inc.
 - k. WallGuard.com.
 - l. <Insert manufacturer's name>.
 - m. or approved equal.
 - 2. Cover: Minimum [0.078-inch- (2.0-mm-)] [0.100-inch- (2.5-mm-)] <Insert dimension> thick, extruded rigid plastic; [as follows:] [in dimensions and profiles indicated on Drawings.]
 - a. Single Handrail: Cylindrical tube profile cover with continuous retainer; with mounting brackets supporting bottom of rail.
 - 1) Tube Diameter: <Insert dimension>.
 - b. Bumper Rail: Cover with [flat] [sculpted with contoured thumb recess on] <Insert description> front side; with 1-1/2-inch- (38-mm-) diameter gripping surface and finger recess on back side; supported by concealed, continuous retainer and extended mounting brackets.
 - 1) Bumper-Rail Dimensions: Nominal [5-1/2 inches high by 1-1/2 inches deep (140 mm high by 38 mm deep)] [5-1/2 inches high by 2 inches deep (140 mm high by 50 mm deep)] <Insert dimensions>.

- 2) Bumper Surface: **[Smooth]** **[Smooth with coextruded accent inlay strip in contrasting color]** **[Grooved]** **<Insert description>**.
 - 3) Accent Inlay Strip: Nominal **[2 inches (50 mm)]** **<Insert dimension>** high by length of rail.
- c. Double Handrail with Bumper-Rail Profile: Two tubes mounted above and below nominal, flat-faced bumper rail; each tube with **1-1/2-inch-** (38-mm-) diameter gripping surface and finger recess on back side; supported by concealed, continuous retainer and extended mounting brackets.
- 1) Bumper-Rail Dimensions: Nominal **[4 inches high by 1-1/2 inches deep (100 mm high by 38 mm deep)]** **<Insert dimensions>**.
 - 2) Bumper Surface: **[Smooth]** **[Smooth with coextruded accent inlay strip in contrasting color]** **[Grooved]** **<Insert description>**.
 - 3) Accent Inlay Strip: Nominal **[2 inches (50 mm)]** **<Insert dimension>** high by length of rail.
- d. Color and Texture: **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from manufacturer's full range]** **<Insert color and texture>**.
3. Retainer: Minimum **0.080-inch-** (2.0-mm-) thick, one-piece, extruded aluminum.
 4. Mounting Bracket: Extended mounting on **[injection-molded plastic]** **[anodized-aluminum]** **<Insert description>** mounting brackets.
 5. End Caps and Corners: Prefabricated, injection-molded plastic; **[matching color]** **[contrasting with color]** **<Insert color>** cover; field adjustable for close alignment with snap-on cover.
 6. Accessories: Concealed splices, cushions, and mounting hardware.
- B. Combination Wood-Plastic Bumper Handrail **<Insert drawing designation>**: Assembly consisting of solid-wood handrail mounted above plastic bumper rail, both mounted on continuous retainer; with reveal between handrail and bumper serving as thumb recess on front side; with **1-1/2-inch-** (38-mm-) diameter gripping surface and finger recess on back side.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Arden Architectural Specialties, Inc.
 - c. Construction Specialties, Inc.
 - d. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - e. Pawling Corporation.
 - f. WallGuard.com.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
 2. Wood Handrail: **1-1/2 inches (38 mm)** in diameter; with matching end caps and corners.

- a. Wood Species: **[Red oak] [Maple] [Ash] [Beech] <Insert species>**.
 - b. Finish: **[Clear] [Stained]**.
 - c. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 3. Bumper: Extruded rigid plastic, minimum **[0.078-inch- (2.0-mm-)] [0.100-inch- (2.5-mm-)]** wall thickness; **[as follows:] [in dimensions and profiles indicated on Drawings.]**
 - a. Profile: **[Flat] [Convex] <Insert profile>** profile, nominal **[4 inches high by 1 inch deep (100 mm high by 25 mm deep)] <Insert profile and dimensions>**.
 - b. Accent Inlay Strip: Nominal **[2 inches (50 mm)] <Insert dimension>** high by length of rail.
 - c. Color and Texture: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>**.
 - d. End Caps and Corners: Prefabricated, injection-molded plastic; color matching bumper; field adjustable for close alignment with snap-on bumper.
 4. Retainer: Minimum **0.0625-inch- (1.6-mm-)** thick, one-piece, extruded aluminum.
 5. Reveal: Extruded rigid plastic or vinyl over aluminum retainer.
 - a. Color: **[Brass] [Chrome] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 6. Accessories: Concealed splices, cushion(s), and mounting hardware.
- C. Wood Handrail with Bumper **<Insert drawing designation>**: Assembly consisting of continuous sculpted, solid-wood handrail, with bumper insert installed in continuous retainer recessed into the face of the wood.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Arden Architectural Specialties, Inc.
 - c. Construction Specialties, Inc.
 - d. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - e. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - f. Pawling Corporation.
 - g. Tepromark International, Inc.
 - h. WallGuard.com.
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
 2. Wood Handrail: **[As indicated on Drawings] <Insert dimensions>** with **1-1/2-inch- (38-mm-)** diameter gripping surface.

- a. End Caps, Returns, Corners, and Mounting Brackets: Solid wood that matches rail.
 - b. Wood Species: [Red oak] [Maple] [Ash] [Beech] [Bamboo] <Insert species>.
 - c. Finish: [Clear] [Stained].
 - d. Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.
3. Bumper: Extruded [rigid plastic] [flexible vinyl], minimum 0.078-inch (2.0-mm) wall thickness; [as follows:] [in dimensions and profiles indicated on Drawings].
- a. Profile: [Half-round profile, nominal 2 inches high by 1 inch deep (50 mm high by 25 mm deep)] [Small rounded profile, nominal 1-1/8 inches high by 1-1/8 inches deep (30 mm high by 30 mm deep)] <Insert profile and dimensions>.
 - b. Color and Texture: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>.
 - c. End Caps and Corners: Prefabricated, injection-molded plastic; color matching bumper; field adjustable for close alignment with snap-on bumper.
4. Retainer: Minimum 0.0625-inch- (1.6-mm-) thick, one-piece, extruded aluminum.
- a. Finish: [Mill] [Brass colored].
5. Accessories: Concealed splices and mounting hardware.
- D. Solid-Wood Handrail <Insert drawing designation>: Assembly consisting of continuous sculpted, solid-wood handrail.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Arden Architectural Specialties, Inc.
 - c. Construction Specialties, Inc.
 - d. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - e. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - f. Pawling Corporation.
 - g. Tepromark International, Inc.
 - h. WallGuard.com.
 - i. <Insert manufacturer's name>.
 - j. or approved equal.
 2. Handrail: [5-1/2 inches high by 1-1/2 inches deep (140 mm high by 38 mm deep)] [As indicated on Drawings] <Insert dimensions> with 1-1/2-inch- (38-mm-) diameter gripping surface.

- a. End Caps, Returns, Corners, and Mounting Brackets: Solid wood that matches rail.
- b. Wood Species: [Red oak] [Maple] [Ash] [Beech] <Insert species>.
- c. Finish: [Clear] [Stained].
- d. Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.

2.4 BED LOCATORS

A. Bed Locators <Insert drawing designation>: Assembly consisting of continuous snap-on plastic cover installed over continuous retainer; with two bed-locator end caps and mounting hardware; cover designed to spring back when hit.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Arden Architectural Specialties, Inc.
 - c. Construction Specialties, Inc.
 - d. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - e. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - f. Pawling Corporation.
 - g. WallGuard.com.
 - h. <Insert manufacturer's name>.
 - i. or approved equal.
2. Cover: Extruded rigid plastic, minimum [0.078-inch (2.0-mm)] <Insert dimension> wall thickness.
 - a. Profile: Large rounded [angled] [bullnose] profile, nominal 4 inches high by 2 inches deep (100 mm high by 50 mm deep).
 - b. Color and Texture: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>.
3. Retainer: Minimum 0.080-inch- (2.0-mm-) thick, one-piece, extruded aluminum.
4. Bed-Locator End Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.
5. Mounting Type: [Surface mounted on 1/2-inch- (13-mm-) thick cushion spacers] [Extended mounting on injection-molded plastic mounting brackets] [Extended mounting on aluminum mounting brackets].

2.5 CORNER GUARDS

A. Surface-Mounted, Resilient, Plastic Corner Guards <Insert drawing designation>: Assembly consisting of snap-on plastic cover installed over continuous retainer;

including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Arden Architectural Specialties, Inc.
 - c. Balco, Inc.
 - d. Construction Specialties, Inc.
 - e. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - f. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - g. Musson Rubber Company.
 - h. Pawling Corporation.
 - i. Tepromark International, Inc.
 - j. WallGuard.com.
 - k. <Insert manufacturer's name>.
 - l. or approved equal.
 2. Cover: Extruded rigid plastic, minimum [0.078-inch (2.0-mm)] [0.100-inch (2.5-mm)] <Insert dimension> wall thickness; [as follows:] [in dimensions and profiles indicated on Drawings.]
 - a. Profile: Nominal [2-inch- (50-mm-) long leg and 1/4-inch (6-mm) corner radius] [3-inch- (75-mm-) long leg and 1/4-inch (6-mm) corner radius] [3-inch- (75-mm-) long leg and 1-1/4-inch (32-mm) corner radius] <Insert dimensions>.
 - b. Height: [4 feet (1.2 m)] [8 feet (2.4 m)] <Insert dimension>.
 - c. Color and Texture: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>.
 3. Retainer: [Minimum 0.060-inch- (1.5-mm-) thick, one-piece, extruded aluminum] [One-piece extruded plastic].
 4. Retainer Clips: Manufacturer's standard impact-absorbing clips.
 5. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.
- B. Flush-Mounted, Resilient, Plastic Corner Guards <Insert drawing designation>:
Assembly consisting of snap-on plastic cover that is flush with adjacent wall surface, installed over continuous retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition; full wall height.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Arden Architectural Specialties, Inc.
 - c. Balco, Inc.

- d. Construction Specialties, Inc.
 - e. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - f. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - g. Pawling Corporation.
 - h. WallGuard.com.
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
2. Cover: Extruded rigid plastic, minimum [0.078-inch (2.0-mm)] [0.100-inch (2.5-mm)] **<Insert dimension>** wall thickness; **[as follows:] [in dimensions and profiles indicated on Drawings.]**
- a. Profile: Nominal [2-inch- (50-mm-) **long leg and 1/4-inch (6-mm) corner radius**] [3-inch- (75-mm-) **long leg and 1/4-inch (6-mm) corner radius**] [3-inch- (75-mm-) **long leg and 1-1/4-inch (32-mm) corner radius**] **<Insert dimensions>**.
 - b. Height: [4 feet (1.2 m)] [8 feet (2.4 m)] **<Insert dimension>**.
 - c. Color and Texture: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>**.
3. Retainer: Minimum 0.060-inch- (1.5-mm-) thick, one-piece, extruded aluminum.
4. Retainer Clips: Manufacturer's standard impact-absorbing clips.
5. Aluminum Cove Base: Nominal [4 inches (100 mm)] [6 inches (150 mm)] **<Insert dimension>** high.
- C. Fire-Rated, Resilient, Plastic Corner Guards **<Insert drawing designation>**: Assembly consisting of snap-on plastic cover that is flush with adjacent wall surface, installed over continuous retainer and intumescent fire barrier; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition; full wall height.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arden Architectural Specialties, Inc.
 - b. Balco, Inc.
 - c. Construction Specialties, Inc.
 - d. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - e. Pawling Corporation.
 - f. WallGuard.com.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
 2. Fire Rating: [1 hour] [2 hours] [**Same rating as wall in which corner guard is installed**]; UL listed and labeled according to UL 2079.
 3. Cover: Extruded rigid plastic, minimum [0.078-inch (2.0-mm)] [0.100-inch (2.5-mm)] **<Insert dimension>** wall thickness; **[as follows:] [in dimensions and profiles indicated on Drawings.]**

- a. Leg: Nominal [2 inches (50 mm)] [3 inches (75 mm)].
 - b. Corner Radius: [1/4 inch (6 mm)] [1-1/4 inches (32 mm)].
 - c. Color and Texture: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>.
4. Retainer: Minimum 0.070-inch- (1.8-mm-) thick, one-piece, extruded aluminum.
 5. Aluminum Cove Base: Nominal [4 inches (100 mm)] [6 inches (150 mm)] <Insert dimension> high.
- D. Surface-Mounted, Opaque-Plastic Corner Guards <Insert drawing designation>:
Fabricated from PVC plastic, acrylic-modified vinyl sheet or opaque polycarbonate sheet; with formed edges; fabricated with 90- or 135-degree turn to match wall condition.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Arden Architectural Specialties, Inc.
 - c. Balco, Inc.
 - d. Boston Retail Products.
 - e. Construction Specialties, Inc.
 - f. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - g. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - h. Kwalu, LLC.
 - i. Musson Rubber Company.
 - j. Pawling Corporation.
 - k. Tepromark International, Inc.
 - l. WallGuard.com.
 - m. wallProtex.
 - n. <Insert manufacturer's name>.
 - o. or approved equal.
 2. Wing Size: Nominal [3/4 by 3/4 inch (20 by 20 mm)] [1-1/8 by 1-1/8 inches (30 by 30 mm)] [2-1/2 by 2-1/2 inches (65 by 65 mm)] <Insert dimensions>.
 3. Mounting: [Countersunk screws through factory-drilled mounting holes] [Adhesive] [Double-faced adhesive foam tape].
 4. Color and Texture: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>.
- E. Surface-Mounted, Transparent-Plastic Corner Guards <Insert drawing designation>:
Fabricated from clear polycarbonate plastic sheet; with formed edges; fabricated with 90- or 135-degree turn to match wall condition.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Floor Products Co., Inc.
 - b. Arden Architectural Specialties, Inc.
 - c. Balco, Inc.
 - d. Construction Specialties, Inc.
 - e. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - f. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - g. Musson Rubber Company.
 - h. Pawling Corporation.
 - i. Tepromark International, Inc.
 - j. WallGuard.com.
 - k. wallProtex.
 - l. **<Insert manufacturer's name>**.
 - m. or approved equal.
2. Wing Size: Nominal [**3/4 by 3/4 inch** (20 by 20 mm)] [**1-1/8 by 1-1/8 inches** (30 by 30 mm)] [**2-1/2 by 2-1/2 inches** (65 by 65 mm)] **<Insert dimensions>**.
 3. Thickness: Minimum [**0.050 inch** (1.3 mm)] [**0.075 inch** (1.9 mm)] [**0.100 inch** (2.5 mm)] **<Insert dimension>**.
 4. Mounting: [**Countersunk screws through factory-drilled mounting holes**] [**Corner clips**].
- F. Surface-Mounted, Metal Corner Guards **<Insert drawing designation>**: Fabricated from one-piece, formed, or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Arden Architectural Specialties, Inc.
 - c. Balco, Inc.
 - d. Boston Retail Products.
 - e. Construction Specialties, Inc.
 - f. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - g. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - h. Pawling Corporation.
 - i. Tepromark International, Inc.
 - j. WallGuard.com.
 - k. **<Insert manufacturer's name>**.
 - l. or approved equal.
 2. Material: Stainless steel, [**Type 304**] [**Type 430**].
 - a. Thickness: Minimum [**0.0500 inch** (1.3 mm)] [**0.0625 inch** (1.6 mm)] [**0.0781 inch** (2.0 mm)] **<Insert dimension>**.
 - b. Finish: [**Directional satin, No. 4**] [**Bright annealed**].

3. Material: Extruded aluminum, minimum **0.0625 inch** (1.6 mm) thick, with clear anodic finish.
4. Material: Brass sheet, minimum **0.0500 inch** (1.3 mm) thick, with **[buffed, smooth specular] [fine satin]** finish.
5. Wing Size: Nominal **[1-1/2 by 1-1/2 inches** (38 by 38 mm)] **[2-1/2 by 2-1/2 inches** (65 by 65 mm)] **[3-1/2 by 3-1/2 inches** (90 by 90 mm)] **<Insert dimensions>**.
6. Corner Radius: **[1/8 inch** (3 mm)] **[3/4 inch** (19 mm)] **<Insert dimension>**.
7. Mounting: **[Flat-head, countersunk screws through factory-drilled mounting holes] [Oval head, countersunk screws through factory-drilled mounting holes] [Double-faced, adhesive foam tape] [Adhesive]**.

2.6 END-WALL GUARDS

- A. Surface-Mounted, Resilient, Plastic End-Wall Guard **<Insert drawing designation>**: Assembly consisting of snap-on plastic cover installed over **[continuous retainer] [continuous retainer at each corner, with end of wall covered by semirigid, impact-resistant sheet wall covering]**; including mounting hardware.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Arden Architectural Specialties, Inc.
 - c. Balco, Inc.
 - d. Construction Specialties, Inc.
 - e. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - f. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - g. Pawling Corporation.
 - h. WallGuard.com.
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
 2. Cover: Extruded rigid plastic, minimum **[0.078-inch** (2.0-mm)] **[0.100-inch** (2.5-mm)] wall thickness; **[as follows:] [in dimensions and profiles indicated on Drawings.]**
 - a. Profile: Nominal **[2-inch-** (50-mm-) **long leg and 1/4-inch** (6-mm) **corner radius] [3-inch-** (75-mm-) **long leg and 1/4-inch** (6-mm) **corner radius] [3-inch-** (75-mm-) **long leg and 1-1/4-inch** (32-mm) **corner radius] <Insert dimensions>**.
 - b. Height: **[4 feet** (1.2 m)] **[8 feet** (2.4 m)] **<Insert dimension>**.
 - c. Color and Texture: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>**.
 3. Retainer: Minimum **0.060-inch-** (1.5-mm-) thick, one-piece, extruded aluminum.
 4. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.

- B. Flush-Mounted, Resilient, Plastic End-Wall Guard **<Insert drawing designation>**: Assembly consisting of snap-on plastic cover that is flush with adjacent wall surface and that covers entire end of wall, installed over **[continuous retainer] [continuous retainer at each corner, with end of wall covered by semirigid, impact-resistant sheet wall covering]**; including mounting hardware.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Arden Architectural Specialties, Inc.
 - c. Balco, Inc.
 - d. Construction Specialties, Inc.
 - e. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - f. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - g. Pawling Corporation.
 - h. WallGuard.com.
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
 2. Cover: Extruded rigid plastic, minimum **[0.078-inch (2.0-mm)] [0.100-inch (2.5-mm)] <Insert dimension>** wall thickness; **[as follows:] [in dimensions and profiles indicated on Drawings.]**
 - a. Profile: Nominal **[2-inch- (50-mm-) long leg and 1/4-inch (6-mm) corner radius] [3-inch- (75-mm-) long leg and 1/4-inch (6-mm) corner radius] [3-inch- (75-mm-) long leg and 1-1/4-inch (32-mm) corner radius] <Insert dimensions>**.
 - b. Height: **[4 feet (1.2 m)] [8 feet (2.4 m)] <Insert dimension>**.
 - c. Color and Texture: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>**.
 3. Retainer: Minimum **0.060-inch- (1.5-mm-)** thick, one-piece, extruded aluminum.
 4. Aluminum Cove Base: Nominal **[4 inches (100 mm)] [6 inches (150 mm)] <Insert dimension>** high.
- C. Fire-Rated, Resilient, Plastic End-Wall Guard **<Insert drawing designation>**: Assembly consisting of snap-on plastic cover that is flush with adjacent wall surface and that covers entire end of wall, installed over continuous retainer and intumescent fire barrier; including mounting hardware; full wall height.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Balco, Inc.
 - b. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - c. Pawling Corporation.
 - d. WallGuard.com.

- e. **<Insert manufacturer's name>**.
 - f. or approved equal.
 2. Fire Rating: [1 hour] [2 hours] [**Same rating as wall in which end guard is installed**]; UL listed and labeled according to UL 2079.
 3. Cover: Extruded rigid plastic, minimum [0.078-inch (2.0-mm)] [0.100-inch (2.5-mm)] **<Insert dimension>** wall thickness; [as follows:] [in dimensions and profiles indicated on Drawings.]
 - a. Leg: Nominal [2 inches (50 mm)] [3 inches (75 mm)] **<Insert dimension>**.
 - b. Corner Radius: [1/4 inch (6 mm)] [1-1/4 inches (32 mm)] **<Insert dimension>**.
 - c. Color and Texture: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] **<Insert color and texture>**.
 4. Retainer: Minimum 0.070-inch- (1.8-mm-) thick, one-piece, extruded aluminum.
 5. Aluminum Cove Base: Nominal [4 inches (100 mm)] [6 inches (150 mm)] **<Insert dimension>** high.
- D. Surface-Mounted, Metal, End-Wall Guards **<Insert drawing designation>**: Fabricated from one-piece, formed, or extruded metal that covers entire end of wall; with formed edges.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.
 2. Material: Stainless steel, [Type 304] [Type 430].
 - a. Thickness: Minimum [0.0500 inch (1.3 mm)] [0.0625 inch (1.6 mm)] [0.0781 inch (2.0 mm)] **<Insert dimension>**.
 - b. Finish: [Directional satin, No. 4] [Bright annealed].
 3. Material: Extruded aluminum, minimum 0.0625 inch (1.6 mm) thick, with clear anodic finish.
 4. Material: Brass sheet, minimum 0.0500 inch (1.3 mm) thick, with [buffed, smooth specular] [fine satin] finish.
 5. Wing Size: Nominal [1-1/2 by 1-1/2 inches (38 by 38 mm)] [2-1/2 by 2-1/2 inches (65 by 65 mm)] [3-1/2 by 3-1/2 inches (90 by 90 mm)] **<Insert dimensions>**.
 6. Corner Radius: [1/8 inch (3 mm)] [3/4 inch (19 mm)] **<Insert dimension>**.
 7. Mounting: [Flat-head, countersunk screws through factory-drilled mounting holes] [Oval head, countersunk screws through factory-drilled mounting holes] [Double-faced, adhesive foam tape] [Adhesive].

2.7 IMPACT-RESISTANT WALL COVERINGS

- A. Impact-Resistant Sheet Wall Covering **<Insert drawing designation>**: Fabricated from plastic sheet wall-covering material.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Arden Architectural Specialties, Inc.
 - c. Balco, Inc.
 - d. Construction Specialties, Inc.
 - e. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - f. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - g. Kwalu, LLC.
 - h. Pawling Corporation.
 - i. Tepromark International, Inc.
 - j. WallGuard.com.
 - k. **<Insert manufacturer's name>**.
 - l. or approved equal.
 2. Size: **[48 by 96 inches (1219 by 2438 mm) for sheet] [48 by 120 inches (1219 by 3048 mm) for roll] [As indicated] <Insert dimensions>**.
 3. Sheet Thickness: **[0.022 inch (0.56 mm)] [0.028 inch (0.7 mm)] [0.040 inch (1.0 mm)] [0.060 inch (1.5 mm)] [0.080 inch (2.0 mm)] [0.093 inch (2.4 mm)] [0.125 inch (3.0 mm)] <Insert dimension>**.
 4. Color and Texture: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>**.
 5. Height: **[Full wall] [Wainscot] [As indicated] <Insert dimension>**.
 6. Trim and Joint Moldings: Extruded rigid plastic that matches sheet wall covering color.
 7. Mounting: Adhesive.
- B. Prelaminated, Impact-Resistant Wall Panels **<Insert drawing designation>**: Rigid wall panels consisting of impact-resistant plastic sheet wall covering material factory laminated to high-impact-resistant core, with moisture-resistant vapor barrier factory laminated to reverse side of panel for stability.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Construction Specialties, Inc.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.
 2. Composition: **[0.028-inch- (0.70-mm-) thick plastic sheet laminated to 3/8-inch- (9.5-mm-) thick, particleboard core] [0.04-inch- (1.02-mm-) thick plastic sheet**

laminated to 3/8-inch- (9.5-mm-) thick, particleboard core] <Insert description>.

3. Sheet Size: [48 by 96 inches (1219 by 2438 mm)] [48 by 108 inches (1219 by 2743 mm)] [48 by 120 inches (1219 by 3048 mm)] [As indicated] <Insert dimensions>.
4. Height: [Full wall] [Wainscot] [As indicated] <Insert dimension>.
5. Sheet Edge: [Square] [Beveled].
6. Trim and Joint Moldings: Extruded rigid plastic that matches sheet wall covering color.
7. Color and Texture: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>.
8. Mounting: Adhesive.

2.8 DOOR PROTECTION SYSTEMS

A. General: Comply with BHMA A156.6.

1. For fire-rated doors, provide door protection systems that are UL listed and labeled.

B. Protection Plates: Fabricated from extruded rigid plastic, of thickness indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Construction Specialties, Inc.
 - c. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - d. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - e. Kwalu, LLC.
 - f. Pawling Corporation.
 - g. Tepromark International, Inc.
 - h. WallGuard.com.
 - i. <Insert manufacturer's name>.
 - j. or approved equal.

C. Full-Height Door-Surface Protection <Insert drawing designation>: Minimum [0.040-inch (1.0-mm)] [0.060-inch (1.5-mm)] [0.080-inch (2.0-mm)] <Insert dimension> wall thickness; with 90-degree bend for door-edge protection.

1. Color and Texture: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>.
2. Mounting: [Adhesive] [Countersunk screws through factory-drilled mounting holes] [Double-faced adhesive foam tape].

- D. Armor Plates <Insert drawing designation>: Minimum [0.040-inch (1.0-mm)] [0.060-inch (1.5-mm)] [0.080-inch (2.0-mm)] <Insert dimension> wall thickness; beveled four sides.
1. Size: [32 inches (813 mm)] [36 inches (914 mm)] [40 inches (1016 mm)] [42 inches (1067 mm)] <Insert dimension> high by door width, with allowance for frame stops.
 2. Color and Texture: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>.
 3. Mounting: [Adhesive] [Countersunk screws through factory-drilled mounting holes] [Double-faced adhesive foam tape].
- E. Kick Plates <Insert drawing designation>: Minimum [0.040-inch (1.0-mm)] [0.060-inch (1.5-mm)] [0.080-inch (2.0-mm)] <Insert dimension> wall thickness; beveled four sides.
1. Size: [8 inches (203 mm)] [10 inches (254 mm)] [12 inches (305 mm)] <Insert dimension> high by door width, with allowance for frame stops.
 2. Color and Texture: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>.
 3. Mounting: [Adhesive] [Countersunk screws through factory-drilled mounting holes] [Double-faced adhesive foam tape].
- F. Mop Plates <Insert drawing designation>: Minimum [0.040-inch (1.0-mm)] [0.060-inch (1.5-mm)] [0.080-inch (2.0-mm)] <Insert dimension> wall thickness; beveled four sides.
1. Size: [4 inches (102 mm)] [6 inches (152 mm)] <Insert dimension> high by 1 inch (25 mm) less than door width.
 2. Color and Texture: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>.
 3. Mounting: [Adhesive] [Countersunk screws through factory-drilled mounting holes] [Double-faced adhesive foam tape].
- G. Stretcher Plates <Insert drawing designation>: Minimum [0.040-inch (1.0-mm)] [0.060-inch (1.5-mm)] [0.080-inch (2.0-mm)] <Insert dimension> wall thickness; beveled four sides.
1. Size: [6 inches (152 mm)] [8 inches (203 mm)] <Insert dimension> high by door width, with allowance for frame stops.
 2. Color and Texture: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>.
 3. Mounting: [Adhesive] [Countersunk screws through factory-drilled mounting holes] [Double-faced adhesive foam tape].
- H. Push Plates <Insert drawing designation>: Minimum [0.040-inch (1.0-mm)] [0.060-inch (1.5-mm)] [0.080-inch (2.0-mm)] <Insert dimension> wall thickness; beveled four sides.

1. Size: [12 inches high by 4 inches wide (305 mm high by 102 mm wide)] [16 inches high by 4 inches wide (406 mm high by 102 mm wide)] <Insert dimensions>.
 2. Color and Texture: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>.
 3. Mounting: [Adhesive] [Countersunk screws through factory-drilled mounting holes] [Double-faced adhesive foam tape].
- I. Door-Edge Protection <Insert drawing designation>: Fabricated from extruded rigid plastic, minimum [0.040-inch (1.0-mm)] [0.060-inch (1.5-mm)] <Insert dimension> wall thickness; formed to fit over door edge without mortising.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Construction Specialties, Inc.
 - c. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - d. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - e. Kwalu, LLC.
 - f. Pawling Corporation.
 - g. WallGuard.com.
 - h. <Insert manufacturer's name>.
 - i. or approved equal.
 2. Shape: [L] [U].
 3. Color and Texture: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>.
 4. Mounting: [Adhesive] [Countersunk screws through factory-drilled mounting holes] [Double-faced adhesive foam tape].
- J. Door-Frame Protector <Insert drawing designation>: Fabricated from extruded rigid plastic, minimum [0.040-inch (1.0-mm)] [0.050-inch (1.3-mm)] [0.060-inch (1.5-mm)] <Insert dimension> wall thickness; formed to fit entire doorframe profile.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Construction Specialties, Inc.
 - c. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - d. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - e. Kwalu, LLC.
 - f. Pawling Corporation.
 - g. WallGuard.com.
 - h. <Insert manufacturer's name>.
 - i. DEN Project Manager.

2. Height: [36 inches (914 mm)] [48 inches (1219 mm)] <Insert dimension>.
 3. Color and Texture: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>.
 4. Mounting: [Adhesive] [Countersunk screws through factory-drilled mounting holes] [Double-faced adhesive foam tape].
- K. Door-Frame Protector <Insert drawing designation>: Assembly consisting of snap-on plastic cover installed over continuous retainer; formed to fit doorframe on opposite side of door swing.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Construction Specialties, Inc.
 - b. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - c. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - d. Pawling Corporation.
 - e. WallGuard.com.
 - f. <Insert manufacturer's name>.
 - g. or approved equal.
 2. Cover: Extruded rigid plastic, minimum 0.080-inch (2.0-mm) wall thickness; in dimensions and profiles indicated.
 - a. Height: [36 inches (914 mm)] [48 inches (1219 mm)] <Insert dimension>.
 - b. Corner Radius: [1/4 inch (6 mm)] [1-1/4 inches (32 mm)].
 - c. Color and Texture: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>.
 3. Retainer: Minimum 0.080-inch- (2.0-mm-) thick, one-piece, extruded aluminum.
- L. Door[-Knob] [-Lever] Protector <Insert drawing designation>: Fabricated from injection-molded plastic, minimum 0.060-inch (1.5-mm) wall thickness.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Construction Specialties, Inc.
 - c. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - d. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - e. Pawling Corporation.
 - f. WallGuard.com.
 - g. <Insert manufacturer's name>.
 - h. or approved equal.

2. Color and Texture: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>**.
3. Mounting: Countersunk screws through factory-drilled mounting holes.

2.9 FABRICATION

- A. Fabricate impact-resistant wall protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.
- B. Preform curved semirigid, impact-resistant sheet wall covering in factory for radius and sheet thickness as follows:
 1. Sheet Thickness of **0.040 Inch** (1.0 mm): **24-inch** (610-mm) radius.
 2. Sheet Thickness of **0.060 Inch** (1.5 mm): **36-inch** (914-mm) radius.
 3. **<Insert thickness and radius>**.
- C. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- D. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.
- E. Miter corners and ends of wood handrails for returns.

2.10 METAL FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 1. Remove tool and die marks and stretch lines, or blend into finish.
 2. Grind and polish surfaces to produce uniform finish, free of cross scratches.
 3. Run grain of directional finishes with long dimension of each piece.
 4. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- B. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances[, **fire rating**,] and other conditions affecting performance of work.

- B. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
 - 1. For impact-resistant wall protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
 - 1. Install impact-resistant wall protection units in locations and at mounting heights indicated on Drawings or, if not indicated, at heights indicated below:
 - a. Crash Rails: **<Insert dimension>** above finished floor.
 - b. Bumper Rails: **<Insert dimension>** above finished floor.
 - c. Rub Rails: **<Insert dimension>** above finished floor.
 - d. Chair Rails: **<Insert dimension>** above finished floor.
 - e. Handrails: **<Insert dimension>** above finished floor.
 - f. Bed Locators: **<Insert dimension>** above finished floor.
 - g. **<Insert product and location>**.
 - 2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
 - a. Provide anchoring devices to withstand imposed loads.
 - b. Where splices occur in horizontal runs of more than **20 feet** (6.1 m), splice aluminum retainers and plastic covers at different locations along the run, but no closer than **12 inches** (305 mm).
 - c. Adjust **[end]** **[and]** **[top]** caps as required to ensure tight seams.
- B. Impact-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.

3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 102600

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Public-use washroom accessories.
 - 2. Public-use shower room accessories.
 - 3. Private-use bathroom accessories.
 - 4. Healthcare accessories.
 - 5. Warm-air dryers.
 - 6. Childcare accessories.
 - 7. Underlavatory guards.
 - 8. Custodial accessories.
- B. Owner-Furnished Material: **<Insert product>**.
- C. Related Sections:
 - 1. Section 088300 "Mirrors" for frameless mirrors.
 - 2. Section 093000 "Tiling" for ceramic toilet and bath accessories.
- D. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Features that will be included for Project.
 - 5. Manufacturer's warranty.
 - 6. Include data substantiating that materials comply with requirements.

- B. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.
 - 1. Approved full-size Samples will be returned and may be used in the Work.
- C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify products using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.8 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Minimum [fifteen (15)] <Insert number> years from date of Substantial Completion.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. A & J Washroom Accessories, Inc.
 2. American Specialties, Inc.
 3. Bobrick Washroom Equipment, Inc.
 4. Bradley Corporation.
 5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.

6. Tubular Specialties Manufacturing, Inc.
7. **<Insert manufacturer's name>**.
8. or approved equal.

B. Toilet Tissue (Roll) Dispenser **<Insert drawing designation>**:

1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
2. Description: **[Roll-in-reserve dispenser with hinged front secured with tumbler lockset] [Single-roll dispenser] [Double-roll dispenser] [Double-roll dispenser with shelf] <Insert description>**.
3. Mounting: **[Recessed] [Partition mounted serving two adjacent toilet compartments] [Surface mounted]**.
4. Operation: **[Noncontrol delivery with standard spindle] [Noncontrol delivery with theft-resistant spindle] [Spindleless with tension-spring controlled delivery] [Spindleless with tension-spring controlled delivery and self-locking device extending through core that prevents core removal until roll is empty] [Eccentric-shaped, molded-plastic spindle revolves one-half revolution per dispensing operation for controlled delivery; core cannot be removed until roll is empty] <Insert description>**.
5. Capacity: Designed for **[4-1/2- or 5-inch- (114- or 127-mm-)] [5-inch- (127-mm-)] <Insert dimension>** diameter tissue rolls.
6. Material and Finish: **[Stainless steel, No. 4 finish (satin)] [Chrome-plated zinc alloy (zamac) or steel] [Satin-finish aluminum bracket with plastic spindle] [ABS plastic, gray] <Insert material and finish>**.

C. Combination Toilet Tissue Dispenser **<Insert drawing designation>**:

1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
2. Description: Combination unit with double-roll toilet tissue dispenser and the following:
 - a. Removable sanitary-napkin waste receptacle with self-closing, disposal-opening cover.
 - b. Seat-cover dispenser with minimum capacity of **[500] [1000] <Insert number>** single or half-fold seat covers.
3. Mounting: **[Recessed] [Surface mounted] [Partition mounted, dual access with two tissue rolls per compartment] [Partition mounted, dual access with two tissue rolls per compartment and with one side that mounts flush with partition of accessible compartment]**.
4. Toilet Tissue Dispenser Capacity: **4-1/2- or 5-inch- (114- or 127-mm-)** diameter tissue rolls.
5. Toilet Tissue Dispenser Operation: **[Noncontrol delivery with theft-resistant spindles] <Insert description>**.
6. Material and Finish: **[Stainless steel, No. 4 finish (satin)] <Insert material and finish>**.
7. Lockset: Tumbler type.

- D. Toilet Tissue (Folded) Dispenser **<Insert drawing designation>**:
1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
 2. Description: Folded-tissue dispenser with cover hinged at bottom.
 3. Mounting: Surface mounted.
 4. Minimum Capacity: **[1250] <Insert number>** single-fold tissues.
 5. Material and Finish: **[Stainless steel, No. 4 finish (satin)] <Insert material and finish>**.
 6. Lockset: Tumbler type.
 7. Refill Indicators: Pierced slots at front.
- E. Toilet Tissue (Jumbo-Roll) Dispenser **<Insert drawing designation>**:
1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
 2. Description: **[One-roll unit] [Two-roll unit with sliding panel to expose other roll]**.
 3. Mounting: Surface mounted.
 4. Capacity: **[9- or 10-inch- (228- or 254-mm-)] <Insert dimension(s)>** diameter rolls.
 5. Material and Finish: **[Stainless steel, No. 4 finish (satin)] [ABS plastic, gray] <Insert material and finish>**.
 6. Lockset: Tumbler type.
 7. Refill Indicator: Pierced slots at front.
- F. Paper Towel (Folded) Dispenser **<Insert drawing designation>**:
1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
 2. Mounting: **[Recessed] [Semirecessed] [Deck mounted, recessed] [Surface mounted]**.
 3. Minimum Capacity: **[400 C-fold or 525 multifold towels] [600 C-fold or 800 multifold towels] [400 single-fold towels] <Insert capacity>**.
 4. Material and Finish: **[Stainless steel, No. 4 finish (satin)] [ABS plastic, gray] <Insert material and finish>**.
 5. Lockset: Tumbler type.
 6. Refill Indicators: Pierced slots at sides or front.
- G. Paper Towel (Roll) Dispenser **<Insert drawing designation>**:
1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
 2. Description: Lever-actuated mechanism permits controlled delivery of paper rolls in preset lengths per stroke.
 3. Mounting: **[Recessed] [Semirecessed] [Surface mounted]**.
 4. Minimum Capacity: **[8-inch- (203-mm-) wide, 800-foot- (244-m-) long roll] <Insert capacity>**.
 5. Material and Finish: **[Stainless steel, No. 4 finish (satin)] [ABS plastic, gray] <Insert material and finish>**.

6. Lockset: Tumbler type.
- H. Waste Receptacle <Insert drawing designation>:
1. Basis-of-Design Product: <Insert manufacturer's name; product name or designation>.
 2. Mounting: [Open top, recessed] [Self-closing disposal-opening cover, recessed] [Semirecessed] [Surface mounted] [Wall mounted for corner installation] [Freestanding] [Undercounter] <Insert description>.
 3. Minimum Capacity: <Insert gal. (L)>.
 4. Material and Finish: [Stainless steel, No. 4 finish (satin)] <Insert material and finish>.
 5. Liner: [Reusable vinyl liner] <Insert liner description>.
 6. Lockset: Tumbler type for waste-receptacle.
- I. Combination Towel (Folded) Dispenser/Waste Receptacle <Insert drawing designation>:
1. Basis-of-Design Product: <Insert manufacturer's name; product name or designation>.
 2. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
 3. Mounting: [Surface mounted] [Surface mounted with stainless-steel collar] [Recessed] [Recessed with projecting receptacle] [Semirecessed].
 - a. Designed for nominal [4-inch (100-mm)] [6-inch (150-mm)] wall depth.
 4. Minimum Towel-Dispenser Capacity: [600 C-fold or 800 multifold paper towels] <Insert capacity>.
 5. Minimum Waste-Receptacle Capacity: [4 gal. (15 L)] [12 gal. (45.4 L)] <Insert value>.
 6. Material and Finish: [Stainless steel, No. 4 finish (satin)] <Insert material and finish>.
 7. Liner: [Reusable, vinyl waste-receptacle liner] <Insert liner description>.
 8. Lockset: Tumbler type for towel-dispenser compartment[and waste receptacle].
- J. Combination Towel (Roll) Dispenser/Waste Receptacle <Insert drawing designation>:
1. Basis-of-Design Product: <Insert manufacturer's name; product name or designation>.
 2. Description: Combination unit for dispensing preset length of roll paper towels, with removable waste receptacle.
 3. Mounting: [Recessed] [Semirecessed] [Surface mounted].
 4. Minimum Towel-Dispenser Capacity: [8-inch- (203-mm-) wide, 800-foot- (244-m-) long roll] <Insert capacity>.
 5. Minimum Waste Receptacle Capacity: [8 gal. (30 L)] [12 gal. (45.4 L)] [15 gal. (56.8 L)] <Insert value>.
 6. Material and Finish: [Stainless steel, No. 4 finish (satin)] <Insert material and finish>.

7. Liner: **[Reusable, vinyl waste-receptacle liner]** <Insert liner description>.
 8. Lockset: Tumbler type for towel dispenser compartment[**and waste receptacle**].
- K. Multipurpose Soap/Towel Dispenser Unit <Insert drawing designation>:
1. Basis-of-Design Product: <Insert manufacturer's name; product name or designation>.
 2. Description: Combination unit for dispensing soap in [liquid or lotion] [lather] form and folded towels.
 3. Mounting: **[Recessed, designed for nominal 4-inch (100-mm) wall depth]** **[Surface mounted with stainless-steel collar]**.
 4. Minimum Soap-Dispenser Capacity: **[80 oz. (2.36 L)]** <Insert value>.
 5. Minimum Towel-Dispenser Capacity: **[600 C-fold or 800 multifold towels]** **[1000 single-fold towels]** <Insert capacity>.
 6. Material and Finish: **[Stainless steel, No. 4 finish (satin)]** <Insert material and finish> for unit body and soap valve.
 7. Lockset: Tumbler type.
- L. Liquid-Soap Dispenser <Insert drawing designation>:
1. Basis-of-Design Product: <Insert manufacturer's name; product name or designation>.
 2. Description: Designed for dispensing soap in [liquid or lotion] [lather] form.
 3. Mounting: **[Deck mounted on vanity]** **[Deck mounted on lavatory]** **[Horizontally oriented, recessed]** **[Horizontally oriented, surface mounted]** **[Vertically oriented, surface mounted]**.
 4. Capacity: <Insert oz. (mL)>.
 5. Materials: <Insert requirements for valve and reservoir materials and finishes>.
 6. Lockset: Tumbler type.
 7. Refill Indicator: Window type.
- M. Grab Bar <Insert drawing designation>:
1. Basis-of-Design Product: <Insert manufacturer's name; product name or designation>.
 2. Mounting: Flanges with **[concealed]** **[exposed]** fasteners.
 3. Material: Stainless steel, **0.05 inch** (1.3 mm) thick.
 - a. Finish: Smooth, No. 4 finish (satin)[**on ends and slip-resistant texture in grip area**].
 4. Outside Diameter: **[1-1/4 inches (32 mm)]** **[1-1/2 inches (38 mm)]**.
 5. Configuration and Length: **[As indicated on Drawings]** **[Straight, 36 inches (914 mm) long]** <Insert configuration and length>.
- N. Vendor <Insert drawing designation>:
1. Basis-of-Design Product: <Insert manufacturer's name; product name or designation>.

2. Type: **[Sanitary napkin] [Sanitary napkin and tampon] [Condom]**.
 3. Mounting: **[Fully recessed, designed for 4-inch (100-mm) wall depth] [Semirecessed] [Surface mounted]**.
 4. Capacity: **<Insert description>**.
 5. Operation: **[No coin (free)] [Single coin (25 cents)] [Two coin (50 cents)] <Insert description>**.
 6. Exposed Material and Finish: **[Stainless steel, No. 4 finish (satin)] <Insert material and finish>**.
 7. Lockset: Tumbler type with separate lock and key for coin box.
- O. Sanitary-Napkin Disposal Unit **<Insert drawing designation>**:
1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
 2. Mounting: **[Recessed] [Partition mounted, dual access] [Surface mounted]**.
 3. Door or Cover: Self-closing, disposal-opening cover **[and hinged face panel with tumbler lockset]**.
 4. Receptacle: Removable.
 5. Material and Finish: **[Stainless steel, No. 4 finish (satin)] [ABS plastic, gray] <Insert material and finish>**.
- P. Seat-Cover Dispenser **<Insert drawing designation>**:
1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
 2. Mounting: **[Surface mounted] [Recessed] [Partition mounted, dual access]**.
 3. Minimum Capacity: **[250] [500] <Insert number>** seat covers.
 4. Exposed Material and Finish: **[Stainless steel, No. 4 finish (satin)] [ABS plastic, gray] <Insert material and finish>**.
 5. Lockset: Tumbler type.
- Q. Fold-Down Purse Shelf **<Insert drawing designation>**:
1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
 2. Description: Hinged unit with spring-loaded shelf that automatically returns to vertical position.
 3. Nominal Size: **[15 inches (381 mm) long by 5-1/2 inches (140 mm) wide] <Insert dimensions>**.
 4. Material and Finish: **[Chrome-plated, cast-zinc alloy (zamac) with stippled finish on tray or stainless steel, No. 4 finish (satin)] [Chrome-plated, cast-zinc alloy (zamac) with stippled finish on tray and bright chrome finish on edges] [Stainless steel, No. 4 finish (satin)]**.
- R. Mirror Unit **<Insert drawing designation>**:
1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
 2. Frame: **[Stainless-steel angle, 0.05 inch (1.3 mm) thick] [Stainless-steel channel] [Stainless steel, fixed tilt] [Stainless steel, adjustable tilt]**.

- a. Corners: **[Manufacturer's standard] [Mitered and mechanically interlocked] [Welded and ground smooth]**.
 3. Integral Shelf: **5 inches** (127 mm) deep.
 4. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
 - b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
 5. Size: **[As indicated on Drawings] <Insert dimensions>**.
- S. Facial Tissue Dispenser **<Insert drawing designation>**:
1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
 2. Mounting: **[Wall mounted, recessed] [Surface mounted]**.
 3. Nominal Depth: **[2-1/4 inches** (57 mm)] **[4 inches** (102 mm)] **<Insert dimension>**.
 4. Capacity: **[150] <Insert number>** double-ply tissues.
 5. Material and Finish:
 - a. Dispenser Face: **[Stainless steel, No. 4 finish (satin)] [Stainless steel, No. 7 finish (polished)] <Insert material and finish>**.
 - b. Cabinet: **[Steel with corrosion-resistant finish] <Insert material and finish>**.

2.3 PUBLIC-USE SHOWER ROOM ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. A & J Washroom Accessories, Inc.
 2. American Specialties, Inc.
 3. Bobrick Washroom Equipment, Inc.
 4. Bradley Corporation.
 5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
 6. Tubular Specialties Manufacturing, Inc.
 7. **<Insert manufacturer's name>**.
 8. or approved equal.
- B. Shower Curtain Rod **<Insert drawing designation>**:
1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
 2. Description: **[1-inch** (25.4-mm) **OD; fabricated from nominal 0.0375-inch-** (0.95-mm-) **thick stainless steel] [1-1/4-inch** (32-mm) **OD; fabricated from nominal 0.05-inch-** (1.3-mm-) **thick stainless steel]**.

3. Mounting Flanges: [**Stainless-steel flanges designed for exposed fasteners**] **<Insert requirements>**.
4. Finish: [**No. 4 (satin)**] **<Insert finish>**.

C. Shower Curtain **<Insert drawing designation>**:

1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
2. Size: Minimum [**6 inches** (152 mm)] [**12 inches** (305 mm)] wider than opening by **72 inches** (1828 mm) high.
3. Material: [**Vinyl, minimum 0.006 inch** (0.15 mm) **thick, opaque, matte**] [**Duck, minimum 8 oz.** (227 g), **white, 100 percent cotton**] [**Nylon-reinforced vinyl, minimum 10 oz.** (284 g) **or 0.008-inch-** (0.2-mm-) **thick vinyl, with integral antibacterial agent**] **<Insert material>**.
4. Color: [**White**] [**Green**] [**As selected from manufacturer's full range**] **<Insert color>**.
5. Grommets: Corrosion resistant at minimum **6 inches** (152 mm) o.c. through top hem.
6. Shower Curtain Hooks: Chrome-plated or stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

D. Folding Shower Seat **<Insert drawing designation>**:

1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
2. Configuration: [**L-shaped seat, designed for wheelchair access**] [**Rectangular seat**] [**Triangular, corner-type seat**] [**Stainless-steel seat designed to fold into recessed-mounted, stainless-steel wall box**].
3. Seat: [**Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by DEN Project Manager**] [**White vinyl padded seat**] [**Stainless steel, No. 4 finish (satin); 0.05-inch** (1.3-mm) **minimum nominal thickness; with single-piece, pan-type construction and edge seams welded and ground smooth**] **<Insert description>**.
4. Mounting Mechanism: [**Stainless steel, No. 4 finish (satin)**] **<Insert description>**.
5. Dimensions: **<Insert dimensions>**.

E. Soap Dish **<Insert drawing designation>**:

1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
2. Description: [**With**] [**Without**] washcloth bar.
3. Mounting: [**Recessed**] [**Surface mounted**].
4. Material and Finish: [**Stainless steel, No. 4 finish (satin)**] **<Insert material and finish>**.

2.4 PRIVATE-USE BATHROOM ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Basco, Inc.
 2. Bobrick Washroom Equipment, Inc.
 3. Franklin Brass by Liberty Hardware Manufacturing Corporation; a Masco company.
 4. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
 5. Ginger; a Masco company.
 6. Seachrome Corporation.
 7. Tubular Specialties Manufacturing, Inc.
 8. **<Insert manufacturer's name>**.
 9. or approved equal.
- B. Toilet Tissue Dispenser **<Insert drawing designation>**:
1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
 2. Description: **[Single-roll dispenser] [Double-roll dispenser] [Single-roll dispenser with hood] [Double-roll dispenser with hood] <Insert description>**.
 3. Mounting: **[Recessed] [Surface mounted]**.
 4. Capacity: Designed for **4-1/2- or 5-inch-** (114- or 127-mm-) diameter tissue rolls.
 5. Material and Finish: **[Solid brass, polished] [Polished brass-plated zinc alloy (zamac)] [Polished chrome-plated brass] [Polished chrome-plated zinc alloy (zamac)] [Stainless steel, No. 4 finish (satin)] [Stainless steel, No. 7 finish (polished)] <Insert material and finish>**.
- C. Shower Curtain Rod **<Insert drawing designation>**:
1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
 2. Outside Diameter: **[1 inch (25.4 mm)] [1-1/4 inches (32 mm)]**.
 3. Mounting: Flanges with **[exposed] [concealed]** fasteners.
 4. Rod Material and Finish: **[Solid brass, polished] [Polished chrome-plated brass] [Stainless steel, No. 4 finish (satin)] [Stainless steel, No. 7 finish (polished)] <Insert material and finish>**.
 5. Flange Material and Finish: **[Polished brass-plated zinc alloy (zamac)] [Polished chrome-plated brass] [Polished chrome-plated zinc alloy (zamac)] [Stainless steel, No. 4 finish (satin)] [Stainless steel, No. 7 finish (polished)] <Insert material and finish>**.
 6. Accessories: Integral chrome-plated brass glide hooks.
- D. Soap Dish **<Insert drawing designation>**:
1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
 2. Description: **<Insert description>**.

3. Mounting: **[Recessed] [Surface mounted]**.
4. Material and Finish: **[Solid brass, polished] [Polished brass-plated zinc alloy (zamac)] [Polished chrome-plated brass] [Polished chrome-plated zinc alloy (zamac)] [Stainless steel, No. 4 finish (satin)] [Stainless steel, No. 7 finish (polished)] <Insert material and finish>**.

E. Medicine Cabinet **<Insert drawing designation>**:

1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
2. Mounting: **[Recessed, for nominal 4-inch (100-mm) wall depth] [Surface mounted]**.
3. Size: **[18 by 24 inches (460 by 610 mm)] <Insert dimensions>**.
4. Door: **[Framed mirror door concealing storage cabinet equipped with continuous hinge and spring-buffered, rod-type stop and magnetic door catch] <Insert description>**.
5. Shelves: **[Three, adjustable] <Insert requirements>**.
6. Material and Finish:
 - a. Cabinet: **[Stainless steel, No. 4 finish (satin)] [Steel with corrosion-resistant finish]**.
 - b. Mirror Frame: **<Insert material and finish>**.
 - c. Door: **<Insert material and finish>**.
 - d. Hinge: **<Insert material and finish>**.
 - e. Shelves: **<Insert material and finish>**.

F. Facial Tissue Dispenser **<Insert drawing designation>**:

1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
2. Mounting: **[Wall mounted, recessed] [Surface mounted]**.
3. Depth: **[2-5/8 inches (67 mm)] [4 inches (102 mm)] <Insert dimension>**.
4. Material and Finish:
 - a. Dispenser Face: **[Polished chrome-plated brass] [Polished brass-plated zinc alloy (zamac)] [Polished chrome-plated steel] [Stainless steel, No. 4 finish (satin)] [Stainless steel, No. 7 finish (polished)] <Insert material and finish>**.
 - b. Cabinet: **[Steel with corrosion-resistant finish] <Insert material and finish>**.

G. Robe Hook **<Insert drawing designation>**:

1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
2. Description: **[Double] [Single]-prong unit**.
3. Material and Finish: **[Solid brass, polished] [Polished brass-plated zinc alloy (zamac)] [Polished chrome-plated brass] [Polished chrome-plated zinc alloy (zamac)] [Stainless steel, No. 4 finish (satin)] [Stainless steel, No. 7 finish (polished)] <Insert material and finish>**.

- H. Toothbrush and Tumbler Holder <Insert drawing designation>:
1. Basis-of-Design Product: <Insert manufacturer's name; product name or designation>.
 2. Description: <Insert description>.
 3. Material and Finish: [Solid brass, polished] [Polished brass-plated zinc alloy (zamac)] [Polished chrome-plated brass] [Polished chrome-plated zinc alloy (zamac)] [Stainless steel, No. 4 finish (satin)] [Stainless steel, No. 7 finish (polished)] <Insert material and finish>.
- I. Towel Bar <Insert drawing designation>:
1. Basis-of-Design Product: <Insert manufacturer's name; product name or designation>.
 2. Description: [3/4-inch- (19-mm-) square tube with rectangular end brackets] [3/4-inch- (19-mm-) round tube with circular end brackets] <Insert description>.
 3. Mounting: Flanges with [concealed] [exposed] fasteners.
 4. Length: [18 inches (457 mm)] [24 inches (610 mm)] [30 inches (762 mm)] <Insert dimension>.
 5. Material and Finish: [Stainless steel, No. 4 finish (satin)] [Stainless steel, No. 7 finish (polished)] [Polished aluminum] <Insert material and finish>.
- J. Towel Pin <Insert drawing designation>:
1. Basis-of-Design Product: <Insert manufacturer's name; product name or designation>.
 2. Description: Projecting minimum of [3 inches (75 mm)] [5 inches (127 mm)] from wall surface.
 3. Material and Finish: [Polished brass-plated zinc alloy (zamac)] [Polished chrome-plated brass] [Stainless steel, No. 4 finish (satin)] [Stainless steel, No. 7 finish (polished)] <Insert material and finish>.
- K. Towel Ring <Insert drawing designation>:
1. Basis-of-Design Product: <Insert manufacturer's name; product name or designation>.
 2. Description: Pin projecting approximately 2-1/2 inches (63 mm) from wall with [square] [circular] [oval] [trapezoidal] ring.
 3. Pin Material and Finish: [Solid brass, polished] [Polished brass-plated zinc alloy (zamac)] [Polished chrome-plated brass] [Polished chrome-plated zinc alloy (zamac)] [Stainless steel, No. 4 finish (satin)] [Stainless steel, No. 7 finish (polished)] <Insert material and finish>.
 4. Ring Material and Finish: [Matching pin] [Clear plastic].
- L. Towel Shelf <Insert drawing designation>:
1. Basis-of-Design Product: <Insert manufacturer's name; product name or designation>.

2. Description: Surface-mounted, guest-towel shelf with four [3/8-inch- (9-mm-) diameter] [5/16-inch- (8-mm-) square] stainless-steel tubes mounted in support arms.
 - a. Towel Bar: [1/4-inch- (6-mm-) diameter] [5/16-inch- (8-mm-) square] stainless-steel towel bar below shelf.
3. Length: [18 inches (457 mm)] [24 inches (610 mm)] <Insert dimension>.
4. Material and Finish: [Polished brass-plated, stainless-steel] [Polished chrome-plated, stainless-steel] [Stainless steel, No. 7 finish (polished)] <Insert material and finish>.

M. Towel Rack <Insert drawing designation>:

1. Basis-of-Design Product: <Insert manufacturer's name; product name or designation>.
2. Description: [Surface-mounted, guest-towel unit with approximately 1/4-inch- (6-mm-) diameter wire rings welded to upright wire bracket] <Insert description>.
3. Capacity: [Two] [Three] [Four] <Insert number> sets of bath towels, hand towels, and washcloths.
4. Nominal Height: [11 inches (279 mm)] [17 inches (432 mm)] [21 inches (533 mm)] <Insert dimension>.
5. Material and Finish: [Polished brass-plated zinc alloy (zamac)] [Polished chrome-plated zinc alloy (zamac)] <Insert material and finish>.

N. Retractable Clothesline <Insert drawing designation>:

1. Basis-of-Design Product: <Insert manufacturer's name; product name or designation>.
2. Description: Surface-mounted [rectangular] [circular] housing with minimum 72-inch- (1829-mm-) long, retractable, spring-actuated, synthetic clothesline and remote retention bracket.
3. Material and Finish [Chrome-plated brass] [Stainless steel, No. 7 finish (polished)].

O. Bottle Opener <Insert drawing designation>:

1. Basis-of-Design Product: <Insert manufacturer's name; product name or designation>.
2. Description: Surface-mounted unit with [standard] [vandal-resistant] fasteners.
3. Material and Finish: [Stainless steel, No. 4 finish (satin)] [Stainless steel, No. 7 finish (polished)] [Chrome-plated steel].

2.5 WARM-AIR DRYERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. A & J Washroom Accessories, Inc.
2. American Dryer, Inc.
3. American Specialties, Inc.
4. Bobrick Washroom Equipment, Inc.
5. Bradley Corporation.
6. Excel Dryer Corporation.
7. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
8. Tubular Specialties Manufacturing, Inc.
9. World Dryer Corporation.
10. **<Insert manufacturer's name>**.
11. or approved equal.

B. Warm-Air Dryer **<Insert drawing designation>**:

1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
2. Mounting: **[Recessed] [Semirecessed] [Surface mounted]**.
3. Operation: **[Touch-button] [Electronic-sensor]** activated with timed power cut-off switch.
 - a. Operation Time: **[30 to 40] [80] <Insert number(s)>** seconds.
4. Cover Material and Finish: **[Steel, with white enamel finish] [Cast iron, with enamel finish in color selected by DEN Project Manager] [Chrome-plated steel] [Stainless steel, No. 4 finish (satin)] [Molded plastic, gray] [Molded plastic, white] <Insert material and finish>**.
5. Electrical Requirements: **[115 V, 13 A, 1500 W] [115 V, 15 A, 1725 W] [115 V, 20 A, 2300 W] [208-240 V, 9-10 A, 1900-2300 W] <Insert electrical requirements>**.

2.6 CHILDCARE ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Specialties, Inc.
2. Brocar Products, Inc.
3. Diaper Deck & Company, Inc.
4. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
5. Koala Kare Products; a division of Bobrick Washroom Equipment, Inc.
6. SSC, Inc.
7. Tubular Specialties Manufacturing, Inc.
8. **<Insert manufacturer's name>**.
9. or approved equal.

B. Diaper-Changing Station **<Insert drawing designation>**:

1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.

2. Description: **[Horizontal] [Vertical]** unit that opens by folding down from stored position and with child-protection strap.
 - a. Engineered to support a minimum of **[250-lb (113-kg)] <Insert value>** static load when opened.
3. Mounting: **[Surface mounted, with unit projecting not more than 4 inches (100 mm) from wall when closed] [Semirecessed, with unit projecting not more than 1 inch (25 mm) from wall when closed]**.
4. Operation: By pneumatic shock-absorbing mechanism.
5. Material and Finish: **[HDPE in manufacturer's standard color] [HDPE with plastic-laminate insert in color selected by DEN Project Manager] [Stainless steel, No. 4 finish (satin), with replaceable insulated polystyrene tray liner and rounded plastic corners] [Stainless steel, No. 4 finish (satin), exterior shell with rounded plastic corners; HDPE interior in manufacturer's standard color] <Insert requirements>**.
6. Liner Dispenser: Built in.

C. Diaper-Pack Vendor **<Insert drawing designation>**:

1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
2. Mounting: **[Surface mounted] [Recessed]**.
3. Minimum Capacity: **[100] <Insert number>** diaper packs.
4. Coin Operation: Coin slot preset for **[one U.S. dollar, adjustable up in 25-cent increments] <Insert requirements>**.
5. Material and Finish: **[Stainless steel, No. 4 finish (satin)] <Insert material and finish>**.

D. Child-Protection Seat **<Insert drawing designation>**:

1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
2. Description: Unit that opens by folding down from stored position and with child-protection strap.
 - a. Engineered to support a minimum of **[80-lb (36-kg)] [150-lb (68-kg)] <Insert value>** static load when opened.
3. Mounting: Surface mounted, with unit projecting not more than **[4-1/2 inches (114 mm)] [6 inches (152 mm)]** from wall when closed.
4. Material and Finish: **[HDPE in manufacturer's standard color] <Insert requirements>**.

2.7 UNDERLAVATORY GUARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Plumberex Specialty Products, Inc.
2. Truebro by IPS Corporation.
3. **<Insert manufacturer's name>**.
4. or approved equal.

B. Underlavatory Guard **<Insert drawing designation>**:

1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
2. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.

2.8 CUSTODIAL ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.
5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
6. Tubular Specialties Manufacturing, Inc.
7. **<Insert manufacturer's name>**.
8. or approved equal.

B. Utility Shelf **<Insert drawing designation>**:

1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
2. Description: With exposed edges turned down not less than **1/2 inch** (13 mm) and supported by two triangular brackets welded to shelf underside.
3. Size: [**16 inches** (406 mm) **long by 6 inches** (152 mm) **deep**] **<Insert dimensions>**.
4. Material and Finish: Not less than nominal **0.05-inch-** (1.3-mm-) thick stainless steel, No. 4 finish (satin).

C. Mop and Broom Holder **<Insert drawing designation>**:

1. Basis-of-Design Product: **<Insert manufacturer's name; product name or designation>**.
2. Description: [**Unit with shelf, hooks, holders, and rod suspended beneath shelf**] **<Insert description>**.
3. Length: [**36 inches** (914 mm)] **<Insert dimension>**.
4. Hooks: [**Three**] **<Insert number>**.
5. Mop/Broom Holders: [**Four**] **<Insert number>**, spring-loaded, rubber hat, cam type.

6. Material and Finish: Stainless steel, No. 4 finish (satin).
 - a. Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.
 - b. Rod: Approximately 1/4-inch- (6-mm-) diameter stainless steel.

D. Paper Towel (Folded) Dispenser <Insert drawing designation>:

1. Basis-of-Design Product: <Insert manufacturer's name; product name or designation>.
2. Mounting: [Recessed] [Semirecessed] [Surface mounted].
3. Minimum Capacity: [400 C-fold or 525 multifold towels] [600 C-fold or 800 multifold towels] [400 single-fold towels] <Insert capacity>.
4. Material and Finish: [Stainless steel, No. 4 finish (satin)] [ABS plastic, gray] <Insert material and finish>.
5. Lockset: Tumbler type.
6. Refill Indicators: Pierced slots at sides or front.

E. Paper Towel (Roll) Dispenser <Insert drawing designation>:

1. Basis-of-Design Product: <Insert manufacturer's name; product name or designation>.
2. Description: Lever-actuated mechanism permits controlled delivery of paper rolls in preset lengths per stroke.
3. Mounting: [Recessed] [Semirecessed] [Surface mounted].
4. Minimum Capacity: [8-inch- (203-mm-) wide, 800-foot- (244-m-) long roll] <Insert capacity>.
5. Material and Finish: [Stainless steel, No. 4 finish (satin)] [ABS plastic, gray] <Insert material and finish>.
6. Lockset: Tumbler type.

F. Liquid-Soap Dispenser <Insert drawing designation>:

1. Basis-of-Design Product: <Insert manufacturer's name; product name or designation>.
2. Description: Designed for dispensing soap in [liquid or lotion] [lather] form.
3. Mounting: [Deck mounted on vanity] [Deck mounted on lavatory] [Horizontally oriented, recessed] [Horizontally oriented, surface mounted] [Vertically oriented, surface mounted].
4. Capacity: <Insert oz. (mL)>.
5. Materials: <Insert requirements for valve and reservoir materials and finishes>.
6. Lockset: Tumbler type.
7. Refill Indicator: Window type.

2.9 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of [six] <Insert number> keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 102800

SECTION 104413 - FIRE VALVE AND EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Fire protection cabinets for the following:
 - a. Portable fire extinguishers.
 - b. Fire hose valves.
 - c. Fire hoses and racks.

- B. Related Sections:

- 1. Section 101400 "Signage" for directional signage to out-of-sight fire extinguishers and cabinets.
- 2. Section 104416 "Fire Extinguishers."
- 3. Section 211100 "Facility Fire-Suppression Water-Service Piping" for hose systems, racks, and valves.
- 4. Section 265100 "Interior Lighting" for fire extinguisher location lights.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 REFERENCE STANDARDS

- A. International Building Code (IBC) with the Denver Amendments
- B. International Fire Code (IFC) with the Denver Amendments
- C. National Fire Protection Association (NFPA): NFPA
- D. NFPA 14 Installation of Standpipe and Hose Systems.
- E. NFPA 10 – Fire Extinguishers – Portable
- F. Note: The most stringent interpretations shall apply. All appendices and annexes shall apply.

1.4 REGULATORY REQUIREMENTS

- A. Conform to Denver Building code with all applicable amendments and NFPA 14 for standpipe and hose system.
- B. Equipment and Components: Bear UL or F M Global label or marking.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
 - 1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
 - 2. Include data substantiating that materials comply with requirements.
 - 3. Show location of knockouts for hose valves.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Initial Selection: For each type of fire protection cabinet indicated.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Size: **6 by 6 inches** (150 by 150 mm) square.
- E. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function. [**Use same designations indicated on Drawings.**]

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire protection cabinets to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
- B. Conform to NFPA 14 for hose systems.

- C. Comply with all requirements of Owner's Insurance Underwriter.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>**.
 - 1. Review methods and procedures related to fire protection cabinets including, but not limited to, the following:
 - a. Schedules and coordination requirements.
- F. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five (5) years' documented experience.
- G. Installer: Company specializing in performing the work of this Section with minimum five (5) years' documented experience.
 - 1. Coordinate valve and fire extinguisher cabinet sizes and locations with wall construction contractor and plumbing contractor to achieve proper fit of cabinets, pipe connections, wall conditions, flush mounting, and other requirements of Project.

1.8 COORDINATION

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate size of fire protection cabinets to ensure that type and capacity of fire hoses, hose valves, and hose racks indicated are accommodated.
- C. Coordinate sizes and locations of fire protection cabinets with wall depths.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

- B. Stainless-Steel Sheet: ASTM A 666, Type 304.
- C. Tempered Break Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.

2.2 VALVE AND EXTINGUISHER CABINETS

- A. General: Provide cabinets to house fire department valves and extinguishers as indicated.
- B. Construction: Manufacturer's standard enameled steel or stainless steel box, with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld all joints and grind smooth. Miter and weld perimeter doorframes.
- C. Cabinet type, suitable for mounting conditions indicated, of the following types:
 - 1. Fire Extinguisher Cabinets (Recessed):
 - a. Type: Larsen "Architectural" series, Model 2712-R, stainless steel finish.
 - b. Door Style: Stainless steel 5/16 inch flat trim fully recessed; key door locks to DEN Master Key System.
 - c. Glazing: Clear tempered breakaway glass.
 - d. Interior Dimensions: 27 inches by 12 inches by 8 inches; interior capacity sufficient for one 10-pound fire extinguisher.
 - e. Provide one 10-pound fire extinguisher with each fire extinguisher cabinet.
 - 2. Fire Extinguisher Cabinets (Surface Mounted):
 - a. Type: Larsen "Architectural" series, Model 2717-SM, steel with white baked enamel finish.
 - b. Door Style: Steel with baked enamel finish and breakaway glazing; key door locks to DEN Master Key System.
 - c. Glazing: Clear tempered breakaway glass.
 - d. Interior Dimensions: 30-1/2 inches by 15-1/2 inches by 8 inches; interior capacity sufficient for one 10-pound fire extinguisher.
 - 3. Fire Valve Cabinets (Recessed):
 - a. Type: Larsen, Model T-VCSS4016-R, stainless steel finish.
 - b. Door Style: Stainless steel 5/16 inch flat trim fully recessed; key door locks to DEN Master Key System.
 - c. Glazing: Clear tempered d breakaway glass.
 - d. Interior Dimensions: 40 inches by 16 inches by 8 inches; interior capacity sufficient for one 10-pound fire extinguisher and one 2-1/2 inch fire department valve with cap and chain.
 - e. Provide one 10-pound fire extinguisher with each fire valve cabinet.
 - 4. Fire Valve Cabinets (Surface Mounted):
 - a. Type: Larsen Model T-VC4016-SM, steel with white baked enamel finish.

- b. Door Style: Steel with white baked enamel finish and breakaway glazing; key door locks to DEN Master Key System.
 - c. Glazing: Clear tempered breakaway glass.
 - d. Interior Dimensions: 43-1/2 inches by 19-1/2 inches by 8-1/2 inches; interior capacity sufficient for one 10-pound fire extinguisher and one 2-1/2 inch fire department valve with cap and chain.
 - e. Provide one 10-pound fire extinguisher with each fire valve cabinet.
- D. Door Material and Construction: Manufacturer's standard door construction, of material indicated, coordinated with cabinet types and trim styles selected.
1. Enameled Steel: Manufacturer's standard finish, hollow steel door construction with tubular stiles and rails.
 2. Stainless steel, ASTM A 167, AISI type 302/304 alloy (for use in all public areas).
 3. Door Glazing: Tempered breakaway glass shall conform to the requirements of Section 088000 "Glazing".
- E. Door Hardware: Provide manufacturer's standard door operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam action latch, or door pull, exposed or concealed, and friction latch. Provide continuous full height hinge permitting door to open 180 degrees. Key door locks per DEN Master Key System (Best Series Cam Locks).

2.3 FIRE PROTECTION CABINET <Insert drawing designation>

- A. Cabinet Type: Suitable for fire [extinguisher] [extinguisher and hose valve] [hose, rack, valve, and extinguisher] [hose, rack, and valve] [hose valve].
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fire End & Croker Corporation; <Insert product name or designation>.
 - b. J. L. Industries, Inc., a division of Activar Construction Products Group; <Insert product name or designation>.
 - c. Kidde Residential and Commercial Division, Subsidiary of Kidde plc; <Insert product name or designation>.
 - d. Larsen's Manufacturing Company; <Insert product name or designation>.
 - e. Modern Metal Products, Division of Technico Inc.; <Insert product name or designation>.
 - f. Moon-American; <Insert product name or designation>.
 - g. Potter Roemer LLC; <Insert product name or designation>.
 - h. Watrous Division, American Specialties, Inc.; <Insert product name or designation>.
 - i. <Insert manufacturer's name; product name or designation>.
 - j. or approved equal.
- B. Cabinet Construction: [Nonrated] [1-hour fire rated] [2-hour fire rated].
1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated

from **0.0428-inch-** (1.1-mm-) thick, cold-rolled steel sheet lined with minimum **5/8-inch-** (16-mm-) thick, fire-barrier material. Provide factory-drilled mounting holes.

- C. Cabinet Material: **[Steel] [Stainless-steel]** sheet.
1. Shelf: Same metal and finish as cabinet.
- D. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.
1. Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box to act as **[plaster stop] [drywall bead]**.
 2. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.
 3. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
- E. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
1. Square-Edge Trim: **1-1/4- to 1-1/2-inch** (32- to 38-mm) backbend depth.
 2. Rolled-Edge Trim: **[2-1/2-inch** (64-mm)] **[4-inch** (102-mm)] **[4-1/2-inch** (114-mm)] **<Insert dimension>** backbend depth.
- F. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim. Provide where walls are of insufficient depth for semirecessed cabinet installation.
- G. Cabinet Trim Material: **[Steel sheet] [Stainless-steel sheet] [Same material and finish as door]**.
- H. Door Material: **[Steel sheet] [Stainless-steel sheet]**.
- I. Door Style: **[Fully glazed, frameless, backless, acrylic panel] [Fully glazed panel with frame] [Horizontal duo panel with frame] [Vertical duo panel with frame] [Center glass panel with frame] [Solid opaque panel with frame] [Flush opaque panel, frameless, with no exposed hinges]**.
- J. Door Glazing: **[Clear float glass] [Tempered float glass (clear)] [Tempered float glass (bronze tint)] [Break glass] [Tempered break glass] [Mirror glass]** .
- K. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide [**projecting lever handle with cam-action latch**] [**projecting door pull and friction latch**] [**recessed door pull and friction latch**] [**manufacturer's standard**].
2. Provide [**continuous hinge, of same material and finish as trim,**] [**concealed hinge**] [**pivot hinge**] [**manufacturer's standard hinge**] permitting door to open 180 degrees.

L. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
3. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
4. Door Lock: [**Cam lock that allows door to be opened during emergency by pulling sharply on door handle**] [**Cylinder lock, keyed alike to other cabinets**].
5. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate [**as indicated**] [**as directed by DEN Project Manager**] <Insert location>.
 - a. Identify fire extinguisher in fire protection cabinet with the words "[**FIRE EXTINGUISHER**] <Insert identification>."
 - 1) Location: Applied to [**cabinet door**] [**cabinet glazing**] [**location indicated on Drawings**].
 - 2) Application Process: [**Silk-screened**] [**Engraved**] [**Etched**] [**Decals**] [**Pressure-sensitive vinyl letters**].
 - 3) Lettering Color: [**Red**] [**Black**] [**White**].
 - 4) Orientation: [**Vertical**] [**Horizontal**] [**As indicated on Drawings**].
6. Alarm: Manufacturer's standard alarm that actuates when fire protection cabinet door is opened and that is powered by [**batteries**] [**low voltage, complete with transformer**].

M. Finishes:

1. Manufacturer's standard baked-enamel paint for the following:
 - a. Exterior of cabinet [**door**] [**trim**] [, **door, and trim**] except for those surfaces indicated to receive another finish.
 - b. Interior of cabinet[**and door**].
2. Steel: [**Factory primed for field painting**] [**Baked enamel or powder coat**].
3. Stainless Steel: [**No. 2B**] [**No. 4**] [**No. 6**] [**No. 7**] [**No. 8**].

- 2.4 SECURITY FIRE PROTECTION CABINET <Insert drawing designation>
- A. Cabinet Type: Suitable for fire [extinguisher] [extinguisher and hose valve] [hose, rack, valve, and extinguisher] [hose, rack, and valve] [hose valve].
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. J. L. Industries, Inc., a division of Activar Construction Products Group; <Insert product name or designation>.
 - b. Larsen's Manufacturing Company; <Insert product name or designation>.
 - c. Potter Roemer LLC; <Insert product name or designation>.
 - d. <Insert manufacturer's name; product name or designation>.
 - e. or approved equal.
- B. Cabinet Construction: [Nonrated] [1-hour fire rated] [2-hour fire rated].
1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls lined with minimum 5/8-inch- (16-mm-) thick, fire-barrier material.
- C. Cabinet Material: [0.0677-inch- (1.7-mm-) thick steel] [0.0966-inch- (2.5-mm-) thick steel] [0.0781-inch- (2.0-mm-) thick, stainless-steel] sheet.
1. Shelf: Same metal and finish as cabinet.
- D. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.
1. Exposed Flat Trim: One-piece combination trim and perimeter doorframe overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
- E. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter doorframe overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
1. Square-Edge Trim: 1-1/4- to 1-1/2-inch (32- to 38-mm) backbend depth.
 2. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.
- F. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall; with no trim. Provide where walls are of insufficient depth for semirecessed cabinet installation.
- G. Cabinet Trim Material: [Steel sheet] [Stainless-steel sheet] [Same material and finish as door].
- H. Door Material: [0.0966-inch- (2.5-mm-) thick steel] [0.0781-inch- (2.0-mm-) thick, stainless-steel] [0.1094-inch- (2.8-mm-) thick, stainless-steel] sheet.

- I. Door Style: Solid opaque panel with frame.
- J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated, and as follows:
1. Recessed door pull.
 2. Continuous Hinge: Same material and finish as trim, permitting door to open 180 degrees.
 3. Mechanical Deadlock: Lockbolt retracted and extended by five-tumbler **[paracentric]** **[mogul]** cylinder; keyed one side.
 - a. Lockbolt: 1-1/2 inches high by 3/4 inch (38 mm high by 19 mm) thick; 5/8-inch (16-mm) throw.
 4. Mechanical Deadlock: As specified in Section 087163 "Detention Door Hardware."
 5. Mechanical Snaplatch: Automatic snaplatch when closed; latchbolt retracted by five-tumbler **[paracentric]** **[mogul]** cylinder; keyed one side.
 - a. Lockbolt: 1 inch high by 7/16 inch (25 mm high by 11 mm) thick; 5/16-inch (8-mm) throw.
 6. Mechanical Snaplatch: As specified in Section 087163 "Detention Door Hardware."
- K. Accessories:
1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to security fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate **[as indicated]** **[as directed by DEN Project Manager]** <Insert location>.
 - a. Identify fire extinguisher in security fire protection cabinet with the words "**[FIRE EXTINGUISHER]** <Insert identification>."
 - 1) Location: Applied to **[cabinet door]** **[location indicated on Drawings]**.
 - 2) Application Process: **[Silk-screened]** **[Engraved]** **[Etched]** **[Decals]** **[Pressure-sensitive vinyl letters]**.
 - 3) Lettering Color: **[Red]** **[Black]** **[White]**.
 - 4) Orientation: **[Vertical]** **[Horizontal]** **[As indicated on Drawings]**.
 3. Keys to Door Locks: Three per lock.
- L. Finishes:
1. Manufacturer's standard baked-enamel paint for the following:
 - a. Exterior of cabinet **[door]** **[trim]** [, **door, and trim]** except for those surfaces

- indicated to receive another finish.
b. Interior of cabinet[**and door**].

2. Steel: [**Factory primed for field painting**] [**Baked enamel or powder coat**].
3. Stainless Steel: No. 4 finish.

2.5 FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
1. Weld joints and grind smooth.
 2. Provide factory-drilled mounting holes.
 3. Prepare doors and frames to receive locks.
 4. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
1. Fabricate doorframes with tubular stiles and rails and hollow-metal design, minimum **1/2 inch** (13 mm) thick.
 2. Fabricate doorframes of one-piece construction with edges flanged.
 3. Miter and weld perimeter doorframes.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 FACTORY FINISHING OF HOSE VALVE AND EXTINGUISHER CABINETS - GENERAL

- A. Painted Finishes: Provide painted finish to comply with requirements indicated below for extent, preparation, and type.
- B. Extent of Painted Finish: Apply painted finish to both concealed and exposed surfaces

of cabinet components, except where other than a painted finish is indicated.

- C. Color: Provide color or color matches indicated, or, if not otherwise indicated, as selected by DEN Project Manager from manufacturer's standard colors.
- D. Preparation: Clean surfaces of dirt, grease, and loose rust or mill scale.
- E. Baked Enamel Finish: Immediately after cleaning and pretreatment, apply cabinet manufacturer's standard baked enamel finish system to the following surfaces:
 - 1. Interior of cabinet.
 - 2. Exterior of cabinet, except for those surfaces indicated to receive another finish.
- F. Stainless Steel Finish: AISI No. 4 polished finish. Furnish with paper masking (for use in all public areas).

2.8 STEEL FINISHES

- A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with **[SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning"] [or] [SSPC-SP 8, "Pickling"] <Insert surface preparation method>.** **[After cleaning, apply a conversion coating suited to the organic coating to be applied over it.]**
- B. Factory Prime Finish: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
- C. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of **2 mils (0.05 mm)**.
 - 1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>.**

2.9 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 3. Directional Satin Finish: No. 4.
 - 4. Dull Satin Finish: No. 6.
 - 5. Reflective, Directional Polish: No. 7.

- 6. Mirrorlike Reflective, Nondirectional Polish: No. 8.
- C. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store cabinets, extinguishers and other equipment in shipping containers, with labeling in place, under provisions of Division 01.

3.2 EXAMINATION

- A. Examine roughing-in for hose **[valves]** **[racks]** and cabinets to verify actual locations of piping connections before cabinet installation.
- B. Examine walls and partitions for suitable framing depth and blocking where **[recessed]** **[semirecessed]** **[recessed and semirecessed]** cabinets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

- A. Prepare recesses for **[recessed]** **[and]** **[semirecessed]** fire protection cabinets as required by type and size of cabinet and trim style.

3.4 INSTALLATION

- A. General: Install fire protection cabinets in locations and at mounting heights indicated **[or, if not indicated, at heights indicated below:]** **[or, if not indicated, at heights acceptable to authorities having jurisdiction.]**

- 1. Fire Protection Cabinets: **[54 inches (1372 mm)]** **<Insert dimension>** above finished floor to top of cabinet.

- B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

- 1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire protection cabinets.
- 2. Provide inside latch and lock for break-glass panels.
- 3. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.
- 4. Fire-Rated, **[Hose and Valve]** **[Hose-Valve]** Cabinets:

- a. Install cabinet with not more than **1/16-inch (1.6-mm)** tolerance between

- pipe OD and knockout OD. Center pipe within knockout.
- b. Seal through penetrations with firestopping sealant as specified in Section 078413 "Penetration Firestopping."

- C. Identification: Apply **[decals]** **[vinyl lettering]** at locations indicated.

3.5 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.
- E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes portable, [**hand-carried**] [**wheeled**] fire extinguishers[**and mounting brackets for fire extinguishers**].
- B. Owner-Furnished Material: [**Hand-carried**] [**Wheeled**] fire extinguishers.
- C. Related Sections:
 - 1. Section 104413 "Fire Valve and Extinguisher Cabinets."
 - 2. Section 211100 "Facility Fire-Suppression Water-Service Piping" for hose systems, racks, and valves.
 - 3. Section 233813 "Commercial-Kitchen Hoods" for fire extinguishing systems provided as part of commercial-kitchen exhaust hoods.
- D. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher[**and mounting brackets**].
 - 1. Include data substantiating that materials comply with requirements.
- B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function.[**Use same designations indicated on Drawings.**]

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide fire extinguishers approved, listed, and labeled by FMG.
- C. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>**.
 - 1. Review methods and procedures related to fire extinguishers including, but not limited to, the following:
 - a. Schedules and coordination requirements.

1.7 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Minimum **[six (6)] <Insert number>** years from date of Substantial Completion.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each [**fire protection cabinet**] [**mounting bracket**] [**fire protection cabinet and mounting bracket**] indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amerex Corporation.
 - b. Ansul Incorporated; Tyco International Ltd.
 - c. Badger Fire Protection; a Kidde company.
 - d. Buckeye Fire Equipment Company.
 - e. Fire End & Croker Corporation.
 - f. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - g. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
 - h. Larsen's Manufacturing Company.
 - i. Moon-American.
 - j. Pem All Fire Extinguisher Corp.; a division of PEM Systems, Inc.
 - k. Potter Roemer LLC.
 - l. Pyro-Chem; Tyco Safety Products.
 - m. **<Insert manufacturer's name>**.
 - n. or approved equal.
 2. Valves: Manufacturer's standard
 3. Handles and Levers: Manufacturer's standard.
 4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B[**and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging**].
- B. Stored-Pressure Water Type **<Insert drawing designation>**: UL-rated 2-A, **2.5-gal.** (9.5-L) nominal capacity, with water in stainless-steel container; with pressure-indicating gage.
- C. Stored-Pressure Antifreeze Water Type **<Insert drawing designation>**: UL-rated 2-A, **2.5-gal.** (9.5-L) nominal capacity, with water and approved antifreeze solution mixed for temperatures as low as **minus 40 deg F** (minus 40 deg C) in stainless-steel container; with pressure-indicating gage.
- D. Stored-Pressure Water-Mist Type **<Insert drawing designation>**: UL-rated 2-A:C, **2.5-gal.** (9.5-L) nominal capacity, with water in enameled-steel container; with pressure-indicating gage.
- E. Pressurized, AFFF-Foam Type **<Insert drawing designation>**: UL-rated [**2-A:10-B, 1.6-gal.** (6-L)] [**3-A:20-B, 2.5-gal.** (9.5-L)] nominal capacity, with AFFF foam in stainless-steel container; with pressure-indicating gage.

- F. Pressurized, FFFP-Foam Type <Insert drawing designation>: UL-rated 3-A:20-B, 2.5-gal. (9.5-L) nominal capacity, with FFFP foam in stainless-steel container; with pressure-indicating gage.
- G. Wet-Chemical Type <Insert drawing designation>: UL-rated 2-A:1-B:C:K, [1.6-gal. (6-L)] [2.5-gal. (9.5-L)] nominal capacity, with potassium [acetate] [citrate] [carbonate]-based chemical in stainless-steel container; with pressure-indicating gage.
- H. Regular Dry-Chemical Type <Insert drawing designation>: UL-rated <Insert capacity> nominal capacity, with sodium bicarbonate-based dry chemical in manufacturer's standard enameled container.
- I. Regular Dry-Chemical Type in Steel Container <Insert drawing designation>: UL-rated [2-B:C, 1-lb (0.4-kg)] [10-B:C, 2.5-lb (1.1-kg)] [10-B:C, 5-lb (2.3-kg)] [40-B:C, 5.5-lb (2.5-kg)] [40-B:C, 6-lb (2.7-kg)] [60-B:C, 10-lb (4.5-kg)] [120-B:C, 20-lb (9.1-kg)] nominal capacity, with sodium bicarbonate-based dry chemical in enameled-steel container.
- J. Regular Dry-Chemical Type in Aluminum Container <Insert drawing designation>: UL-rated [2-B:C, 1-lb (0.4-kg)] [10-B:C, 2.5-lb (1.1-kg)] [10-B:C, 5-lb (2.3-kg)] [40-B:C, 5.5-lb (2.5-kg)] [60-B:C, 10-lb (4.5-kg)] [120-B:C, 20-lb (9.1-kg)] nominal capacity, with sodium bicarbonate-based dry chemical in enameled-aluminum container.
- K. Regular Dry-Chemical Type in Brass Container <Insert drawing designation>: UL-rated [40-B:C, 6-lb (2.7-kg)] [60-B:C, 10-lb (4.5-kg)] [120-B:C, 20-lb (9.1-kg)] nominal capacity, with sodium bicarbonate-based dry chemical in chrome-plated brass container.
- L. Multipurpose Dry-Chemical Type in Steel Container <Insert drawing designation>: UL-rated [1-A:10-B:C, 2.5-lb (1.1-kg)] [2-A:10-B:C, 5-lb (2.3-kg)] [3-A:40-B:C, 5-lb (2.3-kg)] [3-A:40-B:C, 6-lb (2.7-kg)] [4-A:60-B:C, 10-lb (4.5-kg)] [20-A:120-B:C, 20-lb (9.1-kg)] nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.
- M. Multipurpose Dry-Chemical Type in Aluminum Container <Insert drawing designation>: UL-rated [1-A:10-B:C, 2.5-lb (1.1-kg)] [2-A:10-B:C, 5-lb (2.3-kg)] [3-A:40-B:C, 5-lb (2.3-kg)] [3-A:40-B:C, 6-lb (2.7-kg)] [4-A:60-B:C, 10-lb (4.5-kg)] [20-A:120-B:C, 20-lb (9.1-kg)] nominal capacity, with monoammonium phosphate-based dry chemical in enameled-aluminum container.
- N. Multipurpose Dry-Chemical Type in Brass Container <Insert drawing designation>: UL-rated [2-A:10-B:C, 5-lb (2.3-kg)] [3-A:40-B:C, 6-lb (2.7-kg)] [4-A:60-B:C, 10-lb (4.5-kg)] [4-A:80-B:C, 10-lb (4.5-kg)] [20-A:120-B:C, 20-lb (9.1-kg)] nominal capacity, with monoammonium phosphate-based dry chemical in chrome-plated brass container.
- O. Purple-K Dry-Chemical Type in Aluminum Container <Insert drawing designation>: UL-rated [10-B:C, 2.5-lb (1.1-kg)] [30-B:C, 5-lb (2.3-kg)] [120-B:C, 20-lb (9.1-kg)]

nominal capacity, with potassium bicarbonate-based dry chemical in enameled-aluminum container.

- P. Purple-K Dry-Chemical Type in Brass Container <Insert drawing designation>: UL-rated [80-B:C, 10-lb (4.5-kg)] [120-B:C, 20-lb (9.1-kg)] nominal capacity, with potassium bicarbonate-based dry chemical in chrome-plated brass container.
- Q. Carbon Dioxide Type <Insert drawing designation>: Used for all electrical and mechanical rooms. Minimum of one for each room located per NFPA 10 and applicable codes.
1. 5 pound capacity, 5BC UL rating.
 2. UL-rated [5-B:C, 5-lb (2.3-kg)] [10-B:C, 10-lb (4.5-kg)] [10-B:C, 15-lb (6.8-kg)] [10-B:C, 20-lb (9.1-kg)] nominal capacity, with carbon dioxide in [manufacturer's standard enameled-metal] [enameled-steel] [enameled-aluminum] container.
- R. Dry-Powder Type <Insert drawing designation>: [FMG-approved,]UL-rated Class D, 30-lb (13.6-kg) nominal capacity, with [sodium chloride] [copper]-based powder in enameled-steel container; with pressure-indicating gage.
- S. Halon Type <Insert drawing designation>: UL-rated [5-B:C, 2.5-lb (1.1-kg)] [10-B:C, 5-lb (2.3-kg)] nominal capacity, in enameled-steel container; with pressure-indicating gage.
- T. Clean-Agent Type in Aluminum Container <Insert drawing designation>: UL-rated [1-B:C, 1.4-lb (0.6-kg)] [2-B:C, 2.5-lb (1.1-kg)] [5-B:C, 5-lb (2.3-kg)] nominal capacity, with HCFC Blend B agent and inert material in enameled-aluminum container; with pressure-indicating gage.
- U. Clean-Agent Type in Brass Container <Insert drawing designation>: UL-rated [1-A:10-B:C, 11-lb (5-kg)] [2-A:10-B:C, 15.5-lb (7-kg)] nominal capacity, with HCFC Blend B agent and inert material in chrome-plated brass container; with pressure-indicating gage.
- V. Clean-Agent Type in Steel Container <Insert drawing designation>: UL-rated [5-B:C, 4.75-lb (2.2-kg)] [1-A:10-B:C, 10-lb (4.5-kg)] [2-A:10-B:C, 14-lb (6.4-kg)] nominal capacity, with HFC blend agent and inert material in enameled-steel container; with pressure-indicating gage.

2.2 MOUNTING BRACKETS <Insert drawing designation>

- A. Mounting Brackets: Manufacturer's standard[galvanized] steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or [red] [black] baked-enamel finish.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amerex Corporation.
 - b. Ansul Incorporated; Tyco International Ltd.

- c. Badger Fire Protection; a Kidde company.
- d. Buckeye Fire Equipment Company.
- e. Fire End & Croker Corporation.
- f. J. L. Industries, Inc.; a division of Activar Construction Products Group.
- g. Larsen's Manufacturing Company.
- h. Potter Roemer LLC.
- i. **<Insert manufacturer's name>**.
- j. or approved equal.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by DEN Project Manager.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

- a. Orientation: [**Vertical**] [**Horizontal**].

2.3 WHEELED FIRE EXTINGUISHERS **<Insert drawing designation>**

A. Wheeled Fire Extinguishers: Type, size, and capacity for locations indicated, complete with carriage.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Amerex Corporation.
- b. Ansul Incorporated; Tyco International Ltd.
- c. Badger Fire Protection; a Kidde company.
- d. Buckeye Fire Equipment Company.
- e. Fire End & Croker Corporation.
- f. Modern Metal Products; Division of Technico Inc.
- g. Moon-American.
- h. Pyro-Chem; Tyco Safety Products.
- i. **<Insert manufacturer's name>**.
- j. or approved equal.

2. Carriage: Fabricated from enameled-steel pipe, complete with hanger assembly, long-range nozzle, hose, and [**semipneumatic solid-rubber tires**] [**wide-rim wheels**].

- a. Hose: [**15 feet** (4.6 m)] [**50 feet** (15.2 m)] [**100 feet** (30.5 m)].

B. Pressurized, FFFP-Foam Type: UL-rated 20-A:160-B, **33-gal.** (125-L) nominal capacity, with FFFP foam in stainless-steel container.

C. Regular Dry-Chemical Type: UL-rated [**160-B:C, 50-lb** (23-kg)] [**240-B:C, 150-lb** (68-kg)] [**160-B:C, 250-lb** (113-kg)] nominal capacity, with sodium bicarbonate-based dry chemical in [**regulated**] [**stored**] [**direct**]-pressure, enameled-steel container.

- D. Multipurpose Dry-Chemical Type: UL-rated [20-A:160-B:C, 30-lb (13.6-kg)] [30-A:160-B:C, 50-lb (23-kg)] [40-A:240-B:C, 125-lb (57-kg)] [40-A:160-B:C, 250-lb (113-kg)] nominal capacity, with monoammonium phosphate-based dry chemical in [regulated] [stored] [direct]-pressure, enameled-[steel] [aluminum] [steel or -aluminum] container.
- E. Carbon Dioxide Type: UL-rated [20-B:C, 50-lb (23-kg)] [20-B:C, 100-lb (45-kg)] nominal capacity, with carbon dioxide in [manufacturer's standard enameled-metal] [enameled-steel] [enameled-aluminum] container.
- F. Dry-Powder Type: [FMG-approved,]UL-rated Class D, [sodium chloride-based powder, 150-lb (68-kg)] [copper-based powder, 250-lb (113-kg)] nominal capacity, in regulated-pressure, enameled-steel container; with pressure-indicating gage.
- G. Clean-Agent Type: UL-rated [4-A:40-B:C, 65-lb (29-kg)] [10-A:80-B:C, 150-lb (68-kg)] nominal capacity, with HCFC Blend B agent and inert material in stored-pressure, enameled-steel container; with pressure-indicating gage.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers[and mounting brackets] in locations indicated and in compliance with requirements of authorities having jurisdiction.
 - 1. Mounting Brackets: [54 inches (1372 mm)] <Insert dimension> above finished floor to top of fire extinguisher.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 104416

SECTION 105113 - METAL LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Standard metal lockers.
 - 2. Heavy-duty metal lockers.
 - 3. Athletic metal lockers.
 - 4. Open-front athletic metal lockers.
 - 5. Coin-operated metal lockers.
 - 6. Locker benches.
- B. Related Section:
 - 1. Section 105116 "Wood Lockers" for wood-faced and plastic-laminate-faced lockers.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker[**and bench**].
 - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For metal lockers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locker trim and accessories.
 - 2. Include locker identification system and numbering sequence.
- C. Samples for Initial Selection: For units with factory-applied color finishes.

- D. Samples for Verification: For **[metal lockers]** **[and]** **[locker benches]**, in manufacturer's standard sizes.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Full-size units of the following metal locker hardware items equal to **[10]** **<Insert number>** percent of amount installed for each type and finish installed, but no fewer than **[five (5)]** **<Insert number>** units:
 - a. Locks.
 - b. Identification plates.
 - c. Hooks.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain metal lockers^[, **locker benches,**] and accessories from single source from single manufacturer.
- C. Regulatory Requirements: Where metal lockers^{[**and benches]**} are indicated to comply with accessibility requirements, comply with **[the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities"]** **[and]** **[ICC/ANSI A117.1]**.
- D. Preinstallation Conference: Conduct conference at **[Project site]** **[location and time as determined by DEN Project Manager]****<Insert location>**.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.
- B. Deliver [**master and control keys**] [**combination control charts**] to Owner by registered mail or overnight package service[.], **addressed as follows:**
 - 1. **<Insert name and address of Owner's representative>**.

1.9 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.10 COORDINATION

- A. Coordinate sizes and locations of [**concrete**] [**concrete masonry**] [**wood**] bases for metal lockers.
- B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Faulty operation of latches and other door hardware.
 - 2. Damage from deliberate destruction and vandalism is excluded.
 - 3. Warranty Period for Knocked-Down Metal Lockers: Minimum [**two (2)**] **<Insert number>** years from date of Substantial Completion.
 - 4. Warranty Period for All-Welded Metal Lockers: [**Lifetime**] [**Minimum ten (10) years**] **<Insert years>** from date of Substantial Completion.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with **A60** (ZF180) zinc-iron, alloy (galvannealed) coating designation.
- C. Expanded Metal: ASTM F 1267, Type II (flattened), Class I, **3/4-inch** (19-mm) steel mesh, with at least 70 percent open area.
- D. Stainless-Steel Sheet: ASTM A 666, Type 304.
- E. Plastic Laminate: NEMA LD 3, Grade HGP.
- F. Extruded Aluminum: **ASTM B 221** (ASTM B 221M), alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated.
- G. Steel Tube: ASTM A 500, cold rolled.
- H. Particleboard: ANSI A208.1, Grade M-2.
- I. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.
- J. Anchors: Material, type, and size required for secure anchorage to each substrate.
 - 1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls[, **and elsewhere as indicated,**] for corrosion resistance.
 - 2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.2 STANDARD METAL LOCKERS

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Art Metal Products; [**Artisan Silent**] [**Magnum Student K.D. Corridor**] [**Standard K.D.**] [**Standard Quiet**] [**Quiet II**] Lockers.
 - 2. ASI Storage Solutions Inc.; Traditional Collection.
 - 3. DeBourgh Mfg. Co.; Worley Lockers.
 - 4. General Storage Systems Ltd.; Decor Tri-Lok [**Corona**] [**Eclipse**] [**Eclipse II**] [**Smart Line**] [**Titan**] [**Titan II**].
 - 5. Hadrian Manufacturing Inc.; Emperor Lockers.
 - 6. List Industries Inc.; [**Classic Line of Superior KD**] [**Marquis Student Quiet KD**] [**Standard Quiet KD**] [**Whisper Quiet KD**] Lockers.
 - 7. Lyon Workspace Products, LLC; Standard Lockers.
 - 8. Penco Products, Inc.; [**Guardian**] [**Vanguard**] Lockers.

9. Republic Storage Systems Company; **[Designer] [Quiet] [Single Point] [Standard]** Lockers.
 10. Shanahan's Manufacturing Limited; Deluxe Series Lockers.
 11. Tensco Corp.; Tensco Lockers.
 12. **<Insert manufacturer's name; product name or designation>**.
 13. or approved equal.
- B. Locker Arrangement: **[Single tier] [Double tier] [Triple tier] [Box] [Two person] [Duplex] [16 person] [As indicated on Drawings] <Insert configuration>**.
- C. Material: **[Cold-rolled] [Metallic-coated]** steel sheet.
- D. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet as follows:
1. Tops, Bottoms, and Intermediate Dividers: **0.024-inch** (0.61-mm) nominal thickness, with single bend at sides.
 2. Backs and Sides: **0.024-inch** (0.61-mm) nominal thickness, with full-height, double-flanged connections.
 3. Shelves: **0.024-inch** (0.61-mm) nominal thickness, with double bend at front and single bend at sides and back.
- E. Frames: Channel formed; fabricated from **0.060-inch** (1.52-mm) nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.
1. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
 2. Frame Vents: Fabricate face frames with vents.
- F. Doors: One piece; fabricated from **0.060-inch** (1.52-mm) nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.
1. Doors less than **12 inches** (305 mm) wide may be fabricated from **0.048-inch** (1.21-mm) nominal-thickness steel sheet.
 2. Doors for box lockers less than **15 inches** (381 mm) wide may be fabricated from **0.048-inch** (1.21-mm) nominal-thickness steel sheet.
 3. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than **15 inches** (381 mm) wide; welded to inner face of doors.
 4. Stiffeners: Manufacturer's standard full-height stiffener fabricated from **0.048-inch** (1.21-mm) nominal-thickness steel sheet; welded to inner face of doors.
 5. Sound-Dampening Panels: Manufacturer's standard, designed to stiffen doors and reduce sound levels when doors are closed, of die-formed metal with full perimeter flange and sound-dampening material; welded to inner face of doors.
 6. Door Style: **[Unperforated panel.] [Vented panel as follows:]**

- a. Louvered Vents: No fewer than **[six louver openings at top and bottom for single-tier] [three louver openings at top and bottom for double-tier] [two louver openings at top and bottom, or three louver openings at top or bottom, for triple-tier]** <Insert configuration> lockers.
 - b. Security Vents: Manufacturer's standard, stamped horizontal or vertical.
 - c. Perforated Vents: **[Manufacturer's standard shape and configuration]** <Insert shape and configuration>.
 - d. Concealed Vents: Slotted perforations in top and bottom horizontal return flanges of doors.
- G. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees[; **self-closing**].
1. Knuckle Hinges: Steel, full loop, five or seven knuckles, tight pin; minimum **2 inches** (51 mm) high. Provide no fewer than three hinges for each door more than **42 inches** (1067 mm) high.
 2. Continuous Hinges: Manufacturer's standard, steel, full height.
- H. Projecting Door Handle and Latch: Finger-lift latch control designed for use with either built-in combination locks or padlocks; positive automatic latching, chromium plated; pry and vandal resistant.
1. Latch Hooks: Equip **[doors 48 inches** (1219 mm) **and higher with three latch hooks]** **[and] [doors less than 48 inches** (1219 mm) **high with two latch hooks]**; fabricated from **0.105-inch** (2.66-mm) nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.
 2. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
- I. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry and vandal resistant.
1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in key locks, or padlocks; positive automatic latching and prelocking.
 - a. Latch Hooks: Equip **[doors 48 inches** (1219 mm) **and higher with three latch hooks]** **[and] [doors less than 48 inches** (1219 mm) **high with two latch hooks]**; fabricated from **0.105-inch** (2.66-mm) nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.
 - b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated[**with vinyl or nylon**] to prevent metal-to-metal contact, and incorporating a prelocking device that

allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.

2. Single-Point Latching: Nonmoving latch hook **[designed to engage bolt of built-in combination or cylinder lock] [with steel padlock loop that projects through recessed cup and is finished to match metal locker body]**.
 - a. Latch Hook: Equip each door with one latch hook, fabricated from **0.105-inch** (2.66-mm) nominal-thickness steel sheet; welded midway up full-height door strike; with resilient silencer.
- J. Door Handle and Latch for **[Box] [16-Person]** Lockers: Stainless-steel strike plate with integral pull; with steel padlock loop that projects through metal locker door.
- K. Combination Padlocks: **[Key-controlled, three-number dialing combination locks; capable of five combination changes] [Provided by Owner]**.
- L. Built-in Combination Locks: Key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key.
 1. Bolt Operation: **[Manually locking deadbolt] [or] [automatically locking spring bolt]**.
- M. Cylinder Locks: Built-in, flush, cam locks with five-pin tumbler keyway, keyed separately and master keyed. Furnish two change keys for each lock and **[two] <Insert number>** master keys.
 1. Key Type: **[Flat] [Grooved]**, with minimum **2- by 2.68-inch** (51- by 68.3-mm) **key head for accessible lockers]**.
 2. Bolt Operation: **[Manually locking deadbolt] [or] [automatically locking spring bolt]**.
- N. Equipment: Equip each metal locker with identification plate and the following unless otherwise indicated:
 1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
 2. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
 3. **[Triple-Tier] [Box]** Units: One double-prong ceiling hook.
 4. Coat Rods: As indicated on Drawings.
 5. Coat Rods: For each compartment of **[single-tier] [double-tier] [and] [triple-tier]** metal lockers.
 6. Coat Rods: In lieu of ceiling hook for metal lockers **24 inches** (610 mm) high or more.
 7. Coat Rods: In lieu of ceiling hook for metal lockers **18 inches** (457 mm) deep or more.
- O. Accessories:

1. Legs: **6 inches** (152 mm) high; formed by extending vertical frame members, or fabricated from **0.075-inch** (1.90-mm) nominal-thickness steel sheet; welded to bottom of locker.
 - a. Closed Front and End Bases: Fabricated from **0.036-inch** (0.91-mm) nominal-thickness steel sheet.
 2. Continuous Zee Base: Fabricated from [**0.060-inch** (1.52-mm)] [**0.075-inch** (1.90-mm)] [**manufacturer's standard thickness, but not less than 0.060-inch** (1.52-mm)] nominal-thickness steel sheet.
 - a. Height: [**4 inches** (102 mm)] **<Insert dimension>**.
 3. Continuous Sloping Tops: Fabricated from [**0.036-inch** (0.91-mm)] [**0.048-inch** (1.21-mm)] [**manufacturer's standard thickness, but not less than 0.036-inch** (0.91-mm)] nominal-thickness steel sheet.
 - a. Closures: [**Vertical**] [**Hipped**]-end type.
 - b. Sloping-top corner fillers, mitered.
 4. Individual Sloping Tops: Fabricated from **0.024-inch** (0.61-mm) nominal-thickness steel sheet.
 5. Recess Trim: Fabricated from **0.048-inch** (1.21-mm) nominal-thickness steel sheet.
 6. Filler Panels: Fabricated from [**0.036-inch** (0.91-mm)] [**0.048-inch** (1.21-mm)] [**manufacturer's standard thickness, but not less than 0.036-inch** (0.91-mm)] nominal-thickness steel sheet.
 7. Boxed End Panels: Fabricated from **0.060-inch** (1.52-mm) nominal-thickness steel sheet.
 8. Finished End Panels: Fabricated from **0.024-inch** (0.61-mm) nominal-thickness steel sheet.
 9. Center Dividers: Fabricated from **0.024-inch** (0.61-mm) nominal-thickness steel sheet.
- P. Finish: [**Baked enamel**] [**or**] [**powder coat**].
1. Color(s): [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] [**Two colors, with door one color and frame and body another color; as selected by DEN Project Manager from manufacturer's full range**].

2.3 HEAVY-DUTY METAL LOCKERS

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Art Metal Products; [**Bulldog**] [**Champ**] Corridor Lockers.
 2. DeBourgh Mfg. Co.; Sentry Corridor/Personnel Lockers.
 3. List Industries Inc.; Marquis Protector.

4. Lyon Workspace Products, LLC; **[All-Welded] [Integrated Frame]** Lockers.
 5. Penco Products, Inc.; **[All-Welded] [All-Welded Defiant SPL]** Lockers.
 6. **<Insert manufacturer's name; product name or designation>**.
 7. or approved equal.
- B. Locker Arrangement: **[Single tier] [Double tier] [Triple tier] [As indicated on Drawings]** **<Insert configuration>**.
- C. Material: Cold-rolled steel sheet.
- D. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
1. Tops, Bottoms, and Sides: **0.060-inch** (1.52-mm) nominal thickness.
 2. Backs: **0.048-inch** (1.21-mm) nominal thickness.
 3. Shelves: **0.060-inch** (1.52-mm) nominal thickness, with double bend at front and single bend at sides and back.
- E. Frames: Channel formed; fabricated from **0.060-inch** (1.52-mm) nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.
1. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
- F. Doors: One piece; fabricated from **0.075-inch** (1.90-mm) nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.
1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than **15 inches** (381 mm) wide; welded to inner face of doors.
 2. Door Style:
 - a. Louvered Vents: No fewer than **[six louver openings at top and bottom for single-tier] [three louver openings at top and bottom for double-tier] [two louver openings at top and bottom, or three louver openings at top or bottom, for triple-tier]** **<Insert configuration>** lockers.
 - b. Security Vents: Manufacturer's standard, stamped horizontal or vertical.
 - c. Perforated Vents: **[Manufacturer's standard shape and configuration]** **<Insert shape and configuration>**.
- G. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees[; **self-closing**].

1. Knuckle Hinges: Steel, full loop, five or seven knuckles, tight pin; minimum **2 inches** (51 mm) high. Provide no fewer than three hinges for each door more than **42 inches** (1067 mm) high.
 2. Continuous Hinges: Manufacturer's standard, steel, full height.
- H. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry and vandal resistant.
1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks or padlocks; positive automatic latching and prelocking.
 - a. Latch Hooks: Equip [**doors 48 inches** (1219 mm) **and higher with three latch hooks**] [**and**] [**doors less than 48 inches** (1219 mm) **high with two latch hooks**]; fabricated from **0.120-inch** (3.04-mm) nominal-thickness steel sheet; welded to full-height door strikes; with resilient silencer on each latch hook.
 - b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
 2. Single-Point Latching: Nonmoving latch hook [**designed to engage bolt of built-in combination or cylinder lock**] [**with steel padlock loop that projects through recessed cup and is finished to match metal locker body**].
 - a. Latch Hook: Equip each door with one latch hook, fabricated from **0.120-inch** (3.04-mm) nominal-thickness steel sheet; welded midway up full-height door strike; with resilient silencer.
- I. Combination Padlocks: [**Key-controlled, three-number dialing combination locks; capable of five combination changes**] [**Provided by Owner**].
- J. Built-in Combination Locks: Key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key.
1. Bolt Operation: [**Manually locking deadbolt**] [**or**] [**automatically locking spring bolt**].
- K. Equipment: Equip each metal locker with identification plate and the following unless otherwise indicated:
1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
 2. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
 3. Triple-Tier Units: One double-prong ceiling hook.
 4. Coat Rods: As indicated on Drawings.
 5. Coat Rods: For each compartment of [**single-tier**] [**double-tier**] [**and**] [**triple-tier**] metal lockers.

6. Coat Rods: In lieu of ceiling hook for metal lockers **24 inches** (610 mm) high or more.
7. Coat Rods: In lieu of ceiling hook for metal lockers **18 inches** (457 mm) deep or more.

L. Accessories:

1. Legs: **6 inches** (152 mm) high; formed by extending vertical frame members, or fabricated from **0.075-inch** (1.90-mm) nominal-thickness steel sheet; welded to bottom of locker.
 - a. Closed Front and End Bases: Fabricated from **0.036-inch** (0.91-mm) nominal-thickness steel sheet.
2. Continuous Zee Base: Fabricated from, [**0.060-inch** (1.52-mm)] [**0.075-inch** (1.90-mm)] [**manufacturer's standard thickness, but not less than 0.060-inch** (1.52-mm)] nominal-thickness steel sheet.
 - a. Height: [**4 inches** (102 mm)] **<Insert dimension>**.
3. Continuous Sloping Tops: Fabricated from **0.048-inch** (1.21-mm) nominal-thickness steel sheet, with a pitch of approximately 20 degrees.
 - a. Closures: [**Vertical**] [**Hipped**]-end type.
4. Recess Trim: Fabricated from **0.048-inch** (1.21-mm) nominal-thickness steel sheet.
5. Filler Panels: Fabricated from **0.048-inch** (1.21-mm) nominal-thickness steel sheet.
6. Boxed End Panels: Fabricated from **0.048-inch** (1.21-mm) nominal-thickness steel sheet.

M. Finish: [**Baked enamel**] [**or**] [**powder coat**].

1. Color(s): [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] [**Two colors, with door one color and frame and body another color; as selected by DEN Project Manager from manufacturer's full range**].

2.4 ATHLETIC METAL LOCKERS

A. Products: Subject to compliance with requirements, provide one of the following:

1. All-Welded, Athletic Metal Lockers:
 - a. Art Metal Products; [**Box**] [**Bulldog Athletic**] [**Champ Athletic**] [**Turn-Handle Athletic**] Lockers.
 - b. DeBourgh Mfg. Co.; [**P.E.**] [**Physical Education**] [**Sentry**] [**Sophomore**] [**Varsity**] Lockers.

- c. List Industries Inc.; **[Gym Class] [Gym Class II] [Intramural] [Jr. Varsity] [Marquis Champion] [Varsity]** Lockers.
 - d. Lyon Workspace Products, LLC; **[All-Welded Expanded Metal] [Integrated Frame All-Welded]** Lockers.
 - e. Penco Products, Inc.; All-Welded Lockers.
 - f. Republic Storage Systems Company; All-Welded Ventilated Lockers.
 - g. **<Insert manufacturer's name; product name or designation>**.
 - h. or approved equal.
2. Knocked-Down, Athletic Metal Lockers:
- a. Art Metal Products; HDV Lockers.
 - b. ASI Storage Solutions Inc.; Competitor Collection.
 - c. General Storage Systems Ltd.; **[Heavy-Duty] [Mod-U-Vent] [Mod-U-Vent II]** Ventilated Locker.
 - d. Hadrian Manufacturing Inc.; Gladiator Lockers.
 - e. List Industries Inc.; HDV Lockers.
 - f. Lyon Workspace Products, LLC; Expanded Metal Lockers.
 - g. Penco Products, Inc.; Invincible II Lockers.
 - h. Republic Storage Systems Company; Heavy Duty Ventilated Lockers.
 - i. Shanahan's Manufacturing Limited; Pinnacle Lockers.
 - j. **<Insert manufacturer's name; product name or designation>**.
 - k. or approved equal.
- B. Locker Arrangement: **[Single tier] [Double tier] [Triple tier] [Box] [As indicated on Drawings]** **<Insert configuration>**.
- C. Material: **[Cold-rolled] [Metallic-coated]** steel sheet.
- D. Body: Assembled by **[welding] [or] [riveting or bolting]** body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
1. Tops and Bottoms: **0.060-inch** (1.52-mm) nominal thickness, with single bend at edges.
 2. Backs: **0.048-inch** (1.21-mm) nominal thickness.
 3. Shelves: **0.060-inch** (1.52-mm) nominal thickness, with double bend at front and single bend at sides and back.
- E. Unperforated Sides: Fabricated from **[0.048-inch (1.21-mm)] [0.060-inch (1.52-mm)]** nominal-thickness steel sheet.
- F. Perforated Sides: Fabricated from **0.060-inch** (1.52-mm) nominal-thickness steel sheet with manufacturer's standard diamond perforations.
- G. Expanded-Metal Sides: Fabricated from **0.090-inch** (2.28-mm) nominal-thickness expanded metal; welded to **0.105-inch** (2.66-mm) nominal-thickness steel angles or **0.060-inch** (1.52-mm) nominal-thickness steel channel frames.
- H. Frames: Channel formed; fabricated from **0.060-inch** (1.52-mm) nominal-thickness steel sheet or **0.097-inch** (2.45-mm) nominal-thickness steel angles; lapped and factory

welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.

1. Cross Frames for **[Double-Tier] [Triple-Tier]** Lockers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
- I. Reinforced Bottoms: Structural channels, formed from **[0.060-inch (1.52-mm)] [0.075-inch (1.90-mm)]** nominal-thickness steel sheet; welded to front and rear of side-panel frames.
- J. Perforated Doors: One piece; fabricated from **0.075-inch (1.90-mm)** nominal-thickness steel sheet with manufacturer's standard diamond perforations; formed into channel shape with double bend at **[vertical edges and with right-angle single bend at horizontal edges] [and] [latch point (bottom) and right-angle single bend at remaining edges for box lockers]**.
 1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than **15 inches (381 mm)** wide; welded to inner face of doors.
- K. Expanded-Metal Doors: Fabricated from **0.090-inch (2.28-mm)** nominal-thickness expanded metal; welded to **0.105-inch (2.66-mm)** nominal-thickness steel angle frame; with **0.090-inch (2.28-mm)** nominal-thickness, steel sheet lock panel backed by **0.060-inch (1.52-mm)** nominal-thickness steel sheet retainer welded to door frame.
- L. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees; **self-closing**.
 1. Knuckle Hinges: Steel, full loop, five or seven knuckles, tight pin; minimum **2 inches (51 mm)** high. Provide no fewer than three hinges for each door more than **42 inches (1067 mm)** high.
 2. Continuous Hinges: Manufacturer's standard, steel; side or top mounted as required by locker configuration.
 3. Hinges: Manufacturer's standard, steel continuous or knuckle type.
- M. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry and vandal resistant.
 1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in cylinder locks, or padlocks; positive automatic latching and prelocking.
 - a. Latch Hooks: Equip **[doors 48 inches (1219 mm) and higher with three latch hooks] [and] [doors less than 48 inches (1219 mm) high with two latch hooks]**; fabricated from **0.120-inch (3.04-mm)** nominal-thickness steel sheet; welded to full-height door strikes; with resilient silencer on each latch hook.
 - b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal

contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.

2. Single-Point Latching: Nonmoving latch hook [**designed to engage bolt of built-in combination or cylinder lock**] [**with steel padlock loop that projects through recessed cup and is finished to match metal locker body**].
 - a. Latch Hook: Equip each door with one latch hook, fabricated from **0.120-inch (3.04-mm)** nominal-thickness steel sheet; welded midway up full-height door strike; with resilient silencer.
- N. Projecting Turn-Handle and Latch: Steel handle welded to manufacturer's standard, three-point, cremone-type latching mechanism consisting of steel rods or bars that engage main locker frame at top and bottom of door, and center latch that engages strike jamb; with steel padlock loop.
- O. Door Handle and Latch for Box Lockers: Stainless-steel strike plate with integral pull; with steel padlock loop that projects through metal locker door.
- P. Combination Padlocks: [**Key-controlled, three-number dialing combination locks; capable of five combination changes**] [**Provided by Owner**].
- Q. Built-in Combination Locks: Key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key.
 1. Bolt Operation: [**Manually locking deadbolt**] [**or**] [**automatically locking spring bolt**].
- R. Cylinder Locks: Built-in, flush, cam locks with five-pin tumbler keyway, keyed separately and master keyed. Furnish two change keys for each lock and [**two**] <Insert number> master keys.
 1. Key Type: [**Flat**] [**Grooved**], [**with minimum 2- by 2.68-inch (51- by 68.3-mm) key head for accessible lockers**].
 2. Bolt Operation: [**Manually locking deadbolt**] [**or**] [**automatically locking spring bolt**].
- S. Equipment: Equip each metal locker with identification plate and the following unless otherwise indicated:
 1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
 2. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
 3. Triple-Tier Units: One double-prong ceiling hook.
 4. Coat Rods: As indicated on Drawings.
 5. Coat Rods: For each compartment of [**single-tier**] [**double-tier**] [**and**] [**triple-tier**] metal lockers.

6. Coat Rods: In lieu of ceiling hook for metal lockers **24 inches** (610 mm) high or more.
7. Coat Rods: In lieu of ceiling hook for metal lockers **18 inches** (457 mm) deep or more.

T. Accessories:

1. Legs: **6 inches** (152 mm) high; formed by extending vertical frame members, or fabricated from **0.075-inch** (1.90-mm) nominal-thickness steel sheet; welded to bottom of locker.
 - a. Closed Front and End Bases: Fabricated from **0.048-inch** (1.21-mm) nominal-thickness steel sheet.
2. Continuous Zee Base: **4 inches** (102 mm) high; fabricated from **0.075-inch** (1.90-mm) nominal-thickness steel sheet.
3. Continuous Sloping Tops: Fabricated from **0.048-inch** (1.21-mm) nominal-thickness steel sheet, with a pitch of approximately 20 degrees.
 - a. Closures: **[Vertical] [Hipped]**-end type.
4. Recess Trim: Fabricated from **0.048-inch** (1.21-mm) nominal-thickness steel sheet.
5. Filler Panels: Fabricated from **0.048-inch** (1.21-mm) nominal-thickness steel sheet.
6. Boxed End Panels: Fabricated from **0.060-inch** (1.52-mm) nominal-thickness steel sheet.

U. Finish: **[Baked enamel] [or] [powder coat]**.

1. Color(s): **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] [Two colors, with door one color and frame and body another color; as selected by DEN Project Manager from manufacturer's full range]**.

2.5 OPEN-FRONT ATHLETIC METAL LOCKERS

A. Products: Subject to compliance with requirements, provide one of the following:

1. All-Welded, Open-Front Athletic Metal Lockers:
 - a. DeBourgh Mfg. Co.; **[All Sport] [Open Front with Security Compartment]** Lockers.
 - b. List Industries Inc.; **[All-Star] [All-Star Jr.] [MVP] [Rookie] [Touchdown]** Lockers.
 - c. Lyon Workspace Products, LLC; **[Collegiate] [Deluxe Collegiate]** Lockers.
 - d. Penco Products, Inc.; Stadium Lockers.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.

2. Knocked-Down, Open-Front Athletic Metal Lockers:
 - a. ASI Storage Solutions Inc.; Pro Collection.
 - b. Hadrian Manufacturing Inc.; Gladiator Open Front Hockey Lockers.
 - c. Lyon Workspace Products, LLC; [**Collegiate**] [**Deluxe Collegiate**] Lockers.
 - d. Penco Products, Inc.; Stadium Lockers.
 - e. Republic Storage Systems Company; MVP Lockers.
 - f. <Insert manufacturer's name; product name or designation>.
 - g. or approved equal.
- B. Locker Arrangement: Open front, with [seat/shelf] [seat/footlocker] [upper shelf] [upper shelf with security box] [and] [full-width security compartment] [configuration as indicated on Drawings].
- C. Material: [**Cold-rolled**] [**Metallic-coated**] steel sheet.
- D. Body: Assembled by [**welding**] [**or**] [**riveting or bolting**] body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
 1. Tops and Bottoms: 0.060-inch (1.52-mm) nominal thickness, with single bend at edges.
 2. Backs: 0.048-inch (1.21-mm) nominal thickness.
 3. Shelves: 0.060-inch (1.52-mm) nominal thickness, with double bend at front and single bend at sides and back.
- E. Unperforated Sides: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet.
- F. Perforated Sides: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet with manufacturer's standard diamond perforations. Perforations shall not occur [above upper shelf] [at security compartment] [**or**] [at seat/footlocker].
- G. Expanded-Metal Sides: Fabricated from 0.090-inch (2.28-mm) nominal-thickness expanded metal; welded to 0.105-inch (2.66-mm) nominal-thickness steel angles or 0.060-inch (1.52-mm) nominal-thickness steel channel frames.
- H. Frames: Channel formed; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet or 0.105-inch (2.66-mm) nominal-thickness steel angles; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames.
- I. Reinforced Bottoms: Structural channels, formed from 0.075-inch (1.90-mm) nominal-thickness steel sheet; welded to front and rear of side-panel frames.
- J. Seats/Shelves: Full width of metal locker; channel formed; fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet; with stiffeners for reinforcement.
- K. Seats/Footlockers: Enclosure full width of bottom of metal locker; fabricated from cold-rolled steel sheet.

1. Seat/Lid: **0.075-inch** (1.90-mm) nominal-thickness steel sheet; channel formed and reinforced with stiffeners; with manufacturer's standard, steel continuous hinge that is completely concealed and tamper resistant when seat/lid is closed; with padlock hasp.
 2. Front Panel: **0.075-inch** (1.90-mm) nominal-thickness steel sheet; channel formed at top edge; with minilouvers for ventilation; recessed for padlock loop.
 3. Sides: **[Integral part of unperforated] [Unperforated bottom portions of perforated] [0.060-inch** (1.52-mm) **nominal-thickness steel sheet inside expanded-metal]** sides.
- L. Security Boxes: Consisting of partition extending from upper shelf to top of metal locker, fabricated from **0.060-inch** (1.52-mm) nominal-thickness steel sheet; with channel-formed, **0.060-inch** (1.52-mm) nominal-thickness, steel sheet door frame, and door fabricated from **0.075-inch** (1.90-mm) nominal-thickness steel sheet with right-angle single bend at edges; with manufacturer's standard, steel continuous hinge that is completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
1. Single-Point Latching: Stainless-steel strike plate with integral pull; with steel, nonmoving latch hook **[designed to engage bolt of built-in combination or cylinder lock] [with steel padlock loop that projects through door and is finished to match metal locker body]**.
- M. Security Compartments: Full width of metal locker, with door fabricated from **0.075-inch** (1.90-mm) nominal-thickness steel sheet.
- N. Combination Padlocks: **[Key-controlled, three-number dialing combination locks; capable of five combination changes] [Provided by Owner]**.
- O. Built-in Combination Locks: Key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key.
1. Bolt Operation: **[Manually locking deadbolt] [or] [automatically locking spring bolt]**.
- P. Cylinder Locks: Built-in, flush, cam locks with five-pin tumbler keyway, keyed separately and master keyed. Furnish two change keys for each lock and **[two <Insert number> master keys]**.
1. Key Type: **[Flat] [Grooved]**, with minimum **2- by 2.68-inch** (51- by 68.3-mm) **key head for accessible lockers]**.
 2. Bolt Operation: **[Manually locking deadbolt] [or] [automatically locking spring bolt]**.
- Q. Equipment: Equip each metal locker with identification plate and the following unless otherwise indicated:
1. Two single-prong wall hooks bolted to locker back.
 2. Coat rod and two rod holders.

R. Accessories:

1. Continuous Sloping Tops: Fabricated from **0.048-inch** (1.21-mm) nominal-thickness steel sheet, with a pitch of approximately 20 degrees.
 - a. Closures: **[Vertical] [Hipped]**-end type.
2. Recess Trim: Fabricated from **0.048-inch** (1.21-mm) nominal-thickness steel sheet.
3. Filler Panels: Fabricated from **0.048-inch** (1.21-mm) nominal-thickness steel sheet.
4. Boxed End Panels: Fabricated from **0.060-inch** (1.52-mm) nominal-thickness steel sheet.

S. Finish: **[Baked enamel] [or] [powder coat]**.

1. Color(s): **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] [Two colors; as selected by DEN Project Manager from manufacturer's full range]**.

2.6 COIN-OPERATED METAL LOCKERS

A. Products: Subject to compliance with requirements, provide one of the following:

1. American Locker Security Systems, Inc.; **[Ambassador] [Statesman]** Locker.
2. Secura Coin Locker; Secura Coinlock.
3. Shanahan's Manufacturing Limited; **[President] [Senator]** Series.
4. Tiffin Metal Products; Sentinel Locker.
5. **<Insert manufacturer's name; product name or designation>**.
6. or approved equal.

B. Steel Lockers: Fabricated from cold-rolled steel sheet with thicknesses as follows:

1. Tops, Bottoms, Sides, and Shelves: **0.024-inch** (0.61-mm) nominal thickness.
2. Backs: **0.036-inch** (0.91-mm) nominal thickness.
3. Frames: **0.060-inch** (1.52-mm) nominal thickness.
4. Doors: **0.060-inch** (1.52-mm) nominal thickness.
5. Exposed Ends of Nonrecessed Lockers: **0.060-inch** (1.52-mm) nominal thickness.

C. Stainless-Steel Lockers: Fabricated from stainless-steel sheet with thicknesses and finishes as follows:

1. Tops, Bottoms, Sides, Backs, and Shelves: **0.025 inch** (0.64 mm) thick, with No. 2B finish.
2. Frames: **0.062 inch** (1.59 mm) thick, with No. 3 or No. 4 finish.
3. Doors: **0.062 inch** (1.59 mm) thick, with manufacturer's standard patterned finish.
4. Exposed Ends of Nonrecessed Lockers: **0.062 inch** (1.59 mm) thick, with No. 3 or No. 4 finish.

- D. Body: Assembled by welding or riveting body components to frames using manufacturer's standard aluminum or stainless-steel rivets; flanged for double thickness at back vertical corners; back ventilated.
- E. Frames: Channel formed; lapped and welded at corners; with top, bottom, and cross frames welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames, and equip frames with resilient bumpers to cushion door closing.
1. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical mainframe.
- F. Doors: One piece; formed into channel shape at vertical edges and flanged at right angles at horizontal edges; fabricated to swing 180 degrees. Brace or reinforce inner face of doors with manufacturer's standard reinforcing angles, channels, or stiffener panels.
- G. Hinges: Manufacturer's standard, **[full-loop, five- or seven-knuckle type; tight pin; minimum 2-1/2 inches (64 mm) high] [or] [continuous type]**, of same material as door; **self-closing**. Weld hinge to inside of doorframe and attach hinge to door with factory-installed fasteners that are completely concealed and tamper resistant when door is closed.
1. Provide at least three hinges for each door more than **42 inches (1067 mm)** high.
- H. Projecting Door Handle: Manufacturer's standard; stainless steel; pry and vandal resistant.
- I. Built-in, Coin-Operated Locks: Self-contained units mounted on interior of door with replaceable lock cylinders keyed separately and master keyed. Mount instruction decals on both faces of door. Furnish one change key for each lock and one master key.
1. Bolt Operation: **[Manually locking deadbolt] [or] [automatically locking spring bolt]**.
 2. Lock Type: Fee **[return/deposit] [collect/pay]**.
 3. Fee Type: **[Token] [Coin, one quarter] [Coin, two quarters]**.
 4. Coin Box: Manufacturer's standard housing or stainless-steel cash box with stainless-steel flanged cover set into base of lock channel frame. Furnish with removable cylinder and key, and master code changer key.
- J. Finish: **[Baked enamel] [or] [powder coat]**.
1. Color(s): **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] [Two colors, with door one color and frame and body another color; as selected by DEN Project Manager from manufacturer's full range]**.

2.7 KEYLESS LOCKS

- A. Built-in, Card-Operated Locks: Self-contained units mounted on interior of door with replaceable lock cylinders keyed separately and master keyed. Mount instruction decals on both faces of door. Furnish one change card key for each lock and one master card key.
1. Bolt Operation: **[Manually locking deadbolt] [or] [automatically locking spring bolt]**.
- B. Digital Keypad Locks: Battery-powered electronic keypad with reprogrammable manager and owner codes that override access. Three consecutive incorrect code entries shall disable lock for three minutes.
1. Designed for permanently assigned access via entry of user's four-digit code.
 2. Designed for shared or temporary access by multiple users, with user-defined code to lock and unlock. Provide LED indicator to show when lock is in use.

2.8 LOCKER BENCHES

- A. Provide bench units with overall assembly height of **[17-1/2 inches (445 mm)] <Insert dimension>**.
- B. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.
1. Size: Minimum **9-1/2 inches wide by 1-1/4 inches thick** (241 mm wide by 32 mm thick) **[except provide minimum 20-inch- (508-mm-) wide tops where accessible benches are indicated]**.
 2. Laminated clear hardwood with one coat of clear sealer on all surfaces and one coat of clear lacquer on top and sides.
 3. Plastic laminate over particleboard core, with two steel tubes running full length of top and positioned to receive pedestal fasteners.
 - a. Color: **[Match metal lockers] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range]**.
 4. Extruded aluminum with clear anodic finish.
- C. Fixed Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors, and as follows:
1. Tubular Steel: **1-1/2-inch- (38-mm-) diameter steel tubing threaded on both ends, with standard pipe flange at top and bell-shaped cast-iron base; with baked-enamel or powder-coat finish; anchored with exposed fasteners.**

- a. Color: **[Match metal lockers] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range]**.
2. Tubular Steel: **1-1/4-inch-** (32-mm-) diameter steel tubing, with **0.1265-inch-** (3.2-mm-) thick steel flanges welded at top and base; with **[baked-enamel] [zinc-plated]** finish; anchored with exposed fasteners.
 - a. Color: **[Match metal lockers] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range]**.
- D. Freestanding Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top, complete with fasteners, and as follows:
 1. Aluminum: **1/8-inch-thick by 3-inch-wide** (3-mm-thick by 76-mm-wide) channel or **1/4-inch-thick by 3-inch-wide** (6-mm-thick by 76-mm-wide) bar stock, shaped into **[trapezoidal] [inverted-T]** form; with nonskid pads at bottom.
 - a. Finish: **[Clear] [Black] [Gold]** anodic finish.
 2. Stainless Steel: **1/8-inch-thick by 3-inch-wide** (3-mm-thick by 76-mm-wide) channel or **1/4-inch-thick by 3-inch-wide** (6-mm-thick by 76-mm-wide) bar stock, shaped into trapezoidal form; with nonskid pads at bottom. Add finish.

2.9 FABRICATION

- A. Fabricate metal lockers square, rigid, and without warp and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
 1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
 2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.
- B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments. Factory weld frame members of each metal locker together to form a rigid, one-piece assembly.
- C. Knocked-Down Construction: Fabricate metal lockers using nuts, bolts, screws, or rivets for **[nominal assembly at Project site] [preassembly at plant prior to shipping]**.
- D. All-Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds flush.
- E. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than **15 inches** (381 mm) above the floor.
 2. Where hooks, coat rods, or additional shelves are provided, locate no higher than **48 inches** (1219 mm) above the floor.
- F. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.
- G. Coat Rods: Fabricated from [**1-inch-** (25-mm-)] [**3/4-inch-** (19-mm-)] diameter steel, [**chrome finished**] [**nickel plated**].
- H. Identification Plates: Manufacturer's standard, etched, embossed, or stamped [**aluminum**] [**plastic**] plates, with numbers and letters at least **3/8 inch** (9 mm) high.
- I. Continuous Base: Formed into channel or zee profile for stiffness, and fabricated in lengths as long as practical to enclose base and base ends of metal lockers; finished to match lockers.
- J. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.
1. Sloping-top corner fillers, mitered.
- K. Individual Sloping Tops: Fabricated in width to fit one locker frame in lieu of flat locker tops; with integral back; finished to match lockers. Provide wedge-shaped divider panels between lockers.
- L. Recess Trim: Fabricated with minimum **2-1/2-inch** (64-mm) face width and in lengths as long as practical; finished to match lockers.
- M. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.
- N. Boxed End Panels: Fabricated with **1-inch-** (25-mm-) wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.
1. Provide one-piece panels for double-row (back-to-back) locker ends.
- O. Finished End Panels: Designed for concealing unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
1. Provide one-piece panels for double-row (back-to-back) locker ends.
- P. Center Dividers: Full-depth, vertical partitions between bottom and shelf; finished to match lockers.
- 2.10 STEEL SHEET FINISHES
- A. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.

- B. Baked-Enamel Finish: Immediately after cleaning, pretreating, and phosphatizing, apply manufacturer's standard thermosetting baked-enamel finish. Comply with paint manufacturer's written instructions for application, baking, and minimum dry film thickness.
- C. Powder-Coat Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard, baked-polymer, thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

2.11 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install level, plumb, and true; shim as required, using concealed shims.
 - 1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than **36 inches** (910 mm) o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
 - 2. Anchor single rows of metal lockers to walls near top [**and bottom of lockers**] [**of lockers and to floor**].
 - 3. Anchor back-to-back metal lockers to floor.

- B. Knocked-Down Metal Lockers: Assemble with standard fasteners, with no exposed fasteners on door faces or face frames.
- C. All-Welded Metal Lockers: Connect groups together with standard fasteners, with no exposed fasteners on face frames.
- D. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
 - 1. Attach hooks with at least two fasteners.
 - 2. Attach door locks on doors using security-type fasteners.
 - 3. Identification Plates: Identify metal lockers with identification indicated on Drawings.
 - a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
 - b. Attach plates to upper shelf of each open-front metal locker, centered, with a least two aluminum rivets.
 - 4. Attach recess trim to recessed metal lockers with concealed clips.
 - 5. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.
 - 6. Attach sloping-top units to metal lockers, with closures at exposed ends.
 - 7. Attach boxed end panels with concealed fasteners to conceal exposed ends of nonrecessed metal lockers.
 - 8. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.
- E. Fixed Locker Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than **72 inches** (1830 mm) apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.
- F. Freestanding Locker Benches: Place benches in locations indicated on Drawings.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. [**Verify that integral locking devices operate properly.**]
- B. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- C. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 105113

SECTION 105500 - POSTAL SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. USPS-approved horizontal mail receptacles.
2. Private-delivery horizontal mail receptacles.
3. Private postal-facility horizontal mail receptacles.
4. Vertical mail receptacles.
5. USPS-approved cluster box units (CBUs).
6. Neighborhood delivery and collection box units (NDCBUs).
7. USPS-approved parcel lockers.
8. USPS-approved collection boxes.
9. Private collection boxes.
10. Data distribution boxes.
11. Mail chutes.
12. Accessories:
 - a. Directory for mail receptacles.
 - b. Key keeper.
 - c. Key cabinet.
 - d. Mail-sorting collection unit.
 - e. Letter drops.
 - f. Package depository.

- B. Related Sections:

1. **[Section 087100 "Door Hardware"] [Section 087111 "Door Hardware (Descriptive Specification)]** for lock cylinders for postal specialties that are keyed to building keying system and for letter slots in doors.
2. Section 101300 "Directories" for mailbox directories.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of postal specialty. [**Include electrical characteristics.**]
 - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For postal specialties. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Include identification sequence for compartments.
 - 2. Include layout of identification text.
 - 3. Include setting drawings, templates, and installation instructions for anchor bolts and other anchorages installed as part of the work of other Sections.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required, prepared on **6-by-6-inch** (150-by-150-mm) square Samples.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and details of mail chutes, drawn to scale, on which the following items in the vicinity of mail chutes are shown and coordinated with mail chutes, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Ductwork, piping, and their supporting members.
 - 3. Partition-assembly bracing.
 - 4. **<Insert item>**.
- B. Qualification Data: For qualified Installer.
- C. Product Certificates: For each type of postal specialty required to comply with USPS regulations, signed by product manufacturer. [**Include written approval by Postmaster General.**]
- D. Other Informational Submittals: Final USPS local postmaster approval for installed postal specialties to be served by USPS.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For postal specialties and finishes to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Key Blanks: **[50]** <Insert number> for every <Insert number> locks or fraction thereof, for each type of compartment-door lock installed.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing postal specialties and whose installations have been given final approval by local postmasters authorizing use by USPS.
- B. Source Limitations for Each Type of Postal Specialty: Obtain from single source from single manufacturer. **[For USPS-approved products, use only those included on current lists of USPS manufacturers and models.]**
- C. Preinstallation Conference: Conduct conference at **[Project site]** **[location and time as determined by DEN Project Manager]**<Insert location>.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver lock keys to Owner by registered mail or overnight package service with a record of each corresponding lock and key number.
- B. Deliver combination-lock combinations to Owner by registered mail or overnight package service with a record of each corresponding lock and combination.

1.9 COORDINATION

- A. Coordinate layout and installation of mail chutes and attachments to structure with other construction that passes above ceilings, penetrates ceilings, or is supported by them in the vicinity of mail chutes; including light fixtures, HVAC ductwork and equipment, fire-suppression system and other piping, and partition assemblies.
- B. Coordinate layout and installation of **[recessed]** **[and]** **[semirecessed]** postal specialties with wall construction.
- C. Templates: Obtain templates for installing postal specialties and distribute to parties involved.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of postal specialties that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Faulty operation of hardware[**including electrical components**].
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. **<Insert failure modes>**.
2. Warranty Period: Minimum [**five (5)**] **<Insert number>** years from date of Substantial Completion.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum: Manufacturer's standard alloy and temper for type of use and finish indicated, and as follows:
 1. Sheet and Plate: [ASTM B 209](#) (ASTM B 209M).
 2. Extruded Shapes: [ASTM B 221](#) (ASTM B 221M).
- B. Steel Sheet: Cold rolled, ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, exposed matte finish where exposed.
- C. Metallic-Coated Steel Sheet: Galvanized-steel sheet, ASTM A 653/A 653M, [G60](#) (Z180) coating designation, extra smooth where exposed; or electrolytic zinc-coated steel sheet, ASTM A 879/A 879M, Coating Designation [08Z](#) (24G).
- D. Stainless-Steel Sheet: ASTM A 666, Type 304.
- E. Brass Sheet: ASTM B 36/B 36M, manufacturer's standard copper alloy.
- F. Zinc Sheet or Plate: ASTM B 69, manufacturer's standard sheet or plate and zinc alloy.
- G. Die-Cast Aluminum: ASTM B 85, manufacturer's standard aluminum alloy.
- H. Die-Cast Brass: ASTM B 176, manufacturer's standard copper alloy.
- I. Die-Cast Zinc: ASTM B 86, manufacturer's standard zinc alloy.
- J. Steel Anchor Bolts, Nuts, and Washers: ASTM F 1554, Grade 36 or 55, hot-dip galvanized.

- K. Stainless-Steel Anchor Bolts, Nuts, and Washers: ASTM A 193/A 193M, Grade B8M, Type 316.
- L. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 USPS-APPROVED HORIZONTAL MAIL RECEPTACLES

- A. Front-Loading, USPS-Approved Horizontal Mail Receptacles **<Insert drawing designation>**: Consisting of multiple compartments with fixed, solid compartment backs, enclosed within recessed wall box. Provide access to compartments for distributing incoming mail from front of unit by unlocking master lock and swinging side-hinged master door to provide accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door. Comply with **[USPS-STD-4C] [USPS-STD-4B+]**.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Eagle Mailboxes.
 - b. American Postal Manufacturing Co.; Division of Postal Products Unlimited, Inc.
 - c. Auth-Florence Manufacturing; a Florence company.
 - d. Bommer Industries, Inc.
 - e. Jensen Industries.
 - f. Salsbury Industries.
 - g. Security Manufacturing Corporation.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.
 - 2. Mail Delivery: **[USPS] [Private]**.
 - 3. Compartments: **[Number and size as follows:] [As indicated on Drawings, of the following sizes:] [As indicated on Drawings.]**
 - a. Type I: A group of mail receptacles in single-column configuration with single master door, **[three] <Insert number up to eight>** mail compartments not less than **3 inches high by 12 inches wide by 15 inches deep** (76 mm high by 305 mm wide by 381 mm deep), one outgoing mail collection compartment prepared for master-door lock, and one parcel compartment **15 inches high by 12 inches wide by 15 inches deep** (381 mm high by 305 mm wide by 381 mm deep).
 - b. Type II: A group of mail receptacles in double-column configuration with double master door, **[three] <Insert number up to 16>** mail compartments not less than **3 inches high by 12 inches wide by 15 inches deep** (76 mm high by 305 mm wide by 381 mm deep), one outgoing mail collection compartment prepared for master-door lock, and **[one] [two]** parcel compartment(s): **[15 inches high by 12 inches wide by 15 inches deep** (381 mm high by 305 mm wide by 381 mm deep)] **[and] [18 inches high by 12 inches wide by 15 inches deep** (457 mm high by 305 mm wide by 381 mm deep)].

- c. Type III: A group of mail receptacles in double-column configuration with single master door, **[three]** <Insert number up to 16> mail compartments not less than **3 inches high by 12 inches wide by 15 inches deep** (76 mm high by 305 mm wide by 381 mm deep), one outgoing mail collection compartment prepared for master-door lock, and **[one]** **[two]** parcel compartment(s): **[15 inches high by 12 inches wide by 15 inches deep** (381 mm high by 305 mm wide by 381 mm deep)] **[and]** **[18 inches high by 12 inches wide by 15 inches deep** (457 mm high by 305 mm wide by 381 mm deep)].
 - d. Type VI (No Parcel Compartment): A group of mail receptacles in single-column configuration with single master door, **[three]** <Insert number up to nine> mail compartments not less than **3 inches high by 12 inches wide by 15 inches deep** (76 mm high by 305 mm wide by 381 mm deep), and one outgoing mail collection compartment prepared for master-door lock.
 - e. Type VIII (No Parcel Compartment): A group of mail receptacles in double-column configuration with double master door, **[three]** <Insert number up to 19> mail compartments not less than **3 inches high by 12 inches wide by 15 inches deep** (76 mm high by 305 mm wide by 381 mm deep), and one outgoing mail collection compartment prepared for master-door lock.
4. Compartments: **[Number and size as follows:]** **[Number as indicated on Drawings, of the following sizes:]** **[Number and size as indicated on Drawings.]**
- a. Type A: Provide <Insert number> compartments with inside dimensions not less than **5 inches high by 6 inches wide by 15 inches deep** (127 mm high by 152 mm wide by 381 mm deep).
 - b. Type B: Provide <Insert number> compartments with inside dimensions not less than **5 inches high by 12-1/2 inches wide by 15 inches deep** (127 mm high by 318 mm wide by 381 mm deep).
 - c. Type C: Provide <Insert number> compartments with inside dimensions not less than **10-1/2 inches high by 6 inches wide by 15 inches deep** (267 mm high by 152 mm wide by 381 mm deep).
 - d. Type D: Provide <Insert number> compartments with inside dimensions not less than **10-1/2 inches high by 12-1/2 inches wide by 15 inches deep** (267 mm high by 318 mm wide by 381 mm deep).
 - e. Type E: Provide <Insert number> compartments with inside dimensions not less than **16 inches high by 12-1/2 inches wide by 15 inches deep** (406 mm high by 318 mm wide by 381 mm deep).
5. Front-Loading Master Door: Fabricated from extruded aluminum and braced and framed to hold compartment doors; prepared to receive master-door lock.
- a. Master-Door Lock: Door prepared to receive lock provided by local postmaster.
 - b. Master-Door Lock: Cylinder lock keyed to building keying system; with **[two]** **[three]** <Insert number> keys. Provide cylinders specified in Section 087100 "Door Hardware."

6. Compartment Doors: Fabricated from extruded aluminum. Equip each with lock and tenant identification as required by cited standard. **[Provide mail slot in the compartment with master-door lock.]**
 - a. Compartment-Door Locks: Comply with USPS-L-1172C, PSIN O910, for locks and keys, or equivalent as approved by USPS; with three keys for each compartment door. Key each compartment differently.
 - b. Compartment-Door Locks: Five-pin tumbler, cylinder **[cam]** **[spring-latch-type]** locks capable of at least 1000 key changes; with **[two]** **[three]** **<Insert number>** keys for each compartment door. Key each compartment differently.
 - c. Compartment-Door Locks: Removable core locks, furnished by Owner and installed as Work of this Section.
 - d. Compartment-Door Locks: Spring-latch-type lock designed to accommodate cylinders keyed to building keying system; with **[two]** **[three]** **<Insert number>** keys for each compartment door. Provide cylinders specified in Section 087100 "Door Hardware."
 - e. Compartment-Door Locks: Three-digit, single-dial, combination locks with spring latch and automatic throw off. Set each compartment with different combination.
 7. Frames: Fabricated from extruded aluminum or aluminum sheet; ganged and nested units, with cardholder and blank cards for tenant's identification within each compartment.
 8. Snap-on Trim: Fabricated from same material and finish as compartment doors.
 9. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
 10. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:
 - a. Anodic Finish: **[Clear]** **[Brass]** **[Dark bronze]** **[As indicated by manufacturer's designations]** **[As selected by DEN Project Manager from manufacturer's full range]** **<Insert color>**.
 - b. Baked-Enamel or Powder-Coated Finish: **[Silver]** **[Black]** **[Medium bronze]** **[Dark bronze]** **[Gold]** **[Color as indicated by manufacturer's designations]** **[Color as selected by DEN Project Manager from manufacturer's full range]** **<Insert color>**.
- B. Rear-Loading, USPS-Approved Horizontal Mail Receptacles **<Insert drawing designation>**: Consisting of multiple compartments enclosed within recessed wall box. Provide access to compartments for distributing incoming mail from rear of unit with accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door. Comply with **[USPS-STD-4C]** **[USPS-STD-4B+]**.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Eagle Mailboxes.
 - b. American Postal Manufacturing Co.; Division of Postal Products Unlimited, Inc.

- c. Auth-Florence Manufacturing; a Florence company.
 - d. Bommer Industries, Inc.
 - e. Jensen Industries.
 - f. Salsbury Industries.
 - g. Security Manufacturing Corporation.
 - h. <Insert manufacturer's name>.
 - i. or approved equal.
2. Mail Delivery: **[USPS] [Private]**.
3. Compartments: **[Number and size as follows:] [As indicated on Drawings, of the following sizes:] [As indicated on Drawings.]**
 - a. Type IV: A group of mail receptacles in single-column configuration with a rear-access cover, **[three] <Insert number up to eight>** mail compartments not less than **3 inches high by 12 inches wide by 15 inches deep** (76 mm high by 305 mm wide by 381 mm deep), one outgoing mail collection compartment, and one parcel compartment **15 inches high by 12 inches wide by 15 inches deep** (381 mm high by 305 mm wide by 381 mm deep).
 - b. Type V: A group of mail receptacles in double-column configuration with a rear-access cover, **[three] <Insert number up to 16>** mail compartments not less than **3 inches high by 12 inches wide by 15 inches deep** (76 mm high by 305 mm wide by 381 mm deep), one outgoing mail collection compartment, and **[one] [two]** parcel compartment(s) **[15 inches high by 12 inches wide by 15 inches deep** (381 mm high by 305 mm wide by 381 mm deep)] **[and] [18 inches high by 12 inches wide by 15 inches deep** (457 mm high by 305 mm wide by 381 mm deep)].
 - c. Type VII (No Parcel Compartment): A group of mail receptacles in single-column configuration with a rear-access cover, **[three] <Insert number up to nine>** mail compartments not less than **3 inches high by 12 inches wide by 15 inches deep** (76 mm high by 305 mm wide by 381 mm deep), and one outgoing mail collection compartment.
 - d. Type IX (No Parcel Compartment): A group of mail receptacles in double-column configuration with a rear-access cover, **[three] <Insert number up to 19>** mail compartments not less than **3 inches high by 12 inches wide by 15 inches deep** (76 mm high by 305 mm wide by 381 mm deep), and one outgoing mail collection compartment.
4. Compartments: **[Number and size as follows:] [Number as indicated on Drawings, of the following sizes:] [Number and size as indicated on Drawings.]**
 - a. Type A: Provide **<Insert number>** compartments with inside dimensions not less than **5 inches high by 6 inches wide by 15 inches deep** (127 mm high by 152 mm wide by 381 mm deep).
 - b. Type B: Provide **<Insert number>** compartments with inside dimensions not less than **5 inches high by 12-1/2 inches wide by 15 inches deep** (127 mm high by 318 mm wide by 381 mm deep).

- c. Type C: Provide <Insert number> compartments with inside dimensions not less than 10-1/2 inches high by 6 inches wide by 15 inches deep (267 mm high by 152 mm wide by 381 mm deep).
 - d. Type D: Provide <Insert number> compartments with inside dimensions not less than 10-1/2 inches high by 12-1/2 inches wide by 15 inches deep (267 mm high by 318 mm wide by 381 mm deep).
 - e. Type E: Provide <Insert number> compartments with inside dimensions not less than 16 inches high by 12-1/2 inches wide by 15 inches deep (406 mm high by 318 mm wide by 381 mm deep).
5. Rear-Loading Cover: **[Not required] [Lift-off rear cover fabricated from extruded aluminum or aluminum sheet, finished to match front of unit].**
6. Rear-Loading Door: Side hinged, fabricated from extruded aluminum or aluminum sheet, finished to match front of unit; with full-length, stainless-steel piano hinge on one side and **[positive-latching] [locking]** mechanism on the other.
 - a. Rear-Door Lock: Door prepared to receive lock provided by local postmaster.
 - b. Rear-Door Lock: Cylinder lock keyed to building keying system; with **[two] [three]** <Insert number> keys. Provide cylinders specified in Section 087100 "Door Hardware."
 - c. Retain option in first subparagraph below to enable one compartment to serve as outgoing mail receptacle. Insert additional door requirements to suit Project.
7. Compartment Doors: Fabricated from extruded aluminum. Equip each with lock and tenant identification as required by cited standard. **[Provide one compartment with outgoing mail slot.]**
 - a. Compartment-Door Locks: Comply with USPS-L-1172C, PSIN O910, for locks and keys, or equivalent as approved by USPS; with three keys for each compartment door. Key each compartment differently.
 - b. Compartment-Door Locks: Five-pin tumbler, cylinder **[cam] [spring-latch-type]** locks capable of at least 1000 key changes; with **[two] [three]** <Insert number> keys for each compartment door. Key each compartment differently.
 - c. Compartment-Door Locks: Removable core locks, furnished by Owner and installed as Work of this Section.
 - d. Compartment-Door Locks: Spring-latch-type lock designed to accommodate cylinders keyed to building keying system; with **[two] [three]** <Insert number> keys for each compartment door. Provide cylinders specified in Section 087100 "Door Hardware."
 - e. Compartment-Door Locks: Three-digit, single-dial, combination locks with spring latch and automatic throw off. Set each compartment with different combination.
8. Frames: Fabricated from extruded aluminum or aluminum sheet; ganged and nested units, with cardholder and blank cards for tenant's identification behind each compartment.

9. Snap-on Trim: Fabricated from same material and finish as compartment doors.
10. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
11. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:
 - a. Anodic Finish: **[Clear] [Brass] [Dark bronze] [As indicated by manufacturer's designations] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 - b. Baked-Enamel or Powder-Coated Finish: **[Silver] [Black] [Medium bronze] [Dark bronze] [Gold] [Color as indicated by manufacturer's designations] [Color as selected by DEN Project Manager from manufacturer's full range] <Insert color>**.

2.3 PRIVATE-DELIVERY HORIZONTAL MAIL RECEPTACLES

- A. Front-Loading, Private-Delivery Horizontal Mail Receptacles **<Insert drawing designation>**: Consisting of multiple compartments with fixed, solid compartment backs, enclosed within recessed wall box. Provide access to compartments for distributing incoming mail from front of unit by unlocking master lock and swinging side-hinged master door to provide accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Postal Manufacturing Co.; Division of Postal Products Unlimited, Inc.
 - b. Auth-Florence Manufacturing; a Florence company.
 - c. Bommer Industries, Inc.
 - d. Salsbury Industries.
 - e. Security Manufacturing Corporation.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
 2. Front-Loading Master Door: Fabricated from extruded aluminum and braced and framed to hold compartment doors; with master-door lock and concealed, full-length, stainless-steel piano hinge on one side. Fabricate master door to remain open while mail is deposited.
 - a. Master-Door Lock: Manufacturer's standard five-pin tumbler, cylinder lock; with **[two] [three] <Insert number>** keys.
 - b. Master-Door Lock: Cylinder lock keyed to building keying system; with **[two] [three] <Insert number>** keys. Provide cylinders specified in Section 087100 "Door Hardware."
 3. Compartments and Doors: Manufacturer's standard compartments with extruded aluminum doors. Equip each with lock, tenant identification, and concealed,

full-length, flush hinge on one side. Provide one compartment prepared for master-door lock[**and with outgoing mail slot**].

- a. Compartments: **[Number and size as follows:] [As indicated on Drawings, of the following sizes:] [As indicated on Drawings.]**
 - 1) Size 1: Provide **<Insert number>** compartments with inside dimensions not less than **3 inches high by 6 inches wide by 15 inches deep** (76 mm high by 152 mm wide by 381 mm deep).
 - 2) Size 2: Provide **<Insert number>** compartments with inside dimensions not less than **5 inches high by 3-1/2 inches wide by 15 inches deep** (127 mm high by 89 mm wide by 381 mm deep).
 - 3) Size 3: Provide **<Insert number>** compartments with inside dimensions not less than **5 inches high by 7-1/2 inches wide by 15 inches deep** (127 mm high by 191 mm wide by 381 mm deep).
 - 4) Size 4: Provide **<Insert number>** compartments with inside dimensions not less than **10-1/2 inches high by 3-1/2 inches wide by 15 inches deep** (267 mm high by 89 mm wide by 381 mm deep).
 - 5) Size 5: Provide **<Insert number>** compartments with inside dimensions not less than **10-1/2 inches high by 7-1/2 inches wide by 15 inches deep** (267 mm high by 191 mm wide by 381 mm deep).
 - b. Tenant Identification: **2-inch-wide by 5/8-inch-** (51-mm-wide by 16-mm-) high, clear-plastic cardholder set in recessed slot in face of compartment door. Provide cardboard strip and self-adhesive numbers.
 - c. Tenant Identification: Laminated, black plastic tabs, engraved with identification and adhesively applied to face of compartment door.
 - d. Tenant Identification: Identification engraved into face of compartment door.
4. Compartments and Doors: Manufacturer's standard compartments with ornamental doors fabricated from solid, die-cast **[brass] [zinc]**. Equip each with **[glass window,]** lock, nameplate, and two hinges.
- a. Compartments: **[Number and size as follows:] [As indicated on Drawings, of the following sizes:] [As indicated on Drawings.]**
 - 1) Size 1: Provide **<Insert number>** compartments **15 inches** (381 mm) deep with doors **5 inches high by 3-1/2 inches wide** (127 mm high by 89 mm wide).
 - 2) Size 2: Provide **<Insert number>** compartments **15 inches** (381 mm) deep with doors **6 inches high by 5-1/2 inches wide** (152 mm high by 140 mm wide).
 - 3) Size 3: Provide **<Insert number>** compartments **15 inches** (381 mm) deep with doors **6 inches high by 11 inches wide** (152 mm high by 279 mm wide).
5. Compartment-Door Locks: Five-pin tumbler, cylinder **[cam] [spring-latch-type]** locks capable of at least 1000 key changes; with **[two] [three] <Insert number>** keys for each compartment door. Key each compartment differently.

6. Compartment-Door Locks: Removable core locks, furnished by Owner and installed as Work of this Section.
 7. Compartment-Door Locks: Spring-latch-type lock designed to accommodate cylinders keyed to building keying system; with **[two] [three] <Insert number>** keys for each compartment door. Provide cylinders specified in Section 087100 "Door Hardware."
 8. Compartment-Door Locks: Three-digit, single-dial, combination locks with spring latch and automatic throw off. Set each compartment with different combination.
 9. Frames: Fabricated from **[extruded aluminum or aluminum sheet] [brass sheet] [zinc sheet or plate]**; ganged and nested units, with cardholder and blank cards for tenant's identification behind each compartment.
 10. Snap-on Trim: Fabricated from same material and finish as compartment doors.
 11. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
 12. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:
 - a. Anodic Finish: **[Clear] <Insert color>**.
 - b. Baked-Enamel or Powder-Coated Finish: **[Black] [Dark bronze] [Gold] [Medium bronze] [Silver] [Color as indicated by manufacturer's designations] [Color as selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 13. Brass Finish: **[Buffed finish, lacquered] [Hand-rubbed finish, lacquered] [Brushed satin, lacquered] <Insert finish>**.
 14. Zinc Finish: Manufacturer's standard powder-coated finish, **[tan] <Insert color>**.
- B. Rear-Loading, Private-Delivery Horizontal Mail Receptacles **<Insert drawing designation>**: Consisting of multiple compartments enclosed within recessed wall box. Provide access to compartments for distributing incoming mail from rear of unit with accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Postal Manufacturing Co.; Division of Postal Products Unlimited, Inc.
 - b. Auth-Florence Manufacturing; a Florence company.
 - c. Bommer Industries, Inc.
 - d. Salisbury Industries.
 - e. Security Manufacturing Corporation.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
 2. Rear-Loading Cover: **[Not required] [Lift-off rear cover fabricated from extruded aluminum or aluminum sheet, finished to match front of unit]**.
 3. Rear-Loading Door: Side hinged, fabricated from extruded aluminum or aluminum sheet, finished to match front of unit; with full-length, stainless-steel piano hinge on one side and **[positive-latching] [locking]** mechanism on the

- other. Fabricate rear-loading door to open not less than 90 degrees and to remain open while mail is deposited.
- a. Rear-Door Lock: Manufacturer's standard five-pin tumbler, cylinder lock; with **[two]** **[three]** **<Insert number>** keys.
 - b. Rear-Door Lock: Cylinder lock keyed to building keying system; with **[two]** **[three]** **<Insert number>** keys. Provide cylinders specified in Section 087100 "Door Hardware."
 - c. Retain one of two "Compartments and Doors" subparagraphs below.
4. Compartments and Doors: Manufacturer's standard compartments with doors fabricated from extruded aluminum. Equip each with lock, tenant identification, and concealed, full-length, flush hinge on one side. Provide one compartment prepared for master-door lock **[and with outgoing mail slot]**.
- a. Compartments: **[Number and size as follows:] [As indicated on Drawings, of the following sizes:] [As indicated on Drawings.]**
 - 1) Size 1: Provide **<Insert number>** compartments with inside dimensions not less than **3 inches high by 6 inches wide by 15 inches deep** (76 mm high by 152 mm wide by 381 mm deep).
 - 2) Size 2: Provide **<Insert number>** compartments with inside dimensions not less than **5 inches high by 3-1/2 inches wide by 15 inches deep** (127 mm high by 89 mm wide by 381 mm deep).
 - 3) Size 3: Provide **<Insert number>** compartments with inside dimensions not less than **5 inches high by 7-1/2 inches wide by 15 inches deep** (127 mm high by 191 mm wide by 381 mm deep).
 - 4) Size 4: Provide **<Insert number>** compartments with inside dimensions not less than **10-1/2 inches high by 3-1/2 inches wide by 15 inches deep** (267 mm high by 89 mm wide by 381 mm deep).
 - 5) Size 5: Provide **<Insert number>** compartments with inside dimensions not less than **10-1/2 inches high by 7-1/2 inches wide by 15 inches deep** (267 mm high by 191 mm wide by 381 mm deep).
 - b. Tenant Identification: **2-inch-wide by 5/8-inch-** (51-mm-wide by 16-mm-) high, clear-plastic cardholder set in recessed slot in face of compartment door. Provide cardboard strip and self-adhesive numbers.
 - c. Tenant Identification: Laminated, black plastic tabs, engraved with identification and adhesively applied to face of compartment door.
 - d. Tenant Identification: Identification engraved into face of compartment door.
5. Compartments and Doors: Manufacturer's standard compartments with ornamental doors fabricated from solid, die-cast **[brass]** **[zinc]**. Equip each with **glass window,** lock, nameplate, and two hinges.
- a. Compartments: **[Number and size as follows:] [As indicated on Drawings, of the following sizes:] [As indicated on Drawings.]**

- 1) Size 1: Provide **<Insert number>** compartments **15 inches** (381 mm) deep with doors **5 inches high by 3-1/2 inches wide** (127 mm high by 89 mm wide).
 - 2) Size 2: Provide **<Insert number>** compartments **15 inches** (381 mm) deep with doors **6 inches high by 5-1/2 inches wide** (152 mm high by 140 mm wide).
 - 3) Size 3: Provide **<Insert number>** compartments **15 inches** (381 mm) deep with doors **6 inches high by 11 inches wide** (152 mm high by 279 mm wide).
6. Compartment-Door Locks: Five-pin tumbler, cylinder [**cam**] [**spring-latch-type**] locks capable of at least 1000 key changes; with [**two**] [**three**] **<Insert number>** keys for each compartment door. Key each compartment differently.
 7. Compartment-Door Locks: Removable core locks, furnished by Owner and installed as Work of this Section.
 8. Compartment-Door Locks: Spring-latch-type lock designed to accommodate cylinders keyed to building keying system; with [**two**] [**three**] **<Insert number>** keys for each compartment door. Provide cylinders specified in Section 087100 "Door Hardware."
 9. Compartment-Door Locks: Three-digit, single-dial, combination locks with spring latch and automatic throw off. Set each compartment with different combination.
 10. Frames: Fabricated from [**extruded aluminum or aluminum sheet**] [**brass sheet**] [**zinc sheet or plate**]; ganged and nested units, with cardholder and blank cards for tenant's identification behind each compartment.
 11. Snap-on Trim: Fabricated from same material and finish as compartment doors.
 12. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
 13. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:
 - a. Anodic Finish: [**Clear**] **<Insert color>**.
 - b. Baked-Enamel or Powder-Coated Finish: [**Black**] [**Dark bronze**] [**Gold**] [**Medium bronze**] [**Silver**] [**Color as indicated by manufacturer's designations**] [**Color as selected by DEN Project Manager from manufacturer's full range**] **<Insert color>**.
 14. Brass Finish: [**Buffed finish, lacquered**] [**Hand-rubbed finish, lacquered**] [**Brushed satin, lacquered**] **<Insert finish>**.
 15. Zinc Finish: Manufacturer's standard powder-coated finish, [**tan**] **<Insert color>**.

2.4 PRIVATE POSTAL-FACILITY HORIZONTAL MAIL RECEPTACLES

- A. Standard, Rear-Loading Horizontal Mail Receptacles **<Insert drawing designation>**: Consisting of multiple compartments with open backs, enclosed within recessed, modular wall box, with approximate overall module dimensions of **30 inches high by 23-1/2 inches wide by 15-1/2 inches deep** (762 mm high by 596 mm wide by 394 mm deep); for installation between studs spaced **24 inches** (610 mm) o.c. Provide access to compartments for distributing incoming mail from rear of unit with accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Salsbury Industries.
 - b. Security Manufacturing Corporation.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.
 2. Compartments: Provide **[10] [20] [30] <Insert number>** equal-sized compartments within each module.
 3. Compartments: Provide number and size, and number of modules as indicated on Drawings.
 4. Compartment Doors: Fabricated from extruded **[or die-cast]** aluminum. Equip each with lock, tenant identification, and concealed, full-length, flush hinge on one side.
 - a. Tenant Identification: Identification engraved into **[face of compartment door] [self-adhesive placards]**.
 - b. Compartment-Door Locks: Five-pin tumbler, cylinder **[cam] [spring-latch-type]** locks capable of at least 1000 key changes; with **[two] [three] <Insert number>** keys for each compartment door. Key each compartment differently.
 5. Frames: Fabricated from aluminum or cold-rolled steel sheet; ganged and nested units, with cardholder and blank cards for tenant's identification behind each compartment.
 6. Trim: Fabricated from same material as compartment doors.
 7. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
 8. Exposed Aluminum Finish: Finish surfaces exposed to view with **[silver powder coat on doors, black on trim] [gold powder coat on doors and trim] [silver powder coat on doors and trim] <Insert finish>**.
- B. Rack-Ladder, Rear-Loading Horizontal Mail Receptacles **<Insert drawing designation>**: Consisting of multiple compartments with open backs, enclosed within recessed, modular wall box, with approximate overall module dimensions of **12 inches high by 23-1/2 inches wide by 15-1/2 inches deep** (305 mm high by 596 mm wide by 394 mm deep); for installation between rack ladders. Provide access to compartments for distributing incoming mail from rear of unit with accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Salsbury Industries.
 - b. Security Manufacturing Corporation.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.

2. Compartments: Provide one within each module and number of modules as indicated on Drawings.
3. Compartments: Provide **[two] [four] [eight] [12] <Insert number>** equal-sized compartments within each module and number of modules as indicated on Drawings.
4. Compartments: Provide number and size, and number of modules as indicated on Drawings.
5. Compartment Doors: Fabricated from extruded aluminum. Equip each with lock, tenant identification, and concealed, full-length, flush hinge on one side.
 - a. Tenant Identification: Identification engraved into **[face of compartment door] [self-adhesive placards]**.
 - b. Compartment-Door Locks: Five-pin tumbler, cylinder **[cam] [spring-latch-type]** locks capable of at least 1000 key changes; with **[two] [three] <Insert number>** keys for each compartment door. Key each compartment differently.
6. Frames: Fabricated from aluminum or cold-rolled steel sheet; ganged and nested units, with cardholder and blank cards for tenant's identification behind each compartment.
7. Trim: Fabricated from same material as compartment doors.
8. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
9. Rack Ladders: Aluminum or steel with manufacturer's standard finish.
 - a. Height of Rack Ladders: **[Two] [Three] [Four] [Five] [Six]** modules high.
 - b. Provide two rack ladders for first column of modules and one ladder for each additional, adjacent column of modules.
10. Exposed Aluminum Finish: Finish surfaces exposed to view with **[silver powder coat on doors, black on trim] <Insert finish>**.

2.5 VERTICAL MAIL RECEPTACLES

- A. USPS-Approved Vertical Mail Receptacles **<Insert drawing designation>**: Consisting of three to seven compartments enclosed within wall box; with inside dimensions of each compartment not less than **15 inches high by 5 inches wide by 6 inches deep** (381 mm high by 127 mm wide by 152 mm deep). Provide access to compartments for distributing incoming mail from front of unit by unlocking master lock and tilting inner compartments forward as a group. Provide access to each compartment for removing mail by swinging compartment door. Comply with USPS-STD-4B+.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Eagle Mailboxes.
 - b. Auth-Florence Manufacturing; a Florence company.
 - c. Bommer Industries, Inc.
 - d. Salisbury Industries.

- e. Security Manufacturing Corporation.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
2. Mounting: **[Recessed] [Semirecessed with mounting frame] [Surface mounted with mounting frame] [As indicated on Drawings]**.
 3. Mail Delivery: **[USPS] [Private]**.
 4. Compartments: Provide **[three] <Insert number up to seven>**.
 5. Compartments: Provide number as indicated on Drawings.
 6. Compartment Doors and Frames: Fabricated from striated, extruded aluminum. Equip each compartment door with lock, slot in face of door to receive tenant identification, and concealed, full-length, flush hinge on one side. **[Provide one double-wide compartment with outgoing mail slot.]**
 - a. Tenant Identification: **[Cardboard name and number tab] [Laminated, black plastic tabs, engraved with identification]**.
 - b. Compartment-Door Locks: Five-pin tumbler, cylinder **[cam] [spring-latch-type]** locks capable of at least 1000 key changes; with **[two] [three] <Insert number>** keys for each compartment door. Key each compartment differently.
 - c. Compartment-Door Locks: Removable core locks, furnished by Owner and installed as Work of this Section.
 - d. Compartment-Door Locks: Spring-latch-type lock designed to accommodate cylinders keyed to building keying system; with **[two] [three] <Insert number>** keys for each compartment door. Provide cylinders specified in Section 087100 "Door Hardware."
 7. Frames: Fabricated from aluminum or cold-rolled steel sheet; ganged and nested units, with cardholder and blank cards for tenant's identification within each compartment.
 8. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
 9. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:
 - a. Anodic Finish: **[Clear] [Gold] [As indicated by manufacturer's designations] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 - b. Baked-Enamel or Powder-Coated Finish: **[Aluminum] [Black] [Brass] [Dark bronze] [Gold] [Green] [Ivory] [Medium bronze] [Silver] [Color as indicated by manufacturer's designations] [Color as selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
- 2.6 USPS-APPROVED CLUSTER BOX UNITS (CBUs) **<Insert drawing designation>**
- A. General: Consisting of multiple compartments enclosed within freestanding, pedestal-mounted enclosure. Provide access to compartments for distributing incoming mail from front of unit by unlocking master lock and swinging pair of side-hinged master doors to provide accessibility to entire group of compartments.

Provide access to each compartment for removing mail by swinging compartment door. Comply with USPS-B-1118F.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Auth-Florence Manufacturing; a Florence company.
 - b. Jayco Industries.
 - c. Salisbury Industries.
 - d. Security Manufacturing Corporation.
 - e. **<Insert manufacturer's name>**.
 - f. or approved equal.

- B. Compartment Enclosure: Fabricated from aluminum sheet with aluminum mounting pedestal and weather-protection hood, with the following number and size of compartments:
 1. Type I: Provide eight compartments **12 inches wide by 3 inches high by 15 inches deep** (305 mm wide by 76 mm high by 381 mm deep), one outgoing mail compartment **12 inches wide by 3 inches high by 15 inches deep** (305 mm wide by 76 mm high by 381 mm deep), one parcel compartment **12 inches wide by 10 inches high by 15 inches deep** (305 mm wide by 254 mm high by 381 mm deep), and another parcel compartment **12 inches wide by 13-1/2 inches high by 15 inches deep** (305 mm wide by 343 mm high by 381 mm deep).
 2. Type II: Provide 12 compartments **12 inches wide by 3 inches high by 15 inches deep** (305 mm wide by 76 mm high by 381 mm deep), one outgoing mail compartment **12 inches wide by 3 inches high by 15 inches deep** (305 mm wide by 76 mm high by 381 mm deep), and one parcel compartment **12 inches wide by 10 inches high by 15 inches deep** (305 mm wide by 254 mm high by 381 mm deep).
 3. Type III: Provide 16 compartments **12 inches wide by 3 inches high by 15 inches deep** (305 mm wide by 76 mm high by 381 mm deep), one outgoing mail compartment **12 inches wide by 3 inches high by 15 inches deep** (305 mm wide by 76 mm high by 381 mm deep), one parcel compartment **12 inches wide by 10 inches high by 15 inches deep** (305 mm wide by 254 mm high by 381 mm deep), and another parcel compartment **12 inches wide by 13-1/2 inches high by 15 inches deep** (305 mm wide by 343 mm high by 381 mm deep).
 4. Type IV: Provide 13 compartments **12 inches wide by 4-3/4 inches high by 15 inches deep** (305 mm wide by 121 mm high by 381 mm deep), one outgoing mail compartment **12 inches wide by 4-3/4 inches high by 15 inches deep** (305 mm wide by 121 mm high by 381 mm deep), and one parcel compartment **12 inches wide by 10 inches high by 15 inches deep** (305 mm wide by 254 mm high by 381 mm deep).

- C. Compartment Doors and Frames: Fabricated from one-piece extruded aluminum or aluminum sheet. Equip each compartment door with lock, tenant identification, and concealed, full-length, flush hinge on one side. Provide outgoing mail slot with weather protection flap.
 1. Tenant Identification: Number **[engraved into face]** **[applied into recess]** of compartment door.

2. Compartment-Door Locks: Comply with USPS-L-1172C, PSIN O910, for locks and keys, or equivalent as approved by USPS; with three keys for each compartment door. Key each compartment differently.
 3. Parcel-Locker-Door Locks: Two-key security system in which control key provides access to parcel-locker key, which opens compartment and is retained once opened.
- D. Pedestal: Aluminum, with same finish as compartment enclosure and attached with theft-resistant fasteners.
- E. Exposed Aluminum Finish: Finish surfaces exposed to view with powder-coated finish in [**postal gray (light gray)**] [**color as selected by DEN Project Manager from manufacturer's full range of colors**] <Insert color>.
- 2.7 NEIGHBORHOOD DELIVERY AND COLLECTION BOX UNITS (NDCBUs) <Insert drawing designation>
- A. General: Consisting of multiple compartments, with inside dimensions of each compartment not less than **5 inches high by 6 inches wide by 15 inches deep** (127 mm high by 152 mm wide by 381 mm deep), enclosed within freestanding, pedestal-mounted enclosure. Provide access to compartments for distributing incoming mail from rear of unit by side-hinged rear door with accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bommer Industries, Inc.
 - b. Jayco Industries.
 - c. Jensen Industries.
 - d. <Insert manufacturer's name>.
 - e. or approved equal.
- B. Compartment Enclosure: Fabricated from aluminum sheet with integral weather protection hood, with [**eight equal-sized compartments (Type I)**] [**12 equal-sized compartments (Type II)**] [**16 equal-sized compartments (Type III)**] [**compartments of number and size as indicated on Drawings**] <Insert description>.
- C. Compartment Doors and Frames: Fabricated from one-piece extruded aluminum or aluminum sheet. Equip each compartment door with lock, tenant identification, and concealed, full-length, flush hinge on one side. [**Provide top left compartment with outgoing mail slot.**]
1. Tenant Identification: Number engraved into face of compartment door.
 2. Compartment-Door Locks: Dustproof, five-pin tumbler, cylinder cam locks capable of at least 1000 key changes; with [**three**] <Insert number> keys for each compartment door. Key each compartment differently.

- D. Rear-Loading Door: Fabricated from aluminum sheet, with full-length, stainless-steel piano hinge on one side and three-point latching mechanism on the other. Fabricate rear-loading door to open not less than 90 degrees and to remain open while mail is deposited.
1. Rear-Door Lock: Door prepared to receive lock furnished by local postmaster.
 2. Rear-Door Lock: Cylinder lock with **[two] [three] <Insert number>** keys. Provide cylinders specified in Section 087100 "Door Hardware."
- E. Pedestal: **[Same material and finish as compartment enclosure and attached with theft-resistant fasteners] [As indicated on Drawings].**
- F. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:
1. Anodic Finish: **[Clear] <Insert color>**.
 2. Baked-Enamel or Powder-Coated Finish: **[Black] [Dark bronze] [Gold] [Medium bronze] [Color as selected by DEN Project Manager from manufacturer's full range] <Insert color>**.

2.8 USPS-APPROVED PARCEL LOCKERS

- A. Front-Loading, USPS-Approved Indoor Parcel Lockers **<Insert drawing designation>**: Consisting of single or multiple compartments enclosed within a larger enclosure of type indicated below. Provide access to compartments for distributing incoming parcels from front of unit. Provide access to each compartment for removing parcels by swinging compartment door. Comply with **[USPS-STD-4C] [USPS-STD-4B+ or USPS-B-1116A construction, adapted for larger-sized, interior, parcel compartments]**.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Eagle Mailboxes.
 - b. American Postal Manufacturing Co.; Division of Postal Products Unlimited, Inc.
 - c. Auth-Florence Manufacturing; a Florence company.
 - d. Bommer Industries, Inc.
 - e. Jensen Industries.
 - f. Salsbury Industries.
 - g. Security Manufacturing Corporation.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.
 2. Enclosure Type: **[Recessed] [Freestanding]**.
 3. Mail Delivery: **[USPS] [Private]**.
 4. Compartments: **[Number and size as follows:] [As indicated on Drawings, of the following sizes:] [As indicated on Drawings.]**

- a. Type X, Parcel Only (No Master Door): Single parcel receptacle [15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep)] [18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep)].
 - b. Type X, Parcel Only (No Master Door): A group of parcel receptacles in single-column configuration without a master door; [one] [two] compartment(s) 18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep)[and] [one compartment 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep)].
 - c. Type XI, Parcel Only: A group of parcel receptacles in single-column configuration with single master door prepared for master-door lock; [one] [two] [compartment(s) 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep)] [and] [one] [two] [compartment(s) 18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep)].
5. Compartments: Fabricated from aluminum sheet with number and size [as follows:] [as indicated on Drawings.]
- a. Type I: Provide one box with two compartments, one on top of the other, each compartment with inside dimensions of 12 inches wide by 14 inches high by 15 inches deep (305 mm wide by 356 mm high by 381 mm deep).
 - b. Type II: Provide one box with four compartments, side by side, two on top and two on bottom, each compartment with inside dimensions of 12 inches wide by 14 inches high by 15 inches deep (305 mm wide by 356 mm high by 381 mm deep).
6. Front-Loading Master Door: Fabricated to hold compartment doors; prepared to receive master-door lock provided by local postmaster.
7. Compartment Doors and Frames: Fabricated from [same material and finish as adjacent mail receptacles] [extruded aluminum] [aluminum sheet] [metallic-coated steel sheet] [aluminum or metallic-coated steel sheet]. Equip each compartment door with lock, identification, and concealed, full-length, spring-loaded, flush hinge on right side.
- a. Compartment Identification: Black, sequential numbers [engraved into] [stamped onto] recess in face of compartment door.
 - b. Compartment-Door Locks: Dual lock security system in which master lock provides access to customer lock (USPS-L-1172C, PSIN O910) and parcel-locker key opens compartment and is retained once opened.
 - c. Compartment-Door Locks: Two-key security system in which control key provides access to parcel-locker key, which opens compartment and is retained once opened.
8. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:
- a. Anodic Finish: [Clear] [Brass] [Dark bronze] [As indicated by manufacturer's designations] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.

- b. Baked-Enamel or Powder-Coated Finish: **[Silver] [Black] [Medium bronze] [Dark bronze] [Gold] [Color as indicated by manufacturer's designations] [Color as selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 9. Metallic-Coated Steel Finish: Finish surfaces exposed to view with baked-enamel or powder-coated finish; **[color as indicated by manufacturer's designations] [color as selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
- B. Rear-Loading, USPS-Approved Indoor Parcel Lockers **<Insert drawing designation>**: Consisting of single or multiple compartments enclosed within recessed wall box. Provide access to compartments for distributing incoming parcels from rear of unit with accessibility to entire group of compartments. Provide access to each compartment for removing parcels by swinging compartment door. Comply with **[USPS-STD-4C] [USPS-STD-4B+ or USPS-B-1116A construction, adapted for larger-sized, interior, parcel compartments]**.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Eagle Mailboxes.
 - b. American Postal Manufacturing Co.; Division of Postal Products Unlimited, Inc.
 - c. Auth-Florence Manufacturing; a Florence company.
 - d. Bommer Industries, Inc.
 - e. Jensen Industries.
 - f. Salsbury Industries.
 - g. Security Manufacturing Corporation.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.
 2. Mail Delivery: **[USPS] [Private]**.
 3. Compartments: **[Number and size as follows:] [As indicated on Drawings, of the following sizes:] [As indicated on Drawings.]**
 - a. Type XII, Parcel Only: A group of parcel receptacles in single-column configuration with a rear-access cover; **[one] [two] [compartment(s) 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep)] [and] [one] [two] [compartment(s) 18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep)]**.
 4. Compartments: Fabricated enclosure with number and size **[as follows:] [as indicated on Drawings.]**
 - a. Type I: Provide one box with two compartments, one on top of the other, each compartment with inside dimensions of **12 inches wide by 14 inches high by 15 inches deep (305 mm wide by 356 mm high by 381 mm deep)**.

pedestal-mounted enclosure. Provide access to compartments for distributing incoming mail from front of unit by unlocking master lock and swinging pair of side-hinged master doors to provide accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door. Comply with USPS-B-1116A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Auth-Florence Manufacturing; a Florence company.
 - b. Jayco Industries.
 - c. Salsbury Industries.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
2. Compartment Enclosure: Fabricated from aluminum sheet with aluminum mounting pedestal and weather-protection hood, with the following number and size of compartments:
 - a. Type I: Provide one box with two compartments, one on top of the other, each compartment with inside dimensions of **12 inches wide by 14 inches high by 15 inches deep** (305 mm wide by 356 mm high by 381 mm deep).
 - b. Type II: Provide one box with four compartments, side by side, two on top and two on bottom, each compartment with inside dimensions of **12 inches wide by 14 inches high by 15 inches deep** (305 mm wide by 356 mm high by 381 mm deep).
3. Compartment Doors and Frames: Fabricated from one-piece extruded aluminum or aluminum sheet. Equip each compartment door with lock, tenant identification, and concealed, full-length, flush hinge on one side. Provide outgoing mail slot with weather protection flap.
 - a. Locker Identification: Number **[engraved into face] [applied into recess]** of compartment door.
 - b. Door Locks: Two-key security system in which control key provides access to parcel-locker key, which opens compartment and is retained once opened.
4. Pedestal: Aluminum, with same finish as compartment enclosure and attached with theft-resistant fasteners.
5. Exposed Aluminum Finish: Finish surfaces exposed to view with powder-coated finish in **[postal gray (light gray)] [color as selected by DEN Project Manager from manufacturer's full range of colors] <Insert color>**.

2.9 USPS-APPROVED COLLECTION BOXES

- A. USPS-Approved, Front-Loading **[Collection] [Receiving]** Boxes **<Insert drawing designation>**: Consisting of single compartment with fire-resistant cushion bottom, enclosed within wall box, with **[mail slot] [hopper door]** to receive mail. Provide

access to compartment for collecting mail from front of unit. Comply with USPS Publication 16.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Auth-Florence Manufacturing; a Florence company.
 - b. Bommer Industries, Inc.
 - c. Jayco Industries.
 - d. Security Manufacturing Corporation.
 - e. U.S. Chutes; Division of USC Group.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
2. Mail Collection: **[USPS] [Private]**.
3. Mounting: **[Recessed] [Semirecessed] [Surface mounted]**.
4. Type: **[Collection box] [Receiving box for mail chutes]**.
5. Height: Sized to match height of **[four] [five] [six] [seven] <Insert number>** horizontal mail receptacles.
6. Height: **[As indicated on Drawings] <Insert dimension>**.
7. Compartment Door and Frame: Fabricated from **[1/4-inch- (6-mm-)] [minimum 1/8-inch- (3-mm-)]** thick aluminum, with opening not less than **12 by 20 inches (305 by 508 mm)** and not more than **18 by 30 inches (457 by 762 mm)**. Equip door with lock and concealed, full-length, flush hinge on one side.
 - a. Door Lock: Door prepared to receive lock provided by local postmaster.
 - b. Text cited in first subparagraph below is for USPS; revise to suit Project.
 - c. Identification: Engrave face of compartment door with **1-inch- (25-mm-)** high letters as follows: "U.S. MAIL LETTER BOX" on two lines at top or bottom of unit.
 - d. Door Style: **[Set door within face frame] [Extend door full width and height of unit, with no exposed frame]**.
8. Mail Slot: Fabricated from **1/4-inch- (6-mm-)** thick aluminum, with **11-inch-wide by 1-1/4-inch- (279-mm-wide by 32-mm-)** high opening, protected by inside hood and hinge flap, and with inside baffle to prevent removal of mail from box.
9. Hopper Door: Fabricated from **1/4-inch- (6-mm-)** thick aluminum, with opening that allows a bundle measuring **6-1/2 inches wide by 11-1/2 inches long by 4 inches high (165 mm wide by 292 mm long by 102 mm high)** to be deposited, and with inside baffle to prevent removal of mail from box. Equip door with door pull and concealed, full-length bottom hinge.
 - a. Identification: Engrave face of hopper door with **1-inch- (25-mm-)** high letters as follows: "LETTERS AND LETTER MAIL TIED IN BUNDLES."
 - b. Door Style: **[Set door within face frame] [Extend door full width and height of unit, with no exposed frame]**.
10. Exposed Materials: Fabricated from **[stainless-steel-clad] [brass-clad]** extruded or sheet aluminum.

11. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
 12. Schedule-Card Holder: Provide recessed or surface-mounted holder for pick-up schedule card in center of bottom front portion of unit. Fabricate of same material and finish as front of unit.
 13. Mailbag Hooks: Provide two aluminum or stainless-steel hooks at exterior front edge of bottom of surface-mounted units, spaced **15 to 17-1/2 inches** (381 to 445 mm) apart, for supporting mailbags.
 14. Mailbag Rack: Provide internal rack system for supporting mailbags within unit.
- B. USPS-Approved, Rear-Loading Collection Boxes **<Insert drawing designation>**: Consisting of single compartment with fire-resistant cushion bottom, enclosed within recessed wall box, with **[mail slot] [hopper door]** to receive mail. Provide access to compartment for collecting mail from rear of unit. Comply with USPS Publication 16.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Auth-Florence Manufacturing; a Florence company.
 - b. Bommer Industries, Inc.
 - c. Jayco Industries.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
 2. Mail Collection: **[USPS] [Private]**.
 3. Height: Sized to match height of **[four] [five] [six] [seven]** horizontal mail receptacles.
 4. Height: **[As indicated on Drawings] <Insert dimension>**.
 5. Compartment Frame and Front Panel: Fabricated from **[1/4-inch- (6-mm-)] [minimum 1/8-inch- (3-mm-)]** thick aluminum.
 - a. Identification: Engrave face of front panel with **1-inch- (25-mm-)** high letters as follows: "U.S. MAIL LETTER BOX" on two lines at top or bottom of unit.
 6. Mail Slot: Fabricated from **1/4-inch- (6-mm-)** thick metal plate, with **11-inch-wide by 1-1/4-inch- (279-mm-wide by 32-mm-)** high opening, protected by inside hood and hinge flap, and with inside baffle to prevent removal of mail from box.
 7. Hopper Door: Fabricated from **1/4-inch- (6-mm-)** thick metal plate, with opening that allows a bundle measuring **6-1/2 inches wide by 11-1/2 inches long by 4 inches high** (165 mm wide by 292 mm long by 102 mm high) to be deposited, and with inside baffle to prevent removal of mail from box. Equip door with door pull and concealed, full-length bottom hinge.
 - a. Identification: Engrave face of hopper door with **1-inch- (25-mm-)** high letters as follows: "LETTERS AND LETTER MAIL TIED IN BUNDLES."
 - b. Door Style: **[Set door within face frame] [Extend door full width and height of unit, with no exposed frame]**.
 8. Rear-Loading Enclosure: Lift-off rear cover fabricated from same material and finish as front of unit.

9. Rear-Loading Door: Side hinged, with opening not less than **12 by 20 inches** (305 by 508 mm) and not more than **18 by 30 inches** (457 by 762 mm), fabricated from same material and finish as front of unit; with full-length, stainless-steel piano hinge on one side and positive-latching mechanism on the other. Fabricate rear-loading door to remain open while mail is collected.
 - a. Rear-Door Lock: Door prepared to receive lock provided by local postmaster.
10. Exposed Materials: Fabricated from extruded or sheet aluminum.
11. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
12. Schedule-Card Holder: Provide recessed or surface-mounted holder for pick-up schedule card in center of bottom front portion of unit. Fabricate of same material and finish as front of unit.
13. Mailbag Hooks: Provide two aluminum or stainless-steel hooks at exterior front edge of bottom of surface-mounted units, spaced **15 to 17-1/2 inches** (381 to 445 mm) apart, for supporting mailbags.
14. Mailbag Rack: Provide internal rack system for supporting mailbags within unit.

C. Finish surfaces exposed to view as follows:

1. Aluminum Finish: Finish surfaces exposed to view as follows:
 - a. Anodic Finish: **[Clear] [Black] [Gold] [Dark bronze] [Light bronze] [Medium bronze] [As indicated by manufacturer's designations] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 - b. Baked-Enamel or Powder-Coated Finish: **[Black] [Gold] [Dark bronze] [Medium bronze] [Silver] [Color as indicated by manufacturer's designations] [Color as selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
2. Brass Finish: **[Buffed finish, lacquered] [Hand-rubbed finish, lacquered] [Brushed satin, lacquered] <Insert finish>**.
3. Stainless-Steel Finish: No. 4.

2.10 PRIVATE COLLECTION BOXES

- A. Private, Horizontal, Front-Loading Collection Boxes **<Insert drawing designation>**: Consisting of single compartment of same depth as horizontal mail receptacles, enclosed within wall box, with slot in top of front to receive mail. Provide access to compartment for collecting mail from front of unit.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Auth-Florence Manufacturing; a Florence company.
 - b. Bommer Industries, Inc.

- c. **<Insert manufacturer's name>**.
 - d. or approved equal.
 2. Height: Sized to match height of **[four] [five] [six] [seven]** horizontal mail receptacles.
 3. Mounting: **[Recessed] [Semirecessed] [Surface mounted]**.
 4. Compartment Door and Frame: Fabricated from extruded aluminum or aluminum sheet that is **[full height of unit including] [in portion of unit below]** mail slot, and equipped with lock and concealed, continuous side hinge.
 - a. Door Lock: Door prepared to receive lock provided by local postmaster.
 - b. Identification: Engrave face of compartment door with **1-inch-** (25-mm-) high letters as follows: **"[LETTERS] [OUTGOING MAIL] [OFFICE] <Insert text>."**
 5. Aluminum Finish: Finish surfaces exposed to view as follows:
 - a. Anodic Finish: **[Clear] <Insert color>**.
 - b. Baked-Enamel or Powder-Coated Finish: **[Black] [Dark bronze] [Gold] [Medium bronze] [Color as indicated by manufacturer's designations] [Color as selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
- B. Private, Horizontal, Rear-Loading Collection Boxes **<Insert drawing designation>**: Consisting of single compartment of same depth as horizontal mail receptacles, enclosed within recessed wall box, with slot in top of front to receive mail. Provide access to compartment for collecting mail from rear of unit.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Auth-Florence Manufacturing; a Florence company.
 - b. Bommer Industries, Inc.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.
 2. Height: Sized to match height of **[four] [five] [six] [seven]** horizontal mail receptacles.
 3. Rear-Loading Cover: **[Not required] [Lift-off rear cover fabricated from extruded aluminum or aluminum sheet, finished to match front of unit]**.
 4. Rear-Loading Door: Side hinged, fabricated from extruded aluminum or aluminum sheet, finished to match front of unit; with continuous hinge on one side and **[positive-latching] [locking]** mechanism on the other.
 - a. Rear-Door Lock: Door prepared to receive lock provided by local postmaster.
 - b. Rear-Door Lock: Cylinder lock keyed to building keying system; with **[two] [three] <Insert number>** keys. Provide cylinders specified in Section 087100 "Door Hardware."

5. Exposed Materials: Fabricated from extruded or sheet aluminum.
 6. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
 7. Identification: Engrave front of unit below mail slot with **1-inch-** (25-mm-) high letters as follows: "[**LETTERS**] [**OUTGOING MAIL**] [**OFFICE**] <Insert text>."
 8. Aluminum Finish: Finish surfaces exposed to view as follows:
 - a. Anodic Finish: [**Clear**] <Insert color>.
 - b. Baked-Enamel or Powder-Coated Finish: [**Black**] [**Dark bronze**] [**Gold**] [**Medium bronze**] [**Color as indicated by manufacturer's designations**] [**Color as selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
- C. Vertical Collection Boxes <Insert drawing designation>: Consisting of single compartment enclosed within wall box, with slot in top of front to receive mail. Provide access to compartment for collecting incoming mail from front of unit.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Auth-Florence Manufacturing; a Florence company.
 - b. Bommer Industries, Inc.
 - c. Jensen Industries.
 - d. Salsbury Industries.
 - e. Security Manufacturing Corporation.
 - f. <Insert manufacturer's name>.
 - g. or approved equal.
 2. Mounting: [**Recessed**] [**Semirecessed**] [**Surface mounted**].
 3. Size: [**Same height as adjacent vertical mail receptacles**] [**8-3/4 inches wide by 19 inches high by 6-1/2 inches deep** (222 mm wide by 483 mm high by 165 mm deep)] [**15 inches wide by 19 inches high by 6-1/2 inches deep** (381 mm wide by 483 mm high by 165 mm deep)] <Insert dimensions>.
 4. Compartment Door and Frame: Fabricated from aluminum, with opening for mail. Equip door with lock and concealed, full-length, flush hinge on one side. Set door within face frame.
 - a. Door Lock: Door prepared to receive lock provided by local postmaster.
 - b. Door Lock: Cylinder lock keyed to building keying system; with [**two**] [**three**] <Insert number> keys. Provide cylinders specified in Section 087100 "Door Hardware."
 - c. Identification: Engrave face of compartment door with **1-inch-** (25-mm-) high letters as follows: "[**LETTERS**] [**OUTGOING MAIL**] [**OFFICE**] <Insert text>."
 5. Exposed Materials: Fabricated from extruded or sheet aluminum.
 6. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
 7. Aluminum Finish: Finish surfaces exposed to view as follows:

- a. Anodic Finish: **[Clear]** <Insert color>.
 - b. Baked-Enamel or Powder-Coated Finish: **[Aluminum]** **[Black]** **[Brass]** **[Dark bronze]** **[Gold]** **[Green]** **[Ivory]** **[Medium bronze]** **[Silver]** **[Color as indicated by manufacturer's designations]** **[Color as selected by DEN Project Manager from manufacturer's full range]** <Insert color>.
- D. Private, Pedestal-Mounted Collection Boxes <Insert drawing designation>: Consisting of single compartment enclosed within freestanding, pedestal-mounted enclosure, with slot in top of front of unit to receive mail. Provide access to compartment for collecting mail from **[front]** **[or]** **[rear]** of unit through door equipped with concealed, continuous side hinge and lock.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Auth-Florence Manufacturing; a Florence company.
 - b. Salisbury Industries.
 - c. <Insert manufacturer's name>.
 - d. or approved equal.
 2. Compartment Enclosure: Fabricated from extruded aluminum or aluminum sheet with integral weather-protection hood.
 3. Pedestal: **[Same material and finish as parcel locker and attached with theft-resistant fasteners]** **[As indicated on Drawings]**.
 4. Aluminum Finish: Finish surfaces exposed to view as follows:
 - a. Anodic Finish: **[Clear]** <Insert color>.
 - b. Baked-Enamel or Powder-Coated Finish: **[Blue]** **[Gray]** **[White]** **[Color as indicated by manufacturer's designations]** **[Color as selected by DEN Project Manager from manufacturer's full range]** <Insert color>.
- E. Private, Curbside Collection Boxes <Insert drawing designation>: Consisting of single compartment enclosed within curved-top, freestanding enclosure with four legs **and casters**. Fabricate enclosure from welded and riveted steel. Provide hopper door with door pull in top of unit to receive packages, with opening size not less than **4-1/2 inches high by 15-1/2 inches wide** (114 mm high by 394 mm wide). Provide access to compartment for collecting packages from bottom of front of unit through door equipped with concealed, continuous bottom hinge and lock.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charnstrom, W. A. Company.
 - b. Salisbury Industries.
 - c. Security Manufacturing Corporation.
 - d. <Insert manufacturer's name>.
 - e. or approved equal.
 2. Door Lock: **[Five-pin tumbler cylinder]** **[Hasp for padlock]**.

3. Snorkel: Provide rear-mounted, drive-by attachment with opening not less than **12 inches wide by 3 inches high** (305 mm wide by 76 mm high).
4. Steel Finish: Baked-enamel or powder-coated finish; **[gray] [white] [color as indicated by manufacturer's designations] [color as selected by DEN Project Manager from manufacturer's full range] <Insert color>**.

2.11 DATA DISTRIBUTION BOXES

- A. Data Distribution Boxes **<Insert drawing designation>**: Consisting of multiple compartments enclosed within enclosure.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Salsbury Industries.
 - b. Security Manufacturing Corporation.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.
 2. Enclosure Configuration: **[Freestanding] [Recessed in wall] [Recessed in wall and installed between rack ladders]**.
 3. Compartment Access: Provide access to compartments as follows:
 - a. For Distributing Incoming Mail from Front of Unit: Mail slot in each compartment door.
 - b. For Distributing Incoming Mail from Rear of Unit: Open backs **[with aluminum cover finished to match front of unit]**.
 - c. For Removing Mail: Unlocking and swinging compartment door.
 4. Compartments: **[Number and size as follows:] [As indicated on Drawings, of the following sizes:] [As indicated on Drawings.]**
 - a. Size 1: Provide **<Insert number>** compartments with inside dimensions not less than **5 inches high by 12-1/2 inches wide by 15 inches deep** (127 mm high by 318 mm wide by 381 mm deep).
 - b. **<Insert compartment description>**.
 5. Compartment Doors: Equip each with lock and concealed, continuous hinge.
 - a. Door Locks: Five-pin tumbler, cylinder **[cam] [spring-latch-type]** locks capable of at least 1000 key changes; with **[two] [three] <Insert number>** keys for each compartment door. Key each compartment differently.
 - b. Door Locks: Three-digit, single-dial, combination locks with spring latch and automatic throw off. Set each compartment with different combination.
 6. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
 7. Exposed Materials: Fabricated from steel sheet or aluminum with powder-coat finish.

8. Rack Ladders: Aluminum or steel with manufacturer's standard finish.
9. Powder-Coated Finish: [**Silver**] [**Silver with black trim**] [**Silver with slate trim**] [**Sandalwood with sand trim**] [**Color as indicated by manufacturer's designations**] [**Color as selected by DEN Project Manager from manufacturer's full range**] <Insert color>.

2.12 MAIL CHUTES

- A. General: Factory assembled and fabricated with tight joints, overlaps in direction of mail flow, and free of ledges. Provide transition sections so all sections of chutes are connected and overlap at least **2 inches** (51 mm). Fabricate mail chutes so joint sections comply with same dimensions with no reduction in chute size. Provide removable panels for access to concealed portions of chutes that exceed **5 feet** (1.5 m) in length. [**Comply with USPS Publication 16.**]
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. U.S. Chutes; Division of USC Group.
 - b. <Insert manufacturer's name>.
 - c. or approved equal.
 2. Mail Collection: [**USPS**] [**Private**].
 3. Inside Dimensions: [**8 inches wide by 2 inches deep** (203 mm wide by 51 mm deep)] [**14 inches wide by 3 inches deep** (356 mm wide by 76 mm deep)] [**14 inches wide by 7 inches deep** (356 mm wide by 178 mm deep)] <Insert dimensions>.
 4. Mounting: [**Recessed**] [**Semirecessed**] [**Surface mounted**] [**As detailed**].
- B. Exposed Front Panels: Continuous, one-piece frames and covers fabricated from **0.125-inch-** (3.2-mm-) thick, [**stainless-steel-clad**] [**brass-clad**] extruded aluminum, and retaining removable transparent material as follows, for not less than 3/4 of length of front of chute on each floor:
 1. Transparent Material: [**Manufacturer's standard glazing**] <Insert requirement>, complying with USPS Publication 16.
- C. Concealed Front Panels: Consisting of continuous, one-piece frames retaining **0.0269-inch-** (0.7-mm-) thick, metallic-coated steel sheet panels. Extend concealed front panels from top of ceiling fasciae to bottom of floor collar above.
- D. Sides and Backs: Continuous, one-piece, **0.125-inch-** (3.2-mm-) thick aluminum sheet extending from floor to ceiling on each floor and extending **54 inches** (1372 mm) above finish flooring at top story.
- E. Floor and Ceiling Fasciae and Lock Band: Manufacturer's standard, matching material and finish of front frames and covers. Provide lock band with locking device and keyed lock that prevents key removal if locking device is not secured.

- F. Mail Slots: Same material and finish as chute; not less than **4-3/4 inches wide by 1/2 inch high** (121 mm wide by 13 mm high) with device designed to guide mail into inside opening of same size located **2-1/2 inches** (64 mm) below mail slot. Provide mail slots on each floor.
1. Inscribe the words "[**U.S. MAIL**] <Insert text>" on face of mail slots.
- G. Finish surfaces exposed to view as follows:
1. Aluminum Finish: Finish surfaces exposed to view as follows:
 - a. Anodic Finish: [**Clear**] [**Black**] [**Dark bronze**] [**Medium bronze**] [**As indicated by manufacturer's designations**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 - b. Baked-Enamel or Powder-Coated Finish: [**Color as indicated by manufacturer's designations**] [**Color as selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 2. Brass Finish: [**Buffed finish, lacquered**] [**Hand-rubbed finish, lacquered**] [**Brushed satin, lacquered**] <Insert finish>.
 3. Stainless-Steel Finish: No. 4.

2.13 ACCESSORIES

- A. Directory for Mail Receptacles <Insert drawing designation>: Surface-mounted, front-opening unit, with clear glass or plastic window.
1. Framed, Top-Mount Unit for Horizontal Mail Receptacles: Fabricate directory as framed, horizontal unit with modular sections having a [**24-name capacity (3 modules)**] [**32-name capacity (4 modules)**] [**40-name capacity (5 modules)**]; of same material[, size,] and finish as adjacent mail receptacles; mounted above mail receptacles[**as indicated on Drawings**].
 2. Framed, Side-Mount Unit for Horizontal Mail Receptacles: Fabricate directory as framed, horizontal unit with [**50-name capacity, 28 inches** (711 mm)] [**60-name capacity, 33-3/8 inches** (848 mm)] [**70-name capacity, 38-3/4 inches** (984 mm)] high; of same material and finish as adjacent mail receptacles; mounted along side of mail receptacles[**as indicated on Drawings**].
 3. Framed, Side-Mount Unit for Vertical Mail Receptacles: Fabricate directory as framed, vertical unit with modular sections having a [**40-name capacity (1 module)**] [**80-name capacity (2 modules)**] [**120-name capacity (3 modules)**] [**160-name capacity (4 modules)**] [**200-name capacity (5 modules)**]; of same size, material, and finish as adjacent vertical mail compartment doors unless otherwise indicated.
 4. Insert Units for Vertical Mail Receptacles: Fabricate directory as modular inserts having a [**40-name capacity (1 module)**] [**80-name capacity (2 modules)**] [**120-name capacity (3 modules)**] [**160-name capacity (4 modules)**] [**200-name capacity (5 modules)**]; of same size, material, and finish as adjacent vertical mail compartment doors unless otherwise indicated.
 5. Provide name strips made of **1/4-inch-** (6-mm-) high label tape.

- B. Key Keeper **<Insert drawing designation>**: Consisting of single compartment with door; interior compartment size not less than **[4-3/4 inches wide by 2-1/4 inches high by 1-1/2 inches deep]** (121 mm wide by 57 mm high by 38 mm deep) **<Insert dimension>**.**[USPS approved.]**
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Auth-Florence Manufacturing; a Florence company.
 - b. Bommer Industries, Inc.
 - c. Jensen Industries.
 - d. Knox Company.
 - e. Salsbury Industries.
 - f. Security Manufacturing Corporation.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
 2. Mounting: **[Recessed] [Surface mounted]**.
 3. Style: Compartment door **[set within face frame] [extending full width and height of unit, with no exposed frame]**.
 4. Type of Operation: **[Loose key in box] [Retractor reel with minimum 20-inch-(508-mm-) long chain] [Push button, 24-V switch in box]**.
 5. Mail Delivery: **[USPS] [Private]**.
 6. Door Lock: Door prepared to receive lock furnished by local postmaster.
 7. Door Lock: Five-pin tumbler, cylinder cam lock capable of at least 1000 key changes; with **[two] [three] <Insert number>** keys.
 8. Door Lock: Cylinder lock keyed to building keying system; with **[two] [three] <Insert number>** keys. Provide cylinders specified in Section 087100 "Door Hardware."
 9. Exposed Material and Finish: Exposed surfaces fabricated from same material and finish as adjacent mail receptacles.
 10. Exposed Material and Finish: Steel, **[aluminum] [brass]** powder-coated finish.
 11. Exposed Material and Finish: Stainless steel, brushed finish.
 12. Exposed Material and Finish: Aluminum, as follows:
 - a. Anodic Finish: **[Clear] [Brass] [Dark bronze] [As indicated by manufacturer's designations] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 - b. Baked-Enamel or Powder-Coated Finish: **[Black] [Dark bronze] [Medium bronze] [Gold] [Color as indicated by manufacturer's designations] [Color as selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
- C. Key Cabinet **<Insert drawing designation>**: Wall-mounted,**[metallic-coated]** steel cabinet with pivoting, key-holding panels and side-hinged door equipped with five-pin tumbler, cylinder door lock and concealed, full-length flush hinge. Finish cabinet, panels, and door with baked-enamel or powder-coated finish. Provide key control system consisting of key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers.

1. Capacity: Keys for [**150 percent of the number of**] <Insert number> mail-receptacle locks.
 2. Cross-Index System: Consisting of index cards for recording key information. Include three receipt forms for each key-holding hook.
 3. Baked-Enamel or Powder-Coated Finish: [**Color as indicated by manufacturer's designations**] [**Color as selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
- D. Mail-Sorting Collection Unit <Insert drawing designation>: Consisting of **1/4-inch-** (6-mm-) thick, metal faceplate and through-the-wall hopper door(s) allowing receipt and separation of mail.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bommer Industries, Inc.
 - b. Security Manufacturing Corporation.
 - c. U.S. Chutes; Division of USC Group.
 - d. <Insert manufacturer's name>.
 - e. or approved equal.
 2. Hopper Doors: [**One**] [**Two**] [**Three**] door(s), with door pull for each and with opening size not less than <Insert dimensions>.
 - a. Engrave doors with **1-inch-** (25-mm-) high letters as follows: "[**STAMPED MAIL**] [**METERED MAIL**] <Insert text>."
 - b. Identification: Engrave unit at top with **2-inch-** (51-mm-) high letters as follows: "[**U.S. MAIL**] [**UNITED STATES MAIL**] <Insert text>."
 3. Exposed Material and Finish: Exposed surfaces fabricated from same material and finish as adjacent mail receptacles.
 4. Aluminum Finish: Finish surfaces exposed to view as follows:
 - a. Anodic Finish: [**Clear**] [**Black**] [**Dark bronze**] [**Light bronze**] [**Medium bronze**] [**As indicated by manufacturer's designations**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 - b. Baked-Enamel or Powder-Coated Finish: [**Black**] [**Dark bronze**] [**Gold**] [**Medium bronze**] [**Color as indicated by manufacturer's designations**] [**Color as selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 5. Brass Finish: [**Buffed finish, lacquered**] [**Hand-rubbed finish, lacquered**] [**Brushed satin, lacquered**] <Insert finish>.
 6. Stainless-Steel Finish: No. 4.
- E. Letter Drops (Through Wall) <Insert drawing designation>: Consisting of **11-inch-wide by 3-1/2-inch-** (279-mm-wide by 89-mm-) high, top-hinged, spring-loaded flap that pivots inward, held in place by **1-inch-** (25-mm-) wide face frame. Fabricated from **1/4-inch-** (6-mm-) thick aluminum or steel, with exposed surfaces finished to match adjacent mail receptacles.

1. Sleeve: Provide[**metallic-coated**] steel wall sleeve for full depth of wall.
 2. Finished Frame: Provide finished face frame on back side of wall opening.
 3. Identification: Engrave face of swinging flap with **1-inch- (25-mm-)** high letters as follows: "[**U.S. MAIL**] [**LETTERS**] [**OUTGOING MAIL**] <Insert text>."
 4. Exposed Material and Finish: [**Exposed surfaces fabricated from same material and finish as adjacent mail receptacles**] <Insert material and finish>.
- F. Package Depository (Through Wall) <Insert drawing designation>: Consisting of **1/4-inch- (6-mm-)** thick, aluminum or steel face plate and through-the-wall hopper door[**with hinged baffle**] allowing receipt of packages; fabricated from **1/4-inch- (6-mm-)** thick aluminum or steel.
1. Hopper Door: Equipped with door pull and concealed, full-length bottom hinge; with opening size [**not less than 15 inches wide by 6-1/2 inches high** (381 mm wide by 165 mm high)] [**as indicated on Drawings**] <Insert dimensions>.
 2. Sleeve: Provide[**metallic-coated**] steel wall sleeve for full depth of wall.
 3. Slowdown: Provide steel slowdown ramp on back side of wall opening.
 4. Identification: Engrave face of hopper door with **1-inch- (25-mm-)** high letters as follows: "[**BOOK DEPOSITORY**] <Insert text>."
 5. Finish: Exposed surfaces finished same as mail receptacles.
 6. Aluminum Finish: Finish surfaces exposed to view as follows:
 - a. Anodic Finish: [**Clear**] [**As indicated by manufacturer's designations**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 - b. Baked-Enamel or Powder-Coated Finish: [**Dark bronze**] [**Gold**] [**Color as indicated by manufacturer's designations**] [**Color as selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 7. Steel Finish: Finish surfaces exposed to view with baked-enamel or powder-coated finish; [**color as indicated by manufacturer's designations**] [**color as selected by DEN Project Manager from manufacturer's full range**] <Insert color>.

2.14 FABRICATION

- A. Form postal specialties to required shapes and sizes, with true lines and angles, square, rigid, and without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges and corners free of sharp edges and burrs and safe to touch. Fabricate doors of postal specialties to preclude binding, warping, or misalignment.
- B. Preassemble postal specialties in shop to greatest extent possible to minimize field assembly.
- C. Mill joints to a tight, hairline fit. Cope or miter corner joints. Form joints exposed to weather to exclude water penetration.

- D. Drill or punch holes required for fasteners and remove burrs. Use security fasteners where fasteners are exposed. If used, seal external rivets before finishing.
- E. Weld in concealed locations to greatest extent possible without distorting or discoloring exposed surfaces. Remove weld spatter and welding oxides from exposed surfaces.
- F. Fabricate tubular and channel frame assemblies with manufacturer's standard welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support loads.
- G. Fabricate rack ladders to support indicated number of units to form a column of units.
- H. Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with bituminous coating or by applying other permanent separation as recommended by manufacturers of dissimilar metals.

2.15 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.16 COPPER-ALLOY FINISHES

- A. Buffed Finish, Lacquered: M21-O6x (Mechanical Finish: buffed, smooth specular; Coating: clear organic coating as specified below).
- B. Hand-Rubbed Finish, Lacquered: M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear organic coating as specified below).
- C. Brushed Satin Finish, Lacquered: M32-O6x (Mechanical Finish: directionally textured, medium satin; Coating: clear organic coating as specified below).
- D. Clear Organic Coating: Clear, waterborne, air-drying, acrylic lacquer specially developed for coating copper-alloy products, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm). It consists of a solution of methyl methacrylate copolymer with benzotriazole to prevent breakdown of the film in UV light, and is called "Incralac."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions[, **with Installer present,**] for compliance with requirements for roughing-in openings, clearances, and other conditions affecting performance of the Work.
- B. Examine walls and other adjacent construction for suitable conditions where units will be installed.[**Examine locations of electrical connections.**]
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install postal specialties level and plumb, according to manufacturer's written instructions and roughing-in drawings.
 - 1. Where dissimilar metals will be in permanent contact with each other, protect against galvanic action by painting contact surfaces with bituminous coating or by applying other permanent separation as recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact grout, concrete, masonry, or wood, protect against corrosion by painting contact surfaces with bituminous coating.
 - 3. Final acceptance of postal specialties served by USPS depends on compliance with USPS requirements.
- B. Horizontal Mail Receptacles: Install horizontal mail receptacles with center of tenant-door lock cylinders and bottom of compartments at the maximum and minimum heights above finished floor established by USPS and manufacturer's written instructions.
 - 1. Install removable-core and keyed-in door lock cylinders as required for each type of cylinder lock.
 - 2. Install and align two rack ladders for the first column of mail receptacles and one rack ladder for each additional adjacent column of mail receptacles.
- C. Vertical Mail Receptacles: Install vertical mail receptacles with center of master lock cylinder not more than **48 inches** (1219 mm) and not less than **30 inches** (762 mm) above finished floor.
- D. Pedestal-Mounted Postal Specialties: Anchor units with **1/2-inch-** (13-mm-) diameter, [**galvanized**] [**stainless**]-steel anchor bolts with hooked ends.
- E. Collection Boxes: Install collection boxes with [**centerline of mail slots**] [**handle of hopper doors**] not more than **48 inches** (1219 mm) above finished floor.

- F. Receiving Boxes: Install receiving boxes with bottom of unloading door not less than **30 inches** (762 mm) above finished floor.
 - 1. Install receiving boxes with exterior of box bottom not more than **20 inches** (508 mm) above finished floor.
- G. Freestanding Data Distribution Boxes: Locate freestanding data distribution boxes at locations indicated[**or, if not indicated, as directed by DEN Project Manager**].
- H. Rack-Ladder Data Distribution Boxes: Install and align two rack ladders for the first column of data distribution boxes and one rack ladder for each additional adjacent column of data distribution boxes.
- I. Mail Chutes: Mount chutes with bottom ends extending **1 inch** (25 mm) into receiving boxes. Attach chutes with straps, collars, and sleeves. Do not penetrate chute with fasteners.
 - 1. Comply with USPS Publication 16 for installation.
 - 2. Install chutes with centerline of mail slots not more than **48 inches** (1219 mm) above finished floor.
- J. Key Keeper: Install [**horizontally**] [**vertically**] [**as indicated on Drawings**].

3.3 FIELD QUALITY CONTROL

- A. Arrange for USPS personnel to examine and test postal specialties served by USPS after they have been installed according to USPS regulations.
- B. Obtain written final approval of postal specialties to be served by USPS. Obtain this approval from USPS postmaster that authorizes mail collection for the served installation.

3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as postal specialties are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust doors, hardware, and moving parts to function smoothly, and lubricate as recommended by manufacturer. Verify that integral locking devices operate properly.
- C. Touch up marred finishes or replace postal specialties that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by postal specialty manufacturer.
- D. Replace postal specialties that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

- E. On completion of postal specialty installation, clean interior and exterior surfaces as recommended by manufacturer.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to assist Contractor and train Owner's maintenance personnel to adjust, operate, and maintain postal specialties.
 - 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 105500

SECTION 107500 - FLAGPOLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes **[ground-mounted] [wall-mounted] [and] [roof-mounted]** flagpoles made from **[aluminum] [copper alloy (bronze)] [fiberglass] [stainless steel] [and] [steel]**.
- B. Owner-Furnished Material: Flag[s].
- C. Related Sections:
 - 1. Section 076200 "Sheet Metal Flashing and Trim" for counterflashing flashing at roof-mounted flagpoles.
 - 2. Section 264113 "Lightning Protection for Structures" for connecting wall- and roof-mounted metal flagpoles to lightning protection system.
 - 3. Section 265600 "Exterior Lighting" for site lighting fixtures.
- D. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand the effects of gravity loads, and the following loads and stresses within limits and under conditions indicated according to the following design criteria:
 - 1. Seismic Loads: **<Insert seismic criteria>** according to **[SEI/ASCE 7] <Insert requirement>**.
 - 2. Wind Loads: **<Insert wind speed and exposure factor>** according to **[NAAMM FP 1001, "Guide Specifications for Design of Metal Flagpoles."]** **[SEI/ASCE 7] <Insert requirement>**.
 - 3. Base flagpole design on **[polyester] [nylon or cotton]** flags of maximum standard size suitable for use with flagpole or flag size indicated, whichever is more stringent.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.
 - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For flagpoles. Include plans, elevations, details, and attachments to other work. Show general arrangement, jointing, fittings, accessories, grounding, anchoring, and support.
 - 1. Include section, and details of foundation system for ground-mounted flagpoles.
 - 2. Include details of **[wall-mounted]** **[and]** **[roof-mounted]** connections and mountings.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- D. Delegated-Design Submittal: For flagpole assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Include loads, point reactions, and locations for attachment of flagpoles to building's structure.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain **[each type of flagpole]** **[flagpole]** as complete unit, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. General: Spiral wrap flagpoles with heavy paper and enclose in a hard fiber tube or other protective container.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Flagpole; a Kearney-National Inc. company.
2. Atlantic Fiberglass Products, Inc.
3. Baartol Company.
4. Concord Industries, Inc.
5. Eder Flag Manufacturing Company, Inc.
6. Ewing Flagpoles.
7. Lingo Inc.; Acme Flagpole Company Division.
8. Millerbernd Manufacturing Company.
9. Morgan-Francis; Division of Original Tractor Cab Co., Inc.
10. PLP Composite Technologies, Inc.
11. Pole-Tech Company Inc.
12. U.S. Flag & Flagpole Supply, LP.
13. USS Manufacturing Inc.
14. **<Insert manufacturer's name>**.
15. or approved equal.

2.2 FLAGPOLES **<Insert drawing designation>**

- A. Flagpole Construction, General: Construct flagpoles in one piece if possible. If more than one piece is necessary, comply with the following:

1. Fabricate shop and field joints without using fasteners, screw collars, or lead caulking.
2. Provide flush hairline joints using self-aligning, snug-fitting, internal sleeves.
3. Provide self-aligning, snug-fitting joints.

- B. Exposed Height: **[20 feet (6 m)] [25 feet (7.5 m)] [30 feet (9 m)] [35 feet (11 m)] [40 feet (12 m)] [45 feet (13.5 m)] [50 feet (15 m)] [60 feet (18 m)] [70 feet (21 m)] [80 feet (24 m)]**
<Insert height>.

- C. Aluminum Flagpoles: Provide **[cone]** **[entasis]**-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B 241/B 241M, Alloy 6063, with a minimum wall thickness of **3/16 inch** (4.8 mm).
- D. Copper-Alloy (Bronze) Flagpoles: Provide **[cone]** **[entasis]**-tapered flagpoles fabricated from seamless pipe or tube complying with ASTM B 43 or **ASTM B 135** (ASTM B 135M), Alloy UNS C23000 (red brass, 85 percent copper).
- E. Fiberglass Flagpoles: Provide **[cone]** **[entasis]**-tapered flagpoles fabricated from polyester resin reinforced with woven glass-fiber roving with 75 percent of glass fibers parallel to length of flagpole.
- F. Stainless-Steel Flagpoles: Provide **[cone]** **[entasis]**-tapered flagpoles fabricated from pipe, tube, or plate complying with ASTM A 312/A 312M, ASTM A 269, or ASTM A 666, **[Alloy UNS S30400]** **[Alloy UNS S31603]**.
- G. Steel Flagpoles: Provide **[cone-tapered]** **[stepped-sectional]** flagpoles fabricated from standard-weight, seamless steel pipe complying with ASTM A 53/A 53M, Type S, Grade B or steel tube complying with ASTM A 513.
- H. Metal Foundation Tube: Manufacturer's standard corrugated-steel foundation tube, not less than **0.064-inch-** (1.6-mm-) nominal wall thickness. Provide with **3/16-inch** (4.8-mm) steel bottom plate and support plate; **3/4-inch-** (19-mm-) diameter, steel ground spike; and steel centering wedges welded together. Galvanize steel after assembly. Provide loose hardwood wedges at top of foundation tube for plumbing pole.
1. Provide flashing collar of same material and finish as flagpole.
 2. Provide steel ground protectors extending **12 inches** (300 mm) aboveground and **6 inches** (150 mm) belowground for steel flagpoles where flashing collars are not provided.
- I. Sleeve for **[Fiberglass]** **[Aluminum]** Flagpole: **[Fiberglass]** **[or]** **[PVC pipe]** foundation sleeve, made to fit flagpole, for casting into concrete foundation.
1. Provide flashing collar of same material and finish as flagpole.
- J. Cast-Metal Shoe Base: For anchor-bolt mounting; provide with anchor bolts.
1. Provide units made from **[aluminum]** **[steel]** with **[same finish and color as flagpoles]** **<Insert finish and color>**.
 2. Provide ground spike at grade-mounted flagpoles.
 3. Provide connector to building's lightning protection system conductor at roof-mounted flagpoles.
- K. Hinged Baseplate: Cast-metal tilting hinged base and anchored plate joined by permanently secured pivot rod. Provide with stainless-steel screws for securing tilting base to anchored plate when not tilted; provide with anchor bolts.
1. Finish base to match flagpole.
 2. Provide aluminum base or aluminum flashing collar finished to match flagpole.

3. Provide ground spike at grade-mounted flagpoles.
 4. Provide connector to building's lightning protection system conductor at roof-mounted metal flagpoles.
- L. Pivoting Tilt Base: Steel baseplate with channel or rectangular tube uprights, pivot bolt, and locking device for tilting flagpole. Provide tilting flagpole with steel counterweight box and weights, or provide with internal counterweight. Provide base with anchor bolts.
1. Finish base to match flagpole.
 2. Provide ground spike at grade-mounted flagpoles.
 3. Provide connector to building's lightning protection system conductor at roof-mounted metal flagpoles.
- M. Vertical Wall Mount: **[Cast-aluminum] [Cast-copper-alloy (bronze)]** mounting bracket complete with **[escutcheon,]** mounting plate and through-wall anchorage.
1. Provide units with same finish as flagpole.
 2. Provide units with **[gold anodic] [bronze powder-coated] [black powder-coated]** finish.
- N. Outrigger Wall Mount: **[Aluminum] [Copper-alloy (bronze)]** mounting bracket complete with **[escutcheon,]** mounting plate and through-wall anchorage.
1. Provide units with same finish as flagpole.
 2. Provide units with **[gold anodic] [bronze powder-coated] [black powder-coated]** finish.
- O. Braced Roof Mount: Roof-mounted flagpole socket and either rod or tubular braces with turnbuckles and mounting bases. Provide as a complete assembly with anchor bolts and connector for lightning protection system.
1. Provide braces, turnbuckles, and connectors **[made from same metal and]** with same finish as flagpoles.

2.3 FITTINGS

- A. Finial Ball **<Insert drawing designation>**: Manufacturer's standard flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.
1. **0.063-inch** (1.6-mm) spun aluminum, **finished to match flagpole** **[with gold anodic finish]**.
 2. **20-oz.** (0.70-mm) copper with 23-karat gold leaf finish.
 3. Spun stainless steel, finished to match flagpole.
 4. Spun copper alloy, finished to match flagpole.
- B. Finial Eagle **<Insert drawing designation>**: Manufacturer's standard, sized **[as indicated] [as standard with manufacturer for flagpole size indicated] <Insert size>**.

1. Cast aluminum[, **finished to match flagpole**] [**with gold anodic finish**].
 2. **20-oz.** (0.70-mm) copper with 23-karat gold leaf finish.
- C. Internal Halyard, Winch System <**Insert drawing designation**>: Manually operated winch with control stop device and removable handle, stainless-steel cable halyard, and concealed revolving truck assembly with plastic-coated counterweight and sling. Provide flush access door secured with cylinder lock. Finish truck assembly to match flagpole.
1. Halyard Flag Snaps: Provide two [**chromium-plated bronze**] [**stainless-steel**] [**bronze**] [**nylon**] swivel snap hooks per halyard.
 - a. Provide with neoprene or vinyl covers.
 2. Plastic Halyard Flag Clips: Made from injection-molded, UV-stabilized, acetal resin (Delrin). Clips attach to flag and have two eyes for inserting both runs of halyards. Provide two flag clips per halyard.
 - a. Product: Subject to compliance with requirements, provide "Quiet Halyard" flag clasp by Lingo.
- D. Internal Halyard, Cam Cleat System <**Insert drawing designation**>: [**5/16-inch-** (8-mm-) **diameter, braided polypropylene**] <**Insert type**> halyard; cam cleat; and concealed revolving truck assembly with plastic-coated counterweight and sling. Provide flush access door secured with cylinder lock. Finish truck assembly to match flagpole.
1. Halyard Flag Snaps: Provide two [**chromium-plated bronze**] [**stainless-steel**] [**bronze**] [**nylon**] swivel snap hooks per halyard.
 - a. Provide with neoprene or vinyl covers.
 2. Plastic Halyard Flag Clips: Made from injection-molded, UV-stabilized, acetal resin (Delrin). Clips attach to flag and have two eyes for inserting both runs of halyards. Provide two flag clips per halyard.
 - a. Product: Subject to compliance with requirements, provide "Quiet Halyard" flag clasp by Lingo.
- E. External Halyard <**Insert drawing designation**>: Ball-bearing, nonfouling, revolving truck assembly of cast metal with continuous [**5/16-inch-** (8-mm-) **diameter, braided polypropylene halyard**] <**Insert type**> and **9-inch** (228-mm) cast-metal cleats with fasteners. Finish exposed metal surfaces to match flagpole.
1. Provide [**one halyard and one cleat**] [**two halyards and two cleats**] at each flagpole.
 2. Provide cast-metal cleat covers, finished to match flagpole, secured with cylinder locks.
 3. Provide halyard covers consisting of a **2-inch** (50-mm) channel, **60 inches** (1500 mm) long, finished to match flagpole.

4. Halyard Flag Snaps: Provide two [**chromium-plated bronze**] [**stainless-steel**] [**bronze**] [**nylon**] swivel snap hooks per halyard.
 - a. Provide with neoprene or vinyl covers.
5. Plastic Halyard Flag Clips: Made from injection-molded, UV-stabilized, acetal resin (Delrin). Clips attach to flag and have two eyes for inserting both runs of halyards. Provide two flag clips per halyard.
 - a. Product: Subject to compliance with requirements, provide "Quiet Halyard" flag clasp by Lingo.

2.4 MISCELLANEOUS MATERIALS

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.
- B. Drainage Material: Crushed stone, or crushed or uncrushed gravel; coarse aggregate.
- C. Sand: ASTM C 33, fine aggregate.
- D. Elastomeric Joint Sealant: [**Multicomponent nonsag urethane**] [**Single-component nonsag urethane**] [**Single-component neutral- and basic-curing silicone**] [**Single-component neutral-curing silicone**] joint sealant complying with requirements in Section 079200 "Joint Sealants" for Use NT (nontraffic) and for Use M, G, A, and, as applicable to joint substrates indicated, for Use O.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

- A. Natural Satin Finish: AA-M32, fine, directional, medium satin polish; buff complying with AA-M20; seal aluminum surfaces with clear, hard-coat wax.
- B. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
- C. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.

1. Color: [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] <Insert color>.
 2. Color: [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**].
- D. Gold Anodic Finish: AAMA 611, AA-M32C22A43 Class I, 0.018 mm or thicker; gold color.
- E. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils** (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.
- F. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with [**AAMA 2604**] [**AAMA 2605**] and containing not less than [**50**] [**70**] percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color and gloss>.

2.7 STEEL FINISHES

- A. Flagpole Interior Finish: Apply one coat of bituminous paint on interior of flagpole or otherwise treat to prevent corrosion.
- B. Galvanized Finish: Hot-dip galvanize after fabrication to comply with ASTM A 123/A 123M.
- C. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with [**SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning"**] [or] [**SSPC-SP 8, "Pickling"**] <Insert surface preparation method>.[**After cleaning, apply a conversion coating suited to the organic coating to be applied over it.**]
- D. Polyurethane Enamel Finish: Immediately after cleaning, apply manufacturer's standard primer and two-coat, high-gloss, high-build polyurethane-enamel finish.
1. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
- E. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of **2 mils** (0.05 mm).

1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>**.

2.8 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 1. Run grain of directional finishes with long dimension of each piece.
 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 3. Directional Satin Finish: No. 4.

2.9 COPPER-ALLOY FINISHES

- A. Buffed Finish, Lacquered: M21-O6x (Mechanical Finish: buffed, smooth specular; Coating: clear organic, air drying, as specified below).
 1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).
- B. Medium Satin Finish, Lacquered: M32-O6x (Mechanical Finish: medium satin; Coating: clear organic, air drying, as specified below).
 1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of **1 mil** (0.025 mm).
- C. Statuary Conversion Coating over Satin Finish: M31-C55 (Mechanical Finish: directionally textured, fine satin; Chemical Finish: conversion coating, sulfide).
 1. Color: Match DEN Project Manager's sample.

2.10 FIBERGLASS FINISHES

- A. Fiberglass: UV-light stable, hard, high-gloss gel coat or high-gloss, high-build polyurethane or polyester coating.
 1. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, including foundation; accurate placement, pattern, orientation of anchor bolts, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.
- B. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.
- C. Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade. Secure and brace forms to prevent displacement during concreting.
- D. Place concrete, as specified in [**Section 033000 "Cast-in-Place Concrete"**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete."**] Compact concrete in place by using vibrators. Moist-cure exposed concrete for not less than seven days or use nonstaining curing compound.
- E. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

3.3 FLAGPOLE INSTALLATION

- A. General: Install flagpoles where shown and according to[**Shop Drawings and**] manufacturer's written instructions.
- B. Ground Set: Place [**foundation tube,**] [**sleeve,**] center, and brace to prevent displacement during concreting. Place concrete. Plumb and level [**foundation tube**] [**sleeve**] and allow concrete to cure. Install flagpole, plumb, in [**foundation tube**] [**sleeve**].
 - 1. Foundation Tube: Place tube seated on bottom plate between steel centering wedges and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch (50-mm) layer of elastomeric joint sealant and cover with flashing collar.

- C. Baseplate: Cast anchor bolts in concrete foundation. Install baseplate on washers placed over leveling nuts on anchor bolts and adjust until flagpole is plumb. After flagpole is plumb, tighten retaining nuts and fill space under baseplate solidly with nonshrink, nonmetallic grout. Finish exposed grout surfaces smooth and slope 45 degrees away from edges of baseplate.
- D. Mounting Brackets and Bases: Anchor brackets and bases securely through to structural support with fasteners as indicated on Shop Drawings.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 107500

SECTION 013516 - ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes special procedures for alteration work.

1.3 DEFINITIONS

- A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.
- B. Consolidate: To strengthen loose or deteriorated materials in place.
- C. Design Reference Sample: A sample that represents the Architect's prebid selection of work to be matched; it may be existing work or work specially produced for the Project.
- D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.
- E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.
- F. Refinish: To remove existing finishes to base material and apply new finish to match original or as otherwise indicated.
- G. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.
- H. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.
- I. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.
- J. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.

- K. Retain: To keep existing items that are not to be removed or dismantled.
- L. Strip: To remove existing finish down to base material unless otherwise indicated.

1.4 COORDINATION

- A. Alteration Work Subschedule: A construction schedule coordinating the sequencing and scheduling of alteration work for entire Project, including each activity to be performed, and based on Contractor's Construction Schedule. Secure time commitments for performing critical construction activities from separate entities responsible for alteration work.
 - 1. Schedule construction operations in sequence required to obtain best Work results.
 - 2. Coordinate sequence of alteration work activities to accommodate the following:
 - a. Owner's continuing occupancy of portions of existing building.
 - b. Owner's partial occupancy of completed Work.
 - c. Other known work in progress.
 - d. Tests and inspections.
 - 3. Detail sequence of alteration work, with start and end dates.
 - 4. Utility Services: Indicate how long utility services will be interrupted. Coordinate shutoff, capping, and continuation of utility services.
 - 5. Use of elevator and stairs.
 - 6. Equipment Data: List gross loaded weight, axle-load distribution, and wheelbase dimension data for mobile and heavy equipment proposed for use in existing structure. Do not use such equipment without certification from Contractor's professional engineer that the structure can support the imposed loadings without damage.
- B. Pedestrian and Vehicular Circulation: Coordinate alteration work with circulation patterns within Project building(s) and site. Some work is near circulation patterns [and adjacent to restricted areas] <Insert item of concern>. Circulation patterns cannot be closed off entirely and in places can be only temporarily redirected around small areas of work.[Access to restricted areas may not be obstructed.] Plan and execute the Work accordingly.

1.5 PROJECT MEETINGS FOR ALTERATION WORK

- A. Preliminary Conference for Alteration Work: Before starting alteration work, [conduct] [Architect will conduct] [Construction Manager will conduct] conference at [Project site] <Insert location>.
 - 1. Attendees: In addition to representatives of Owner,[Construction Manager,] Architect, and Contractor,[Owner's insurer,] testing service representative, specialists, and chemical-cleaner manufacturer(s) shall be represented at the meeting.
 - 2. Agenda: Discuss items of significance that could affect progress of alteration

work, including review of the following:

- a. Alteration Work Subschedule: Discuss and finalize; verify availability of materials, specialists' personnel, equipment, and facilities needed to make progress and avoid delays.
 - b. Fire-prevention plan.
 - c. Governing regulations.
 - d. Areas where existing construction is to remain and the required protection.
 - e. Hauling routes.
 - f. Sequence of alteration work operations.
 - g. Storage, protection, and accounting for salvaged and specially fabricated items.
 - h. Existing conditions, staging, and structural loading limitations of areas where materials are stored.
 - i. Qualifications of personnel assigned to alteration work and assigned duties.
 - j. Requirements for extent and quality of work, tolerances, and required clearances.
 - k. Embedded work such as flashings and lintels, special details, collection of waste, protection of occupants and the public, and condition of other construction that affects the Work or will affect the work.
3. Reporting: [Record] [Architect will record] [Construction Manager will record] conference results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from conference.
- B. Coordination Meetings: Conduct coordination meetings specifically for alteration work at [weekly] [monthly] <Insert interval> intervals. Coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner,[Construction Manager,] Architect, and Contractor, each specialist, supplier, installer, and other entity concerned with progress or involved in planning, coordination, or performance of alteration work activities shall be represented at these meetings. All participants at conference shall be familiar with Project and authorized to conclude matters relating to alteration work.
 2. Agenda: Review and correct or approve minutes of previous coordination meeting. Review other items of significance that could affect progress of alteration work. Include topics for discussion as appropriate to status of Project.
 - a. Alteration Work Subschedule: Review progress since last coordination meeting. Determine whether each schedule item is on time, ahead of schedule, or behind schedule. Determine how construction behind schedule will be expedited with retention of quality; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities are completed within the Contract Time.
 - b. Schedule Updating: Revise Contractor's Alteration Work Subschedule after each coordination meeting where revisions to schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.

- c. Review present and future needs of each entity present, including review items listed in the "Preliminary Conference for Alteration Work" Paragraph in this article and the following:
 - 1) Interface requirements of alteration work with other Project Work.
 - 2) Status of submittals for alteration work.
 - 3) Access to alteration work locations.
 - 4) Effectiveness of fire-prevention plan.
 - 5) Quality and work standards of alteration work.
 - 6) Change Orders for alteration work.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.6 MATERIALS OWNERSHIP

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered or uncovered during the Work, regardless of whether they were previously documented, remain Owner's property.
 1. Carefully dismantle and salvage each item or object in a manner to prevent damage and protect it from damage, then promptly deliver it to Owner where directed[at Project site] <Insert location>.

1.7 INFORMATIONAL SUBMITTALS

- A. Alteration Work Subschedule:
 1. Submit alteration work subschedule within [seven] [30] <Insert number> days of date established for[commencement of alteration work] <Insert requirement>.
- B. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements that are to remain, including finish surfaces, that might be misconstrued as damage caused by Contractor's alteration work operations.
- C. Alteration Work Program: Submit [30 days] <Insert time> before work begins.
- D. Fire-Prevention Plan: Submit [30 days] <Insert time> before work begins.

1.8 QUALITY ASSURANCE

- A. Specialist Qualifications: An experienced firm regularly engaged in specialty work similar in nature, materials, design, and extent to alteration work as specified in each Section and that has completed a minimum of [five] <Insert number> recent projects with a record of successful in-service performance that demonstrates the firm's qualifications to perform this work.

1. Field Supervisor Qualifications: Full-time supervisors experienced in specialty work similar in nature, material, design, and extent to that indicated for this Project. Supervisors shall be on-site when specialty work begins and during its progress. Supervisors shall not be changed during Project except for causes beyond the control of the specialist firm.
 - a. Construct new mockups of required work whenever a supervisor is replaced.
 - B. Title X Requirement: Each firm conducting activities that disturb painted surfaces shall be a "Lead-Safe Certified Firm" according to 40 CFR 745, Subpart E, and use only workers that are trained in lead-safe work practices.
 - C. Alteration Work Program: Prepare a written plan for alteration work for whole Project, including each phase or process and protection of surrounding materials during operations. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole-Project alteration work program with specific requirements of programs required in other alteration work Sections.
 1. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.
 2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.
 - D. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Owner's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.
 - E. Safety and Health Standard: Comply with ANSI/ASSE A10.6.
- 1.9 STORAGE AND HANDLING OF SALVAGED MATERIALS
- A. Salvaged Materials:
 1. Clean loose dirt and debris from salvaged items unless more extensive cleaning is indicated.
 2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area [on-site] [off-site] [designated by Owner] [indicated on Drawings].
 5. Protect items from damage during transport and storage.
 - B. Salvaged Materials for Reinstallation:
 1. Repair and clean items for reuse as indicated.
 2. Pack or crate items after cleaning and repairing; cushion against damage during

- handling. Label contents of containers.
3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.
- C. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.
- D. Storage: Catalog and store items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.
1. Identify each item for reinstallation with a nonpermanent mark to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying marks.
 2. Secure stored materials to protect from theft.
 3. Control humidity so that it does not exceed 85 percent. Maintain temperatures 5 deg F (3 deg C) or more above the dew point.
- E. Storage Space:
1. Owner will arrange for limited on-site location(s) for free storage of salvaged material. This storage space [includes] [does not include] security[and climate control] for stored material.
 2. Arrange for off-site locations for storage and protection of salvaged material that cannot be stored and protected on-site.
- 1.10 FIELD CONDITIONS
- A. Survey of Existing Conditions: Record existing conditions that affect the Work by use of [measured drawings] [preconstruction photographs] [and] [preconstruction videotapes] <Insert requirement>.
1. Comply with requirements specified in Section 013233 "Photographic Documentation."
- B. Discrepancies: Notify Architect of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling work.
- C. Owner's Removals: Before beginning alteration work, verify in correspondence with Owner that the following items have been removed:
1. <Insert items to be removed by Owner>.
- D. Size Limitations in Existing Spaces: Materials, products, and equipment used for performing the Work and for transporting debris, materials, and products shall be of sizes that clear surfaces within existing spaces, areas, rooms, and openings, including

temporary protection, by [12 inches (300 mm)] <Insert dimension> or more.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION

- A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from alteration work.
1. Use only proven protection methods, appropriate to each area and surface being protected.
 2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration work is being performed.
 3. Erect temporary barriers to form and maintain fire-egress routes.
 4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during alteration work.
 5. Contain dust and debris generated by alteration work, and prevent it from reaching the public or adjacent surfaces.
 6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
 7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
 8. Provide supplemental sound-control treatment to isolate demolition work from other areas of the building.
- B. Temporary Protection of Materials to Remain:
1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
 2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.
- C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
- D. Utility and Communications Services:
1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration work before commencing operations.
 2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration work.
 3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.

- E. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is functioning properly.
1. Prevent solids such as adhesive or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from alteration work.
 2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.
- F. Existing Roofing: Prior to the start of work in an area, install roofing protection[as indicated on Drawings].

3.2 PROTECTION FROM FIRE

- A. General: Follow fire-prevention plan and the following:
1. Comply with NFPA 241 requirements unless otherwise indicated.[Perform duties titled "Owner's Responsibility for Fire Protection."]
 2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.
 - a. If combustible material cannot be removed, provide fire blankets to cover such materials.
- B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:
1. Obtain Owner's approval for operations involving use of[open-flame or] welding or other high-heat equipment.[Use of open-flame equipment is not permitted.] Notify Owner [at least 72 hours] <Insert requirement> before each occurrence, indicating location of such work.
 2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
 3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
 4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
 5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
 6. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:

- a. Train each fire watch in the proper operation of fire-control equipment and alarms.
 - b. Prohibit fire-watch personnel from other work that would be a distraction from fire-watch duties.
 - c. Cease work with heat-generating equipment whenever fire-watch personnel are not present.
 - d. Have fire-watch personnel perform final fire-safety inspection each day beginning no sooner than [30 minutes] <Insert time> after conclusion of work[in each area] to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.
 - e. Maintain fire-watch personnel at[each area of] Project site until [60 minutes] [two hours] <Insert time> after conclusion of daily work.
- C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire extinguisher and blanket use.
- D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.
1. Remove temporary guards at the end of work shifts, whenever operations are paused, and when nearby work is complete.

3.3 PROTECTION DURING APPLICATION OF CHEMICALS

- A. Protect motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.
- B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in alteration work program. Use covering materials and masking agents that are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.
- C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.
- D. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.
- E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

3.4 GENERAL ALTERATION WORK

- A. Have specialty work performed only by qualified specialists.
- B. Ensure that supervisory personnel are present when work begins and during its progress.
- C. Record existing work before each procedure (preconstruction), and record progress during the work. Use digital preconstruction documentation [photographs] [or] [video recordings]. Comply with requirements in Section 013233 "Photographic Documentation."
- D. Perform surveys of Project site as the Work progresses to detect hazards resulting from alterations.
- E. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.
 - 1. Do not proceed with the work in question until directed by Architect.

END OF SECTION 013516

SECTION 111300 - LOADING DOCK EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Dock levelers.
2. Truck levelers.
3. Truck restraints.
4. Light-communication systems.
5. Dock bumpers.
6. Dock lifts (scissors lifts).
7. Dock seals.
8. Dock shelters.
9. Transparent-strip door curtains.

B. Related Sections:

1. **[Section 033000 "Cast-in-Place Concrete"] [Section 033053 "Miscellaneous Cast-in-Place Concrete"]** for concrete work for recessed loading dock equipment.
2. Section 055000 "Metal Fabrications" for **[curb angles at edges of recessed pits] [and] [loading dock platform edge channels]**.
3. Section 083323 "Overhead Coiling Doors" for coiling and other overhead doors electrically interlocked to dock levelers.
4. Section 083613 "Sectional Doors" for coiling and other overhead doors electrically interlocked to dock levelers.
5. Section 221119 "Domestic Water Piping Specialties" for pit drains for loading dock equipment permanently installed in pits.
6. Section 265100 "Interior Lighting" and Section 265600 "Exterior Lighting" for dock lighting fixtures.
7. Division 26 Sections for electrical wiring and connections for loading dock Equipment.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. Operating Range: Maximum amount of travel above and below the loading dock level.
- B. Working Range: Recommended amount of travel above and below the loading dock level for which loading and unloading operations can take place.

1.4 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. Z53.1 - Safety Color Code for Marking Physical Hazards.
- B. American Society of Mechanical Engineers (ASME):
 - 1. MH 14.1 - American National Standard Loading Dock Levelers and Dockboards.
- C. American Wood Preservers Bureau (AWPB):
 - 1. LP-2 - Softwood Lumber, Timber, and Plywood Pressure Treated with Water-borne Preservatives for Above Ground Use.
- D. Commercial Standard (CS):
 - 1. 202 - Industrial Lifts and Hinged Loading Ramps.
- E. Federal Standard (FED-STD):
 - 1. 191A-5134.1 - Strength of Cloth, Tearing; Tongue Method.
 - 2. 191A-5306 - Abrasion Resistance of Cloth; Rotary Platform, Double Head (Taber) Method.
- F. Product Standard (PS):
 - 1. 20-70 - American Softwood Lumber Standard.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for loading dock equipment. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For loading dock equipment. Include plans, elevations, sections, large-scale details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Provide location template drawings for items supported or anchored to permanent construction.
 3. Furnish roughing in drawings for electrical service well in advance of concrete work.
 4. Material test reports from a qualified independent testing agency indicating compliance of dock levelers with requirements of ANSI MH 14.1 for determining rated capacity indicated.
 5. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For each type of dock[-seal] [and] [-shelter] fabric indicated.
- D. Samples for Verification: For each type of dock[-seal] [and] [-shelter] fabric indicated.
- 1.6 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For qualified Installer.
 - B. Welding certificates.
 - C. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency; indicate compliance of dock levelers with requirements in MH 30.1 for determining rated capacity, which is based on comprehensive testing within last two years of current products.
 1. Submittal Form: According to MH 30.1, Appendix A.
 - D. Warranty: Sample of special warranty.
- 1.7 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For loading dock equipment to include in operation and maintenance manuals.
 1. Include name, address, and telephone number of the manufacturer's nearest authorized service representative.
 - B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of the types of units required for this Project.
 - 1. Maintenance Proximity: Not more than **[two (2)] <Insert number>** hours' normal travel time from Installer's place of business to Project site.
- B. Dock Leveler Standard: Comply with applicable requirements of ASME/ANSI MH14.1 for construction and operation of dock levelers and dockboards.
- C. Hydraulic Dock Lift Standards: Comply with applicable requirements of CS 202 for construction and operation of hydraulic dock lifts (scissor lifts).
- D. Source Limitations: Obtain each loading dock Equipment component as a complete unit produced by a single manufacturer, including necessary accessories, fittings, and anchorages.
- E. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.
 - 1. Inspect and discuss electrical roughing-in, equipment bases, and other preparatory work specified elsewhere.
 - 2. Review sequence of operation for each type of loading dock equipment.
 - 3. Review coordination of interlocked equipment specified in this Section and elsewhere.
 - 4. Review required testing, inspecting, and certifying procedures.
 - 5. **<Insert requirement>**.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle dock **[seals] [shelters] [seals and shelters]** in a manner to avoid significant or permanent damage to fabric or frame.
 - 1. Comply with manufacturer's written instructions for minimum and maximum temperature requirements for storage.

1.10 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of construction contiguous with loading dock equipment, including [**recessed pit dimensions**] [**slopes of driveways**] [**and**] [**heights of loading docks**], by field measurements before fabrication.

1.11 WARRANTY

- A. Special Warranty for Dock Levelers: Manufacturer's standard form, executed by manufacturer, in which manufacturer agrees to repair or replace dock-leveler components that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Structural failures including cracked or broken structural support members, load-bearing welds, and front and rear hinges.
 - b. Faulty operation of operators, control system, or hardware.
 - c. Deck plate failures including cracked plate or permanent deformation in excess of **1/4 inch** (6 mm) between deck supports.
 - d. Hydraulic system failures including failure of hydraulic seals and cylinders.
 - e. **<Insert failure modes>**.
2. Warranty Period for Structural Assembly: Minimum [**ten (10)**] **<Insert number>** years from date of Substantial Completion.
3. Warranty Period for Hydraulic System: Minimum [**five (5)**] **<Insert number>** years from date of Substantial Completion.
4. Warranty shall be for unlimited usage of leveler for the specified rated capacity over the term of the warranty.

1.12 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide [**twelve (12)**] **<Insert number>** months' full maintenance by skilled employees of loading dock equipment Installer. Include [**monthly**] [**quarterly**] preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper loading dock equipment operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.
- B. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard [**yearly**] **<Insert time period>** maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.13 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to

satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM 36/A 36M.
- B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from steel plate complying with ASTM A 572/A 572M, Grade 55 (380).
- C. Steel Tubing: ASTM A 500, cold formed.
- D. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- E. Wood: DOC PS 20 dimension lumber, select structural grade, kiln dried.
- F. Pressure-Treated Wood: DOC PS 20 dimension lumber, select structural grade, kiln dried, and pressure treated with waterborne preservatives to comply with AWPA C2.

2.2 RECESSED DOCK LEVELERS <Insert drawing designation>

- A. General: Recessed, hinged-lip-type dock levelers designed for permanent installation in concrete pits preformed in the edge of loading platform; of type, function, operation, capacity, size, and construction indicated; and complete with controls, safety devices, and accessories required.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Beacon Industries, Inc.
 - b. Blue Giant Equipment Corporation.
 - c. Chalfant Dock Equipment.
 - d. DLM, Inc.
 - e. Ellis Industries, Inc.
 - f. Flexon, Inc.
 - g. Kelly Company, Inc.
 - h. McGuire, W. B. Co., Inc.; Division of Overhead Door Corporation.
 - i. Nordock Inc.
 - j. NOVA Technology International, L.L.C.
 - k. Pentalift Equipment Corporation.
 - l. Pioneer Loading Dock Equipment.
 - m. Poweramp; Division of Systems, Inc.
 - n. Rite-Hite Corporation.
 - o. Rol-Lift Corporation.
 - p. Rotary Products Inc.
 - q. Serco Engineering Corp.

- r. SPX Dock Products - Kelley.
 - s. SPX Dock Products - Serco.
 - t. Vestil Manufacturing Company.
 - u. **<Insert manufacturer's name.>**
 - v. or approved equal.
- B. Standard: Comply with MH 30.1[, **except for structural testing to establish rated capacity**].
- C. Rated Capacity: Capable of supporting total gross load of **<Insert capacity>** without permanent deflection or distortion.
- D. Platform: Not less than [3/16-inch- (5-mm-)] [1/4-inch- (6-mm-)] [3/8-inch- (9.5-mm-)] **<Insert dimension>** thick, nonskid steel plate.
1. Platform Size: **[As indicated on Drawings] <Insert size>**.
 2. Frame: **[Manufacturer's standard] [Clean-pit type, designed to support leveler at sides of pit, with no side-to-side supports at front of pit floor]**.
 3. Toe Guards: Equip open sides of dock leveler over range indicated with metal toe guards.
 - a. Toe-Guard Range: Entire upper **[operating] [working]** range.
- E. Hinged Lip: Not less than [1/2-inch- (13-mm-)] [5/8-inch- (16-mm-)] [3/4-inch- (19-mm-)] [1-inch- (25-mm-)] **<Insert dimension>** thick, nonskid steel plate.
1. Hinge: Full width, piano-type hinge with heavy-wall hinge tube[**and greased fittings**], with gussets on lip and ramp for support.
 2. Safety Barrier Lip: Designed to protect material-handling equipment from an accidental fall from loading platform edge of the dock leveler when the leveler is not in use.
- F. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform.
1. Vertical Travel: Operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact with the following minimum working range:
 - a. Above Adjoining Platform: [12 inches (305 mm)] [18 inches (457 mm)] [**As indicated on Drawings] <Insert dimension>**.
 - b. Below Adjoining Platform: [12 inches (305 mm)] [14 inches (356 mm)] [**As indicated on Drawings] <Insert dimension>**.
 2. Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.
 3. Automatic Lateral Compensation: Tilting of ramp with lip extended and resting on truck bed shall compensate automatically for canted truck beds of up to 4 inches (102 mm) over width of ramp.

4. Lip Operation: Manufacturer's standard mechanism that automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck, and automatically retracts lip when truck departs.
 - a. Length of Lip Extension: [16 inches (406 mm)] [18 inches (457 mm)] [20 inches (508 mm)] [As indicated on Drawings].
 5. Automatic Ramp Return: Automatic return of unloaded ramp, from raised or lowered positions to stored position, level with platform, as truck departs.
 6. Interlock: Leveler will not operate while [overhead door is in closed position] [leveler night lock is engaged] [truck restraint is not engaged] [inflatable dock seal is not inflated] [and] [inflatable dock shelter is not inflated] <Insert equipment and condition>.
- G. Mechanical Operating System: Manual control; counterbalance and spring operation. Spring-operated raising and walk-down lowering of unloaded ramp. Equip leveler with an upward-biased-spring counterbalancing mechanism controlled by a hold-down device. Ramp raises to top limit of operating range by operating recessed control handle in ramp to disengage hold-down device. Ramp lowers below platform level with lip retracted by operating auxiliary, recessed control handle to release support legs.
1. Free-Fall Protection: Manufacturer's standard protection system to limit free fall of loaded ramps with front edge supported by truck bed.
- H. Hydraulic Operating System: Electric control from a remote-control station; fully hydraulic operation. Electric-powered hydraulic raising and hydraulic lowering of ramp. Equip leveler with a packaged unit including a unitized, totally enclosed, nonventilated electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity of leveler indicated. Include means for lowering ramp below platform level with lip retracted behind dock bumpers. Provide a hydraulic velocity fuse connected to main hydraulic cylinder to limit loaded ramp's free fall to not more than 3 inches (76 mm).
1. Remote-Control Station: [Weatherproof single] [Single]-button station of the constant-pressure type, enclosed in NEMA ICS 6, [Type 4] [Type 12] <Insert type> box. Ramp raises by depressing and holding button; ramp lowers at a controlled rate by releasing button.
 2. Remote-Control Station with Emergency Stop: [Weatherproof multibutton] [Multibutton] control station with an UP button of the constant-pressure type and an emergency STOP button of the momentary-contact type, enclosed in NEMA ICS 6, [Type 4] [Type 12] <Insert type> box. Ramp raises by depressing and holding UP button; ramp lowers at a controlled rate by releasing UP button. All ramp movement stops, regardless of position of ramp or lip, by depressing STOP button. Normal operation resumes by engaging a manual reset button or by pulling out STOP button.
 - a. Dual-Panel Control Station: Remote-control station for operating side-by-side dock levelers.

- L. Integral Molded-Rubber Dock Bumpers: Fabricated from [4-inch- (102-mm-)] [6-inch- (152-mm-)] <Insert dimension> thick, heavy molded-rubber compound reinforced with nylon, rayon, or polyester cord; with Type A Shore durometer hardness of 80, plus or minus 5, when tested according to ASTM D 2240. Provide two dock bumpers for each recessed dock leveler, attached to face of loading dock with expansion bolts.
- M. Integral Laminated-Tread Dock Bumper: Fabricated from [4-1/2-inch- (114-mm-)] [6-inch- (152-mm-)] <Insert dimension> thick, multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two 3/4-inch- (19-mm-) diameter, steel supporting rods that are welded at one end to 1/4-inch- (6-mm-) thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than 1 inch (25 mm) of tread plies extending beyond the face of closure angles.
- N. Accessories:
1. Curb Angles: 3-by-3-by-1/4-inch (76-by-76-by-6-mm) galvanized-steel curb angles for edge of recessed leveler pit, with 1/2-inch- (13-mm-) diameter by 6-inch- (152-mm-) long concrete anchors welded to angle at 6 inches (152 mm) o.c.
 2. Self-Forming Pan: Manufacturer's standard prefabricated, self-forming steel form system for poured-in-place construction of concrete pit.
 3. Night Locks: Manufacturer's standard means to prevent extending lip and lowering ramp when overhead doors are locked.
 4. Side and rear weatherseals.
 5. Foam insulation under dock-leveler platform.
 6. [Abrasive skid-resistant] [Smooth] surface.
 7. <Insert accessory>.
- O. Finish: [Paint] [Hot-dip galvanize] dock levelers after assembly[and testing].
1. Toe Guards: Paint [yellow] [orange] <Insert color> to comply with ANSI Z535.1.

2.3 EDGE-OF-DOCK LEVELERS <Insert drawing designation>

- A. General: Surface-mounted, hinged-lip-type, edge-of-dock levelers designed for permanent installation on face of loading dock platform; of type, function, operation, capacity, size, and construction indicated; and complete with controls, safety devices, and accessories required.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Beacon Industries, Inc.
 - b. Blue Giant Equipment Corporation.
 - c. Chalfant Dock Equipment.
 - d. DLM, Inc.
 - e. Ellis Industries, Inc.
 - f. Flexon, Inc.
 - g. Kelly Company, Inc.

- h. McGuire, W. B. Co., Inc.; Division of Overhead Door Corporation.
 - i. Nordock Inc.
 - j. NOVA Technology International, L.L.C.
 - k. Pentalift Equipment Corporation.
 - l. Pioneer Loading Dock Equipment.
 - m. Poweramp; Division of Systems, Inc.
 - n. Rol-Lift Corporation.
 - o. Rotary Products Inc.
 - p. Serco Engineering Corp.
 - q. Vestil Manufacturing Company.
 - r. **<Insert manufacturer's name>**.
 - s. or approved equal.
- B. Standard: Comply with MH 30.1[, **except for structural testing to establish rated capacity**].
- C. Rated Capacity: Capable of supporting total gross load of **<Insert capacity>** without permanent deflection or distortion.
- D. Platform Ramp Width: [66 inches (1676 mm)] [72 inches (1829 mm)] [78 inches (1981 mm)] [84 inches (2134 mm)] [**As indicated on Drawings**] **<Insert dimension>**.
- E. Hinged Lip: Not less than [3/8-inch- (9.5-mm-)] [7/16-inch- (11-mm-)] [1/2-inch- (13-mm-)] **<Insert dimension>** thick, nonskid steel tread plate.
- 1. Hinge: Full width, piano-type hinge with heavy-wall hinge tube[**and greased fittings**], with gussets on lip and ramp for support.
- F. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform.
- 1. Vertical Travel: Operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact with the following minimum working range:
 - a. Above Adjoining Platform: [5 inches (127 mm)] [6 inches (152 mm)] [**As indicated on Drawings**] **<Insert dimension>**.
 - b. Below Adjoining Platform: [5 inches (127 mm)] [**As indicated on Drawings**] **<Insert dimension>**.
 - 2. Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.
 - 3. Automatic Lateral Compensation: Tilting of ramp with lip extended and resting on truck bed shall compensate automatically for canted truck beds of up to 3 inches (76 mm) over width of ramp.
 - 4. Lip Operation: Manufacturer's standard mechanism that automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck, and automatically retracts lip when truck departs.

- a. Length of Lip Extension: [15 inches (381 mm)] [17 inches (432 mm)] [**As indicated on Drawings**] <Insert dimension>.
5. Automatic Ramp Return: Automatic return of unloaded ramp, from raised or lowered positions to stored position, level with platform, as truck departs. Leveler shall be capable of retracting to stored position while truck is at loading dock.
- G. Mechanical Operating System: Manual control; counterbalance and spring operation. Spring-operated raising and walk-down lowering of unloaded ramp. Equip leveler with a torsion-spring counterbalancing mechanism controlled by a hold-down device.
 1. Lever Handle: Self-storing lever handle for raising unloaded ramp with minimal lifting force by pulling lever back to extend lip and pushing lever forward to lower ramp and lip.
 2. Removable Lifting Handle: For raising unloaded ramp by lifting action.
- H. Hydraulic Operating System: Electric control from a remote-control station; fully hydraulic operation. Electric-powered hydraulic raising and hydraulic lowering of ramp. Equip leveler with a packaged unit including a unitized, totally enclosed, nonventilated electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity of leveler indicated. Provide a hydraulic velocity fuse connected to main hydraulic cylinder to limit loaded ramp's free fall to not more than 3 inches (76 mm).
 1. Remote-Control Station: [**Weatherproof single**] [**Single**]-button station of the constant-pressure type, enclosed in NEMA ICS 6, [**Type 12**] <Insert type> box. Ramp and lip raise to vertical position and extend to truck bed by depressing and holding button.
- I. Construction: Fabricate dock-leveler frame, platform supports, and lip supports from structural- and formed-steel shapes. Weld platform and hinged lip to supports. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles.
 1. Cross-Traffic Support: Manufacturer's standard method of supporting ramp at platform level in stored position with lip retracted. Provide a means to release supports to allow ramp to descend below platform level.
 2. Maintenance Strut: Integral strut to positively support ramp in up position during maintenance of dock leveler.
- J. Integral Molded-Rubber Dock Bumpers: Fabricated from [4-inch- (102-mm-)] [6-inch- (152-mm-)] <Insert dimension> thick, heavy molded-rubber compound reinforced with nylon, rayon, or polyester cord; with Type A Shore durometer hardness of 80, plus or minus 5, when tested according to ASTM D 2240. Provide two dock bumpers for each recessed dock leveler, attached to face of loading dock with expansion bolts.
- K. Integral Laminated-Tread Dock Bumper: Fabricated from [4-1/2-inch- (114-mm-)] [6-inch- (152-mm-)] <Insert dimension> thick, multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two

3/4-inch- (19-mm-) diameter, steel supporting rods that are welded at one end to **1/4-inch-** (6-mm-) thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than **1 inch** (25 mm) of tread plies extending beyond the face of closure angles.

L. Accessories:

1. Self-forming pan.
2. Cast-in-place design.
3. Run-off guards.
4. Ramp approach plate.
5. **<Insert accessory>**.

M. Dock-Leveler Finish: Painted in manufacturer's standard color.

2.4 TOP-OF-DOCK LEVELERS **<Insert drawing designation>**

A. General: Surface-mounted, hinged-lip-type, top-of-dock levelers designed for permanent installation on top edge of loading dock platform without concrete pit; of type, function, operation, capacity, size, and construction indicated; and complete with controls, safety devices, and accessories required.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Beacon Industries, Inc.
 - b. Pioneer Loading Dock Equipment.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.

B. Standard: Comply with MH 30.1[, **except for structural testing to establish rated capacity**].

C. Rated Capacity: Capable of supporting total gross load of **<Insert capacity>** without permanent deflection or distortion.

D. Platform Width: [**72 inches** (1829 mm)] [**As indicated on Drawings**] **<Insert dimension>**.

E. Hinged Lip: Not less than [**3/8-inch-** (9.5-mm-)] [**7/16-inch-** (11-mm-)] thick, nonskid steel plate.

1. Hinge: Full width, piano-type hinge with heavy-wall hinge tube[**and greased fittings**], with gussets on lip and ramp for support.

F. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform.

1. Vertical Travel: Operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact with a minimum working

- range of [10 inches (250 mm)] <Insert dimension> above and [4 inches (102 mm)] <Insert dimension> below adjoining platform level.
2. Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.
 3. Lip Operation: Manufacturer's standard mechanism that automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck, and automatically retracts lip when truck departs.
 - a. Length of Lip Extension: [15 inches (381 mm)] [As indicated on Drawings] <Insert dimension>.
 4. Automatic Ramp Return: Automatic return of unloaded ramp, from raised or lowered positions to stored position, level with platform, as truck departs. Leveler shall be capable of retracting to stored position while truck is at loading dock.
- G. Mechanical Operating System: Manual control; counterbalance and spring operation. Spring-operated raising and walk-down lowering of unloaded ramp. Equip leveler with a torsion-spring counterbalancing mechanism controlled by a hold-down device.
1. Removable Lifting Hook: For raising unloaded ramp by lifting action and pushing forward to lower ramp and lip.
- H. Hydraulic Operating System: Electric control from a remote-control station, fully hydraulic operation. Electric-powered hydraulic raising and hydraulic lowering of ramp. Equip leveler with a packaged unit including a unitized, totally enclosed, nonventilated electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity of leveler indicated.
1. Remote-Control Station: [Weatherproof single] [Single]-button station of the constant-pressure type, enclosed in NEMA ICS 6, [Type 12] <Insert type> box. Ramp and lip raise to vertical position and extend to truck bed by depressing and holding button.
- I. Construction: Fabricate dock-leveler frame, platform supports, and lip supports from structural- or formed-steel shapes. Weld platform and hinged lip to supports. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles.
- J. Integral Molded-Rubber Dock Bumpers: Fabricated from [4-inch- (102-mm-)] [6-inch- (152-mm-)] <Insert dimension> thick, heavy molded-rubber compound reinforced with nylon, rayon, or polyester cord; with Type A Shore durometer hardness of 80, plus or minus 5, when tested according to ASTM D 2240. Provide two dock bumpers for each recessed dock leveler, attached to face of loading dock with expansion bolts.
- K. Integral Laminated-Tread Dock Bumper: Fabricated from [4-1/2-inch- (114-mm-)] [6-inch- (152-mm-)] <Insert dimension> thick, multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two

3/4-inch- (19-mm-) diameter, steel supporting rods that are welded at one end to **1/4-inch-** (6-mm-) thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than **1 inch** (25 mm) of tread plies extending beyond the face of closure angles.

- L. Dock-Leveler Finish: Painted in manufacturer's standard color.

2.5 VERTICAL-STORING DOCK LEVELERS <Insert drawing designation>

- A. General: Recessed, hinged-lip-type, vertical-storing dock levelers designed for permanent installation in shallow concrete pits preformed in the edge of loading platform; of type, function, operation, capacity, size, and construction indicated; and complete with controls, safety devices, and accessories required.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Blue Giant Equipment Corporation.
- b. McGuire, W. B. Co., Inc.; Division of Overhead Door Corporation.
- c. Nordock Inc.
- d. Pentalift Equipment Corporation.
- e. Poweramp; Division of Systems, Inc.
- f. Rite-Hite Corporation.
- g. Rol-Lift Corporation.
- h. SPX Dock Products - Kelley.
- i. SPX Dock Products - Serco.
- j. <Insert manufacturer's name>.
- k. or approved equal.

- B. Standard: Comply with MH 30.1[, **except for structural testing to establish rated capacity**].

- C. Rated Capacity: Capable of supporting total gross load of <Insert capacity> without permanent deflection or distortion.

- D. Platform: Not less than [**3/16-inch-** (5-mm-)] [**1/4-inch-** (6-mm-)] thick, nonskid steel plate.

1. Platform Size: [**As indicated on Drawings**] <Insert size>.

- E. Hinged Lip: Not less than [**1/2-inch-** (13-mm-)] [**5/8-inch-** (16-mm-)] thick, nonskid steel plate.

1. Hinge: Full width, piano-type hinge with heavy-wall hinge tube[**and greased fittings**], with gussets on lip and ramp for support.

- F. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform.

1. Vertical Travel: Operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact with the following minimum working range:
 - a. Above Adjoining Platform: [6 inches (152 mm)] [10 inches (250 mm)] [12 inches (305 mm)] [As indicated on Drawings] <Insert dimension>.
 - b. Below Adjoining Platform: [6 inches (152 mm)] [As indicated on Drawings] <Insert dimension>.
 2. Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.
 3. Automatic Lateral Compensation: Tilting of ramp with lip extended and resting on truck bed shall compensate automatically for canted truck beds of up to 4 inches (102 mm) over width of ramp.
 4. Lip Operation: Manufacturer's standard mechanism that automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck, and automatically retracts lip when truck departs.
 - a. Length of Lip Extension: [16 inches (406 mm)] [18 inches (457 mm)] [20 inches (508 mm)] [As indicated on Drawings] <Insert dimension>.
- G. Hydraulic Operating System: Electric control from a remote-control station; fully hydraulic operation. Electric-powered hydraulic raising and hydraulic lowering of ramp. Equip leveler with a packaged unit including a unitized, totally enclosed, nonventilated electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity of leveler indicated. Provide a hydraulic velocity fuse connected to main hydraulic cylinder to limit loaded ramp's free fall to not more than 3 inches (76 mm). Provide mechanical lock that prevents leveler from lowering without hydraulic pressure.
1. Remote-Control Station: [Weatherproof single] [Single]-button station of the constant-pressure type, enclosed in NEMA ICS 6, [Type 12] <Insert type> box. Ramp lowers at a controlled rate.
 2. Remote-Control Station with Emergency Stop: [Weatherproof multibutton] [Multibutton] control station with an UP button of the constant-pressure type and an emergency STOP button of the momentary-contact type, enclosed in NEMA ICS 6, [Type 12] <Insert type> box. Ramp raises by depressing and holding UP button; ramp lowers at a controlled rate by releasing UP button. All ramp movement stops, regardless of position of ramp or lip, by depressing STOP button. Normal operation resumes by engaging a manual reset button or by pulling out STOP button.
 - a. Master Panel: Control panel with integral fused disconnecting means for operating dock leveler, dock door, and truck restraints.
 3. Independent Lip Operation: Electric-powered hydraulic raising and lowering of lip, controlled independent of raising and lowering of ramp.

- H. Construction: Fabricate dock-leveler frame, platform supports, [**run-off guards,**] and lip supports from structural- or formed-steel shapes. Weld platform and hinged lip to supports. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles.
- I. Integral Molded-Rubber Dock Bumpers: Fabricated from [4-inch- (102-mm-)] [6-inch- (152-mm-)] <Insert dimension> thick, heavy molded-rubber compound reinforced with nylon, rayon, or polyester cord; with Type A Shore durometer hardness of 80, plus or minus 5, when tested according to ASTM D 2240. Provide two dock bumpers for each recessed dock leveler, attached to face of loading dock with expansion bolts.
- J. Integral Laminated-Tread Dock Bumper: Fabricated from [4-1/2-inch- (114-mm-)] [6-inch- (152-mm-)] <Insert dimension> thick, multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two 3/4-inch- (19-mm-) diameter, steel supporting rods that are welded at one end to 1/4-inch- (6-mm-) thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than 1 inch (25 mm) of tread plies extending beyond the face of closure angles.
- K. Accessories:
1. Interlock: Leveler will not operate while [**overhead door is in closed position**] [**and**] [**truck restraint is not engaged**].
 2. Curb Angles: 3-by-3-by-1/4-inch (76-by-76-by-6-mm) galvanized-steel curb angles for edge of recessed leveler pit, with 1/2-inch- (13-mm-) diameter by 6-inch- (152-mm-) long concrete anchors welded to angle at 6 inches (152 mm) o.c.
 3. <Insert accessory>.
- L. Finish: [**Paint**] [**Hot-dip galvanize**] dock levelers after assembly [**and testing**].

2.6 TRUCK LEVELERS <Insert drawing designation>

- A. General: Two-cylinder, hydraulic ramp designed to raise and lower end of truck at loading dock. Equip leveler with a packaged unit including a unitized electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity indicated. Provide manufacturer's standard means for limiting loaded ramp's free fall.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Lifts, Inc.
 - b. Autoquip Corporation.
 - c. Beacon Industries, Inc.
 - d. Pentalift Equipment Corporation.
 - e. Poweramp; Division of Systems, Inc.
 - f. Rite-Hite Corporation.
 - g. SPX Dock Products - Serco.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Beacon Industries, Inc.
 - b. Blue Giant Equipment Corporation.
 - c. Chalfant Dock Equipment.
 - d. DLM, Inc.
 - e. Ellis Industries, Inc.
 - f. Flexon, Inc.
 - g. Kelly Company, Inc.
 - h. McGuire, W. B. Co., Inc.; Division of Overhead Door Corporation.
 - i. Nordock Inc.
 - j. NOVA Technology International, L.L.C.
 - k. Pentalift Equipment Corporation.
 - l. Pioneer Loading Dock Equipment.
 - m. Poweramp; Division of Systems, Inc.
 - n. Rite-Hite Corporation.
 - o. Rol-Lift Corporation.
 - p. Serco Engineering Corp.
 - q. SPX Dock Products - Kelley.
 - r. SPX Dock Products - Serco.
 - s. Vestil Manufacturing Company.
 - t. **<Insert manufacturer's name>**.
 - u. or approved equal.

- B. Standard: Comply with MH 30.3.

- C. Rated Capacity: Capable of supporting total gross load of **<Insert capacity>** without permanent deflection or distortion.

- D. Operating Range: Capable of restraining rear-impact guards within a range from:
 1. Vertical: [**12 inches** (305 mm)] [**30 inches** (762 mm)] [**As indicated on Drawings <Insert dimension>**] above driveway.
 2. Horizontal: [**12 inches** (305 mm)] [**As indicated on Drawings <Insert dimension>**] in front of dock bumpers.

- E. Power Operating System: Manufacturer's standard electromechanical or hydraulic unit.
 1. Remote-Control Station: Single-button station of the constant-pressure type, enclosed in NEMA ICS 6, [**Type 12 <Insert type>**] box. Restraint is engaged by depressing and holding button; restraint is released by releasing button.
 2. Interlock: Leveler will not operate while truck restraint is not engaged.

- F. Mechanical Operating System: Restraint operates by use of a lifting rod or hook to raise engagement device.

- G. Rear-Impact-Guard Sensor: Detects presence of rear-impact guard[**and automatically returns to stored position if rear-impact guard is not engaged**].

- H. Caution Signs: Exterior, surface mounted; designed to inform both dock attendant and truck driver; with sign copy as follows. Provide one sign at each truck-restraint location.
1. Sign Copy in Forward and Reverse Text: **[Manufacturer's standard text permitting truck movement with green light]** <Insert text>.
 2. Interior Sign Copy: **[Manufacturer's standard text permitting truck movement with green light]** <Insert text>.
- I. Light-Communication System: Red and green illuminated signal-light sets, with lens approximately 4 inches (102 mm) in diameter, designed to indicate status to both dock attendant and truck driver. Equip system with steel control panel located at interior of dock that **[includes illuminated lights indicating]** **[indicates]** status of exterior signal lights. Provide signal-light set and control panel at each location indicated for light-communication system. Enclose exterior signal-light sets in steel or plastic housing with sunshade.
1. Manual Operation: System is activated by push button or switch located on **[interior]** **[truck-restraint]** control panel.
 2. Automatic Operation: System is activated automatically by **[limit switch]** **[photoelectric sensor]** **[magnetic switch]** mounted on overhead door track. Provide on-off switch located on **[light-communication system]** **[truck-restraint]** control panel.
 3. Automatic Operation: System is activated automatically when device engages rear-impact guard. Provide on-off switch located on truck-restraint control panel.
 4. Mounting: **[Wall]** **[Driveway]** **[Pit]**.
- J. Alarm: **[Audible]** **[Visual]** **[Audible and visual]** system indicating that rear-impact guard is not engaged, with manual reset.
- K. Accessories: **[Interlock to dock leveler]** **[Key switch]** <Insert accessory>.
- L. Truck-Restraint Finish: **[Painted]** **[Hot-dip galvanized]**.

2.8 LIGHT-COMMUNICATION SYSTEMS

- A. General: Provide communication system consisting of signal-light sets, caution signs, alarms, and controls for each location indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Beacon Industries, Inc.
 - b. Nordock Inc.
 - c. Rite-Hite Corporation.
 - d. SPX Dock Products - Kelley.
 - e. SPX Dock Products - Serco.
 - f. Vestil Manufacturing Company.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.

- B. Caution Signs: Surface mounted; designed to inform both dock attendant and truck driver; with sign copy as follows:
1. Exterior Sign Copy in Forward and Reverse Text: **[Manufacturer's standard text permitting truck movement with green light]** <Insert text>.
 2. Interior Sign Copy: **[Manufacturer's standard text permitting truck movement with green light]** <Insert text>.
- C. Signal-Light Sets: Red and green illuminated signal-light sets, with lens approximately 4 inches (102 mm) in diameter, designed to indicate status to both dock attendant and truck driver. Equip system with steel control panel that **[includes illuminated lights indicating] [indicates]** status of exterior signal lights; located at interior of dock. Provide signal-light set and control panel at each location indicated for light-communication system. Enclose signal lights in steel or plastic housing, with exterior signal-light sets equipped with sunshade.
1. Manual Operation: Lights are activated by push button or switch located on **[interior signal-light enclosure] [control panel]**.
 2. Automatic Operation: Lights are activated automatically by **[limit switch] [photoelectric sensor] [magnetic switch]** mounted on overhead door track. Provide on-off switch located on control panel.

2.9 DOCK BUMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Floor Products Company, Inc.
 2. Beacon Industries, Inc.
 3. Chalfant Dock Equipment.
 4. Durable Corporation.
 5. Ellis Industries, Inc.
 6. Flexon, Inc.
 7. Hugger Dock Equipment Company; Division of Columbus Foam Products, Inc.
 8. Pawling Corporation; Architectural Products Division.
 9. Pentalift Equipment Corporation.
 10. Pioneer Loading Dock Equipment.
 11. Rite-Hite Corporation.
 12. Rol-Lift Corporation.
 13. SPX Dock Products - Kelley.
 14. SPX Dock Products - Serco.
 15. Super Seal Mfg. Ltd.
 16. Tennessee Mat Company, Inc.
 17. Vestil Manufacturing Company.
 18. **<Insert manufacturer's name>**.
 19. or approved equal.
- B. Laminated-Tread Dock Bumper **<Insert drawing designation>**: Fabricated from multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies

under pressure on not less than two **3/4-inch-** (19-mm-) diameter, steel supporting rods that are welded at one end to **1/4-inch-** (6-mm-) thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than **1 inch** (25 mm) of tread plies extending beyond the face of closure angles.

1. Thickness: [4-1/2 inches (114 mm)] [6 inches (152 mm)] [**As indicated on Drawings**] <Insert dimension>.
 2. Horizontal Style: [6 inches (152 mm)] [10 inches (250 mm)] [12 inches (305 mm)] high by [length indicated on Drawings] <Insert dimension>.
 3. Vertical Style: 8 inches (203 mm) wide by [20 inches (508 mm) high] [24 inches (610 mm) high] [36 inches (914 mm) high] [height indicated on Drawings] <Insert dimension>.
- C. Molded-Rubber Bumpers <Insert drawing designation>: Fabricated from molded-rubber compound reinforced with nylon, rayon, or polyester cord; with Type A Shore durometer hardness of 80, plus or minus 5, when tested according to ASTM D 2240; of size and configuration indicated. Fabricate units with not less than two predrilled anchor holes.
1. Configuration: [T shape] [Inverted-L shape] [Square] [Rectangular] [**As indicated on Drawings**] <Insert configuration>.
 2. Thickness: [2 inches (50 mm)] [3 inches (76 mm)] [4 inches (102 mm)] [6 inches (152 mm)] [**As indicated on Drawings**] <Insert dimension>.
- D. Extruded-Rubber Bumpers <Insert drawing designation>: Fabricated from ASTM D 2000, extruded synthetic rubber with Type A Shore durometer hardness of 75, plus or minus 5, when tested according to ASTM D 2240; of size and configuration indicated. Furnish units with predrilled anchor holes and concealed, flat, steel mounting bar.
1. Configuration: [**Flat or ribbed, with 2-inch** (50-mm) **nominal thickness and 9-inch** (229-mm) **height**] [4-1/2-inch- (114-mm-) **wide base and 4-inch** (102-mm) **depth with half-oval shape that compresses and returns to original shape**] [**As indicated on Drawings**] <Insert configuration>.
- E. Steel-Face, Laminated-Tread Bumpers <Insert drawing designation>: Fabricated from multiple, uniformly thick plies cut from fabric-reinforced rubber tires and with **3/8-inch** (9.5-mm) steel faceplate of same size as rubber surface. Laminate plies under pressure on not less than two **3/4-inch-** (19-mm-) diameter, steel supporting rods that are welded at one end to **1/4-inch-** (6-mm-) thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than **1 inch** (25 mm) of tread plies extending beyond the face of closure angles. Weld face plate to two steel support brackets, which shall extend back to and engage **3/4-inch-** (19-mm-) diameter support rods in elongated holes, allowing steel face to float on impact.
1. Thickness: [4-1/2 inches (114 mm)] [6 inches (152 mm)] [**As indicated on Drawings**] <Insert dimension>.
 2. Horizontal Style: [6 inches (152 mm)] [10 inches (250 mm)] [12 inches (305 mm)] high by [length indicated] <Insert dimension>.

3. Vertical Style: **8 inches** (203 mm) wide by [**20 inches** (508 mm) **high**] [**24 inches** (610 mm) **high**] [**36 inches** (914 mm) **high**] [**height indicated**] **<Insert dimension>**.

F. Anchorage Devices: Hot-dip galvanized-steel anchor bolts, nuts, washers, bolts, sleeves, cast-in-place plates, and other anchorage devices as required to fasten bumpers securely in place and to suit installation type indicated.

2.10 DOCK LIFTS **<Insert drawing designation>**

A. General: Built-in, scissors-type, single-leg, hydraulic dock lift of capacity, size, and construction indicated; complete with controls, safety devices, and accessories required.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Advance Lifts, Inc.
- b. Autoquip Corporation.
- c. Beacon Industries, Inc.
- d. Blue Giant Equipment Corporation.
- e. ECOA Industrial Products, Inc.
- f. Equipment Company of America.
- g. Nordock Inc.
- h. Pentalift Equipment Corporation.
- i. Rol-Lift Corporation.
- j. SPX Dock Products - Kelley.
- k. SPX Dock Products - Serco.
- l. Vestil Manufacturing Company.
- m. **<Insert manufacturer's name>**.
- n. or approved equal.

B. Standard: MH 29.1.

C. Rated Capacity: Lifting capacity of not less than [**8000 lb** (3629 kg) **with 6500-lb** (2948-kg)] [**indicated on Drawings**] **<Insert load>** axle load at ends and [**5000-lb** (2268-kg)] [**indicated on Drawings**] **<Insert load>** axle load at sides.

D. Platform: [**Nonskid, safety-tread**] [**Smooth-surface**] heavy steel deck plate.

1. Platform Size: [**As indicated on Drawings**] **<Insert size>**.
2. Platform Guarding: [**Bevel toe guards**] [**Toe sensor**] [**Indicator bar**] [**Skirts**] [**Enclosure**] to comply with requirements in MH 29.1.
3. [**Removable**] [**Fixed**] Handrails: Equip lift with handrails on two sides of platform with a single, removable chain across each end. Provide handrails not less than **39 inches** (991 mm) high with midrail and **4-inch-** (102-mm-) high kick plate at bottom.[**Mount rail sockets flush with platform surface.**]

E. Bridge: [**Nonskid, safety-tread steel**] [**High-tensile aluminum**] plate.

1. Hinged Bridge: Hinged, throw-over bridge bolted to full-length, heavy-duty, piano-type hinge welded to toe guard at end of platform. Provide bridge complete with heavy-duty lifting chains. Chamfer edge of bridge to minimize obstructing wheels of material-handling vehicles.
 2. Size: [18 inches (457 mm) long by 60 inches (1524 mm) wide] [18 inches (457 mm) long by 72 inches (1829 mm) wide] [As indicated on Drawings] <Insert size>.
 3. Locations: [Ends] [Sides] [As indicated on Drawings].
- F. Function: Dock lifts shall compensate for differences in height between truck bed and loading platform.
1. Vertical Travel: Maximum of [60 inches (1524 mm)] <Insert height> from a lowered height of [12 inches (305 mm)] <Insert height> for a total raised height of [72 inches (1829 mm)] <Insert total height>.
 2. Travel Speed: Nominal raising speed of [8 fpm (0.04 m/s)] [10 fpm (0.05 m/s)] [12 fpm (0.06 m/s)] <Insert speed>.
 3. Vertical Travel and Travel Speed: [As indicated on Drawings.]
 4. Hinged Throw-Over Bridges Operation: [Manual] [Manual-assist bridge winch] [Automatic powered].
- G. Hydraulic Operating System: Self-contained, electric, hydraulic power unit for raising and lowering lift; of size, type, and operation needed for capacity of lift indicated; controlled from a remotely located push-button station.
1. Power Unit: Consisting of continuous-duty motor, high-pressure gear pump, valve manifold, oil-line filters, and oil reservoir.
 - a. Equip manifold with relief valve, check valve, pressure-compensated flow-control valve, and solenoid valve and with provisions for lowering lift manually if power fails.
 - b. Equip reservoir, valve manifold, and pressure line with oil-line filters.
 2. Cylinders: Equip lift with not less than two heavy-duty, high-pressure, hydraulic, ram-type cylinders. Rams shall be manufacturer's standard, either direct-displacement plunger or rod-and-piston type with positive internal stops. Cylinder rods shall be chrome plated and polished.
 - a. Rate of Descent Protection: Pressure-compensated flow control or hydraulic velocity fuse to limit down speed for each cylinder.
 3. Remote-Control Station: Multibutton control station of the constant-pressure type with UP and DOWN push buttons. Controller shall consist of magnetic motor starter with three-pole adjustable overloads and 24-V control transformer with 4-A, fused secondary prewired to terminal strips and enclosed in NEMA ICS 6, [Type 12] <Insert type> box.
 - a. Upper-Travel-Limit Switch: Equip unit with manufacturer's standard, adjustable, upper-travel-limit switch.

- H. Construction: Fabricate lift from structural-steel shapes rigidly welded and reinforced for maximum strength, safety, and stability. Design assembly to withstand deformation during both operating and stored phases of service. Provide mounting brackets and removable lifting eyes for ease of installation.
1. Scissors Mechanism: Fabricate leg members from heavy, steel-formed tube or plate members to provide maximum strength and rigidity.
 2. Scissors Configuration: [**Single leg**] [**Multiple width**] [**Multiple length**].
 3. Bearings: Pivot points with permanently lubricated antifriction bushings or sealed ball-bearings for minimum maintenance.
 4. Maintenance Leg: Removable, safety maintenance leg or hinged, safety maintenance bars.
 5. Mounting: [**Surface**] [**Pit**].
- I. Dock Lift Finish: [**Painted**] [**Hot-dip galvanized**].
1. Toe Guards: Paint [**yellow**] [**orange**] <Insert color> to comply with ANSI Z535.1.

2.11 FOAM-PAD DOCK SEALS <Insert drawing designation>

- A. General: Dock seals consisting of fabric-covered foam pads designed to compress **4 to 5 inches** (102 to 127 mm) under pressure of truck body to form an airtight seal at jambs and head of loading dock openings; of type, size, and construction indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Beacon Industries, Inc.
 - b. Blue Giant Equipment Corporation.
 - c. Chalfant Dock Equipment.
 - d. DLM, Inc.
 - e. Ellis Industries, Inc.
 - f. Fairborn U.S.A., Inc.
 - g. Flexon, Inc.
 - h. Hugger Dock Equipment Company; Division of Columbus Foam Products, Inc.
 - i. McGuire, W. B. Co., Inc.; Division of Overhead Door Corporation.
 - j. Nordock Inc.
 - k. NOVA Technology International, L.L.C.
 - l. Pentalift Equipment Corporation.
 - m. Pioneer Loading Dock Equipment.
 - n. Rite-Hite Corporation.
 - o. Rotary Products Inc.
 - p. Serco Engineering Corp.
 - q. SPX Dock Products - Kelley.
 - r. SPX Dock Products - Serco.
 - s. Super Seal Mfg. Ltd.
 - t. Vestil Manufacturing Company.
 - u. <Insert manufacturer's name>.

- v. or approved equal.
- B. Door Opening Size: **[As indicated on Drawings]** <Insert width and height>.
- C. Stationary Head Pad: **[8 inches (203 mm)] [12 inches (305 mm)] [18 inches (457 mm)] [24 inches (610 mm)]** high and same depth as jamb pads[; **beveled**]; sized for opening width.
- D. Adjustable Head Pad: **[18 inches (457 mm)] [24 inches (610 mm)] [30 inches (762 mm)]** high and same depth as jamb pads; sized for opening width; with manufacturer's standard hardware and tension spring or counterweight mechanism for adjusting height of pad.
- E. Jamb Pads: **[Square] [Beveled; tapered to reduce opening width]**.
1. Nominal Size: **[12 inches (305 mm)] [As indicated on Drawings]** <Insert size> wide and sized for opening height.
- F. Construction: Consisting of single- or double-ply, coated, fabric-covered, urethane-foam core with supporting frame. Fabricate jamb and head pads of same depth and sized for opening width.
1. **[Pressure-Treated]** Wood Support Frame: Factory painted; with steel mounting hardware.
2. Steel Support Frame: Steel channel frame of manufacturer's standard weight, shape, and finish; with steel mounting hardware.
3. Tapered Side Panels: Taper side panels to angle required to accommodate sloped loading dock approach grades and make sealing edge of dock shelter parallel to back edge of truck. Taper for **[declined] [inclined]** approach.
4. Cover Fabric: Vinyl-coated nylon or polyester with minimum total weight of **[22 oz./sq. yd. (746 g/sq. m)] [40 oz./sq. yd. (1356 g/sq. m)]**.
- a. Color: **[Black] [Green] [Blue] [Brown] [Tan] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range]** <Insert color>.
5. Cover Fabric: Neoprene-coated nylon with minimum total weight of **[16 oz./sq. yd. (543 g/sq. m)] [40 oz./sq. yd. (1356 g/sq. m)] [45 oz./sq. yd. (1526 g/sq. m)]**.
- a. Color: **[Black] [Green] [Blue] [Brown] [Tan] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range]** <Insert color>.
6. Cover Fabric: Hypalon-coated nylon with minimum total weight of **[16 oz./sq. yd. (543 g/sq. m)] [40 oz./sq. yd. (1356 g/sq. m)]**.
- a. Color: **[Black] [Green] [Blue] [Brown] [Tan] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample]**

**[As selected by DEN Project Manager from manufacturer's full range]
<Insert color>.**

7. Cover Fabric: Manufacturer's proprietary cover fabric complying with the following minimum requirements:
 - a. Tearing strength of not less than **[300 by 300 lbf (1334 by 1334 N)] <Insert value>** when tested according to ASTM D 2261.
 - b. Abrasion resistance of not less than **[6000] <Insert number>** cycles when tested according to FED-STD-191A-5306.
 - c. Tensile strength of not less than **[1200 by 1200 lbf (5338 by 5338 N)] <Insert value>** when tested according to FED-STD-191A-5100.1.
 - d. Cold resistance to **minus 40 deg F** (minus 40 deg C) when tested according to FED-STD-191A-5874.
 - e. Color: **[Black] [Green] [Blue] [Brown] [Tan] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>.**
8. Guide Strips: **4-inch-** (102-mm-) wide, coated, nylon guide strips on jamb pads.
9. Pleated Protectors: On face of jamb pads of overlapping layers of coated fabric attached to base fabric; **[4-inch (102-mm)] [8-inch (203-mm)] [16-inch (406-mm)]** wear exposure.

2.12 INFLATABLE DOCK SEALS **<Insert drawing designation>**

- A. General: Inflatable dock seals consisting of one-piece jamb[, **sill,**] and header seals designed to inflate by motor/blower and compress against truck bodies to form airtight seals at loading dock openings; of type, size, and construction indicated.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Locke Dock Seal; Division of O'Neal Tarpaulin Co.
 - b. Pentalift Equipment Corporation.
 - c. SPX Dock Products - Kelley.
 - d. SPX Dock Products - Serco.
 - e. Super Seal Mfg. Ltd.
 - f. **<Insert manufacturer's name>.**
 - g. or approved equal.
- B. Door Opening Size: **[As indicated on Drawings] <Insert width and height>.**
- C. Head Members: **[One] [Two] <Insert number>.**
- D. Jamb Members: **[One] [Two] <Insert number>.**
- E. Construction: Fabricate header seal full width over jamb seals. Mount seals on pressure-treated wood frame with hot-dip galvanized-steel mounting hardware. Inflate

seals by use of 1/2-hp motor/blower with on-off switch, mounted above header seal in galvanized-steel hood. Provide bottom of header and jamb seals with grommets to allow for release of moisture and excess air.

1. Fabric: Neoprene-coated nylon with minimum total weight of **14 oz./sq. yd.** (475 g/sq. m).
 - a. Color: **[Black] [Gray] [Blue] [Brown] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
2. Fabric: Manufacturer's proprietary fabric complying with the following minimum requirements:
 - a. Tearing strength of not less than **[110 by 85 lbf (489 by 378 N)] <Insert value>** when tested according to ASTM D 2261.
 - b. Abrasion resistance of not less than **[490] <Insert number>** cycles when tested according to FED-STD-191A-5306.
 - c. Tensile strength of not less than **[500 by 440 lbf (2224 by 1957 N)] <Insert value>** when tested according to FED-STD-191A-5100.1.
 - d. Cold resistance to **minus 40 deg F** (minus 40 deg C) when tested according to FED-STD-191A-5874.
 - e. Color: **[Black] [Gray] [Blue] [Brown] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.

2.13 FRAME-TYPE DOCK SHELTERS <Insert drawing designation>

- A. General: Dock shelters designed to form a seal with sides and top of truck body while leaving entire width and height of truck's rear opening unobstructed; of type, size, and construction indicated.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Beacon Industries, Inc.
 - b. Chalfant Dock Equipment.
 - c. DLM, Inc.
 - d. Ellis Industries, Inc.
 - e. Fairborn U.S.A., Inc.
 - f. Flexon, Inc.
 - g. Hugger Dock Equipment Company; Division of Columbus Foam Products, Inc.
 - h. McGuire, W. B. Co., Inc.; Division of Overhead Door Corporation.
 - i. Nordock Inc.
 - j. NOVA Technology International, L.L.C.
 - k. Pentalift Equipment Corporation.
 - l. Pioneer Loading Dock Equipment.
 - m. Rite-Hite Corporation.

- n. Rotary Products Inc.
 - o. SPX Dock Products - Kelley.
 - p. SPX Dock Products - Serco.
 - q. Super Seal Mfg. Ltd.
 - r. Vestil Manufacturing Company.
 - s. <Insert manufacturer's name>.
 - t. or approved equal.
- B. Door Opening Size: **[As indicated on Drawings]** <Insert width and height>.
- C. Rigid-Frame Type: Fabricated from translucent, **[fabric-covered]** **[fiberglass]** side and top panels attached to fixed supporting framework. Provide head and side curtains with built-in flexible stays, wind straps between head curtain and side frame, pleated protectors on head curtain, and a yellow aim patch on side curtains. Slope head frame from center for drainage. Provide replaceable, fabric-covered, tapered, foam-bottom pads and protective steel bumpers of size and type required for application shown.
- D. Flexible-Frame Type: Fabricated from fabric-covered side and top panels attached to retractable supporting framework with independent spring-tension extension arms. Provide head and side curtains with built-in flexible stays, pleated protectors on head curtain, and a yellow aim patch on side curtains. Provide replaceable, fabric-covered, tapered, foam-bottom pads of size and type required for application shown.
- E. Head-Pad Height: **[12 inches (305 mm)] [18 inches (457 mm)] [24 inches (610 mm)] [30 inches (762 mm)]**.
- F. Construction: Fabricate framework, pads, bumpers, fabric for curtains and panels, and other components to sizes and shapes indicated or required to fit door opening sizes shown and allow for not less than **18 inches (457 mm)** of truck-body penetration when truck is docked.
- 1. Wood Framework: Factory painted, mechanically fastened together using nails and lag bolts or metal connectors to form a rigid assembly.
 - 2. Steel Framework: Zinc-plated steel tubing of size and thickness standard with manufacturer, with joints welded.
 - 3. Top and Side Panels: White, translucent fiberglass, **0.045 inch (1.1 mm)** thick, weighing **6 oz./sq. ft. (1831 g/sq. m)**.
 - 4. Top and Side Panels: White, translucent vinyl, weighing **14 oz./sq. ft. (4272 g/sq. m)**.
 - 5. Tapered Side Panels: Taper side panels to angle required to accommodate sloped loading dock approach grades and make sealing edge of dock shelter parallel to back edge of truck. Taper for **[declined]** **[inclined]** approach.
 - 6. Cover Fabric: Vinyl-coated nylon with minimum total weight of **[22 oz./sq. yd. (746 g/sq. m)] [40 oz./sq. yd. (1356 g/sq. m)]**.
- a. Color: **[Black]** **[Green]** **[Blue]** **[Brown]** **[Tan]** **[As indicated by manufacturer's designations]** **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from manufacturer's full range]** <Insert color>.

7. Cover Fabric: Polyurethane-coated nylon with minimum total weight of **25 oz./sq. yd.** (848 g/sq. m).
 - a. Color: **[Black] [Green] [Blue] [Brown] [Tan] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
8. Cover Fabric: Neoprene-coated nylon with minimum total weight of **[16 oz./sq. yd.** (543 g/sq. m)] **[40 oz./sq. yd.** (1356 g/sq. m)] **[45 oz./sq. yd.** (1526 g/sq. m)].
 - a. Color: **[Black] [Green] [Blue] [Brown] [Tan] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
9. Cover Fabric: Hypalon-coated nylon with minimum total weight of **[16 oz./sq. yd.** (543 g/sq. m)] **[40 oz./sq. yd.** (1356 g/sq. m)].
 - a. Color: **[Black] [Green] [Blue] [Brown] [Tan] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
10. Cover Fabric: Manufacturer's proprietary cover fabric complying with the following minimum requirements:
 - a. Tearing strength of not less than **[300 by 300 lbf** (1334 by 1334 N)] **<Insert value>** when tested according to ASTM D 2261.
 - b. Abrasion resistance of not less than **[6000]** **<Insert number>** cycles when tested according to FED-STD-191A-5306.
 - c. Tensile strength of not less than **[1200 by 1200 lbf** (5338 by 5338 N)] **<Insert value>** when tested according to FED-STD-191A-5100.1.
 - d. Cold resistance to **minus 40 deg F** (minus 40 deg C) when tested according to FED-STD-191A-5874.
 - e. Color: **[Black] [Green] [Blue] [Brown] [Tan] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
11. Pleated Protectors: Overlapping layers of same fabric as cover.

G. Accessories:

1. Buffer flaps.
2. Bottom filler curtain.
3. Bottom seal pads.
4. **<Insert accessory>**.

2.14 INFLATABLE DOCK SHELTERS <Insert drawing designation>

- A. General: Inflatable dock shelters designed to inflate by motor/blower and compress against truck bodies to form airtight seals at loading dock openings; of type, size, and construction indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. air Locke Dock Seal; Division of O'Neal Tarpaulin Co.
 - b. Nordock Inc.
 - c. Pentalift Equipment Corporation.
 - d. Rite-Hite Corporation.
 - e. SPX Dock Products - Kelley.
 - f. SPX Dock Products - Serco.
 - g. Super Seal Mfg. Ltd.
 - h. <Insert manufacturer's name>.
 - i. or approved equal.
- B. Door Opening Size: [As indicated on Drawings] <Insert width and height>.
- C. Rigid Canopy: Consisting of rigid canopy, fabric-covered header curtain, and one-piece inflatable header and jamb seals. Fabricate canopy from white, translucent plastic attached to rigid support framework.
- D. Rigid Canopy and Sides: Consisting of rigid canopy and sides, fabric-covered header curtain, and one-piece, inflatable header and jamb seals. Fabricate canopy and sides from white, translucent plastic attached to rigid support framework.
- E. Construction: Fabricate header seal full width over jamb seals. Mount seals on pressure-treated wood frame with hot-dip galvanized-steel mounting hardware. Provide header curtain with built-in flexible stays and two yellow aim patches. Slope canopy frame from center for drainage. Provide two protective steel bumpers of size and type required for application shown. Inflate seals by use of a 1/2-hp motor/blower with on-off switch, mounted under canopy frame. Provide bottom of header and jamb seals with grommets to allow for release of moisture and excess air.
1. Shape and Size: Fabricate framework, fabric for curtains, and other components to sizes and shapes indicated or required to fit door opening sizes shown and allow for not less than **12 inches** (305 mm) of truck-body penetration when truck is docked.
 2. Wood Framework: Fasten members together mechanically using nails and lag bolts or metal connectors to form a rigid assembly.
 3. Steel Framework: Zinc-plated steel tubing of size and thickness standard with manufacturer, with joints welded.
 4. Fabric: [**Polyurethane**] [**Vinyl**]-coated nylon with minimum total weight of **14 oz./sq. yd.** (475 g/sq. m).

- a. Color: **[Black] [Green] [Blue] [Brown] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
5. Fabric: Manufacturer's proprietary fabric complying with the following minimum requirements:
- a. Tearing strength of not less than **[110 by 85 lbf (489 by 378 N)] <Insert value>** when tested according to ASTM D 2261.
 - b. Abrasion resistance of not less than **[490] <Insert number>** cycles when tested according to FED-STD-191A-5306.
 - c. Tensile strength of not less than **[500 by 440 lbf (2224 by 1957 N)] <Insert value>** when tested according to FED-STD-191A-5100.1.
 - d. Cold resistance to **minus 40 deg F** (minus 40 deg C) when tested according to FED-STD-191A-5874.
 - e. Color: **[Black] [Green] [Blue] [Brown] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.

2.15 TRANSPARENT-STRIP DOOR CURTAINS <Insert drawing designation>

- A. General: Door curtains consisting of overlapping strips suspended from top of opening to form a sealed door curtain. Provide strips of length required to suit opening height and with sufficient number in unit to close opening width with overlap indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Floor Products Company, Inc.
 - b. Chalfant Dock Equipment.
 - c. Chase Doors.
 - d. Flexon, Inc.
 - e. Hugger Dock Equipment Company; Division of Columbus Foam Products, Inc.
 - f. Pawling Corporation; Architectural Products Division.
 - g. Rotary Products Inc.
 - h. Super Seal Mfg. Ltd.
 - i. Verilon Vinyl.
 - j. Vestil Manufacturing Company.
 - k. **<Insert manufacturer's name>**.
 - l. or approved equal.
- B. Strip Material: Curved, clear, transparent, extruded PVC. Fabricate strips for manufacturer's standard method of attachment to overhead mounting system indicated.
1. Standard Grade: Designed to withstand temperature range of **0 to plus 150 deg F** (minus 18 to plus 66 deg C).

2. Low-Temperature Grade: USDA accepted, designed to withstand temperature range of **minus 30 to plus 150 deg F** (minus 34 to plus 66 deg C).
 3. Strip Width and Thickness: **6 inches** (152 mm) wide and **0.060 inch** (1.5 mm) thick.
 4. Strip Width and Thickness: **8 inches** (203 mm) wide and **0.080 inch** (2 mm) thick.
 5. Strip Width and Thickness: **12 inches** (305 mm) wide and **0.120 inch** (3 mm) thick.
 6. Strip Width and Thickness: **16 inches** (406 mm) wide and **0.160 inch** (4 mm) thick.
 7. Overlap: [**None**] [**One-third**] [**One-half**] [**Two-thirds**] [**Three-quarters**] [**Full**].
- C. Header Mounting: Consisting of an angle bolted or welded to opening lintel; equip angle with permanently attached mounting pins and a steel-angle or -plate retaining strip attached to angle with wing nuts.
- D. Wall Surface Mounting: Consisting of a steel plate bolted to side of lintel; equip plate with permanently attached, threaded, mounting pins and steel-angle or -plate retaining strip attached to plate with wing nuts.
- E. Wall Surface Mounting: Consisting of steel pipe attached to side of lintel by manufacturer's standard, winged-U-type suspension brackets.
- F. Wall Surface Mounting: Consisting of a rigid, vinyl wall-mounting unit bolted to side of lintel above opening; equip unit with a similarly formed, rigid, vinyl retainer attached to unit with wing nuts.

2.16 GENERAL FINISH REQUIREMENTS

- A. Finish loading dock equipment after assembly and testing.

2.17 STEEL FINISHES

- A. Galvanizing: Hot-dip galvanize components as indicated to comply with the following:
1. ASTM A 123/A 123M for iron and steel loading dock equipment.
 2. ASTM A 153/A 153M or ASTM F 2329 for iron and steel hardware for loading dock equipment.
- B. [**Galvanized-Steel**] [**and**] [**Steel**] Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat in manufacturer's standard color.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of loading dock equipment.

- B. Examine roughing-in for electrical systems for loading dock equipment to verify actual locations of connections before equipment installation.
- C. Examine walls and floors of pits for suitable conditions where recessed loading dock equipment is to be installed. Pits shall be plumb and square and properly sloped for drainage from back to front of loading dock.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate size and location of loading dock equipment indicated to be attached to or recessed into concrete or masonry, and furnish anchoring devices with templates, diagrams, and instructions for their installation.
 - 1. Coordinate delivery of anchoring devices to Project site to avoid delaying progress.
- B. Set curb angles in concrete edges of dock-leveler recessed pits with tops flush with loading platform. Fit exposed connections together to form hairline joints.
- C. Set curb angles in concrete edges of truck-leveler recessed pits with tops flush with driveway. Fit exposed connections together to form hairline joints.
- D. Place self-forming pan system for [**recessed dock**] [**edge-of-dock**] levelers in proper relation to loading platform before pouring concrete.
- E. Clean recessed pits of debris.

3.3 INSTALLATION

- A. General: Install loading dock equipment, including [**motors**] [**pumps**] [**control stations**] [**wiring**] [**safety devices**] [**light-communication systems**] [**and**] [**accessories**] as required for a complete installation. Comply with manufacturer's detailed instructions for installing loading dock Equipment.
 - 1. Rough-in electrical connections.
- B. Hydraulic Dock Lifts: Coordinate forming the pit for hydraulic dock lifts to ensure that the depth is adequate to accommodate the lift in proper relationship to the loading platform. Attach the lift securely to the pit floor according to the manufacturer's directions.
- C. Recessed Dock Levelers: Attach dock levelers securely to loading dock platform, flush with adjacent loading dock surfaces and square to recessed pit.
- D. [**Edge**] [**Top**]-of-Dock Levelers: Attach dock levelers to loading dock platform in a manner that complies with requirements indicated for arrangement and position relative to top of platform.

1. Weld anchor holes in contact with continuous embedded loading dock edge channel. Weld or bolt bumper blocks to face of loading dock.
- E. Truck Levelers: Attach truck levelers securely to driveway construction with expansion anchors and bolts.
- F. Truck Restraints: Attach truck restraints in a manner that complies with requirements for arrangement and height required for device to engage vehicle rear-impact guard.[**Interconnect control panel and signals with dock leveler.**]
1. Wall-Mounted Units: Weld truck restraints to steel [**curb angle**] [**edge channel**] [**mounting plate**] embedded in loading dock edge.
 2. Wall-Mounted Units: Anchor truck restraints to face of loading dock with expansion anchors and bolts.
 3. Driveway-Mounted Units: Anchor truck restraints to driveway with expansion anchors and bolts.
 4. Pit-Mounted Units: Anchor truck restraints to concrete pit with expansion anchors and bolts.
- G. Dock Bumpers: Attach dock bumpers to face of loading dock in a manner that complies with requirements indicated for spacing, arrangement, and position relative to top of platform and anchorage.
1. Welded Attachment: Plug-weld anchor holes in contact with steel inserts and fillet weld at other locations.
 2. Bolted Attachment: Attach dock bumpers to preset anchor bolts embedded in concrete or to cast-in-place inserts or threaded studs welded to embedded-steel plates or angles. If preset anchor bolts, cast-in-place inserts, or threaded studs welded to embedded-steel plates or angles are not provided, attach dock bumpers by drilling and anchoring with expansion anchors and bolts.
 3. Screw Attachment: Attach dock bumpers to wood construction with lag bolts as indicated.
- H. Dock Lifts: Attach dock lifts securely to [**loading platform**] [**floor of recessed pit**] [**surface of driveway**].
- I. Dock Seals: Attach dock-seal support frames securely to building structure in proper relation to openings, dock bumpers, and dock levelers to ensure compression of dock seals when trucks are positioned against dock bumpers.
- J. Dock Shelters: Attach dock shelters securely to building structure in proper relation to openings, dock bumpers, and dock levelers to ensure an effective seal of dock-shelter curtains with sides and top of truck body when trucks are positioned against dock bumpers.
- K. Transparent-Strip Door Curtains: Attach door-curtain mounting system to lintel with screw anchors or toggle bolts. Mount curtain strips to achieve overlap indicated.

3.4 ADJUSTING

- A. Adjust loading dock equipment to function smoothly and safely, and lubricate as recommended by manufacturer.
- B. Test [**dock levelers**] [**lifts**] [**dock levelers and lifts**] for vertical travel within operating range indicated.
- C. After completing installation of exposed, factory-finished loading dock equipment, inspect exposed finishes and repair damaged finishes.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain loading dock equipment.
 - 1. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and Equipment
 - 2. Train the Owner's maintenance personnel on procedures and schedules related to start up and shutdown, troubleshooting, servicing, and preventive maintenance.
 - 3. Review data in operating instructions and maintenance manuals.
 - 4. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days' advanced notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 111300

SECTION 112600 - UNIT KITCHENS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes factory-fabricated and -assembled unit kitchens with **[metal]** **[laminate-clad]** **[wood]** cabinets, countertops, fixtures, appliances, and accessories.
- B. Related Sections:
 - 1. **[Section 231123 "Facility Natural-Gas Piping"] [Section 231126 "Facility Liquefied-Petroleum Gas Piping"]** for gas connections to unit kitchen appliances.
 - 2. Section 233113 "Metal Ducts" for ducted extensions and fans for **[exhaust hoods]** **[and]** **[range hoods]** of unit kitchens.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, finishes, furnished specialties, and accessories. Include rated capacities, operating characteristics, and utility requirements of appliances.
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Data for Credit EA 1.4: For appliances, documentation indicating that products are ENERGY STAR rated.
 - 2. Certificates for **[Credit MR 6]** **[Credit MR 7]**: Chain-of-custody certificates indicating that cabinets **[and countertops]** comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
 - 3. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that products contain no urea formaldehyde.

4. Laboratory Test Reports for Credit IEQ 4: For **[adhesives] [and] [composite wood products]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 1. Wiring Diagrams: For power, signal, and control wiring.
 - D. Samples for Initial Selection: For units with factory-applied color finishes.
 - E. Samples for Verification: For each type of exposed finish required, in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics, prepared on Samples of size indicated below:
 1. Metal finish for cabinets **[and countertops]**, **8 by 10 inches** (200 by 250 mm).
 2. Wood finish for cabinets, **8 by 10 inches** (200 by 250 mm).
 3. Plastic laminate for **[cabinets] [countertops] [cabinets and countertops]**, **8 by 10 inches** (200 by 250 mm).
 4. Solid surfacing for countertops, **6 inches** (150 mm) square.
 5. One full-size unit of each type of exposed hardware.
- 1.4 INFORMATIONAL SUBMITTALS
- A. Product Certificates: For each type of unit kitchen, from manufacturer.
 - B. Manufacturer Certificate: Signed by manufacturer certifying that units comply with requirements.
 - C. Warranty: Sample of special warranty.
- 1.5 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For unit kitchen appliances to include in maintenance manuals.
 - B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".
- 1.6 QUALITY ASSURANCE
- A. Manufacturer Qualifications: A qualified manufacturer that fabricates unit kitchens **[and their components]**.
 - B. Source Limitations: Obtain unit kitchens from single source from single manufacturer.

- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of unit kitchens and are based on the specific system indicated. Other manufacturers' products complying with requirements may be considered. Refer to Division 01 Section "Substitutions."
- D. Regulatory Requirements: Where unit kitchens are indicated to comply with accessibility requirements, comply with **[the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines] [ICC/ANSI A117.1] [HUD's "Fair Housing Accessibility Guidelines"] [and] <Insert regulation>**.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
1. Built-in Refrigerators: Listed and labeled for recessed installation. Mount label to be visible after installation of unit; include electrical rating, type of refrigerant, and minimum installation clearances.
 2. Refrigerated Unit Kitchens[**and Wet Bars**]: Listed and labeled for entire unit as a single integrated system. Mount label to be visible after installation of unit; include electrical rating, type of refrigerant, and minimum installation clearances.
- F. **[Wood] [Laminate-Clad]** Cabinet Fabrication Standard:
1. KCMA A161.1. Provide cabinets with KCMA's "Certified Cabinet" seal affixed to a semiexposed location of each unit and showing compliance with standard.
 2. AWI 400B, Custom grade.
 3. Either fabrication standard above.
- G. Appliance Standards:
1. Refrigerators and Freezers: UL 250 or AHAM ER-1.
 2. Electric Ranges: UL 858 or AHAM HRF-1.
 3. Microwave Ovens: UL 923.
 4. Gas-Burning Appliances: ANSI Z21 Series, and certified by CSA International, UL, or another testing and inspecting agency acceptable to authorities having jurisdiction.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Deliver factory-assembled units, individually factory packaged and protected. Label with manufacturer's name, product name, and model number.
1. Deliver unit kitchens only after utility roughing-in is complete and construction in spaces to receive unit kitchens is substantially complete and ready for installation.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install unit kitchens until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of construction contiguous with unit kitchens by field measurements before fabrication.

1.9 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that unit kitchens can be supported and installed as indicated.
- B. Roughing-in Drawings: Obtain and distribute to the parties involved roughing-in drawings for plumbing, mechanical, and electrical service connections for installing unit kitchens. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing services to comply with indicated requirements.
- C. Coordinate wiring requirements and current characteristics of unit kitchens with building electrical system.
- D. Coordinate layout and installation of plumbing, mechanical, and electrical services for unit kitchens.

1.10 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace hermetically sealed refrigerator compressor system of unit kitchens that fail within specified warranty period.
 - 1. Warranty Period: Minimum **[five (5)]** <Insert number> years from date of Substantial Completion.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Acme Kitchenettes Corp.
 2. Cervitor Kitchens, Inc.
 3. Dwyer Kitchens.
 4. Kitchen Systems, Inc.
 5. **<Insert manufacturer's name>**.
 6. or approved equal.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
- B. Porcelain-Enamel-Finished Steel Sheet: ASTM A 424, enameling-grade steel, uncoated thickness indicated; with exposed face and edges coated with primer, ground coat, and color cover coat; and concealed face coated with primer and ground coat; acid resistant.
- C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
- D. Certified Wood: Fabricate cabinets[**and countertops**] from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- E. Composite Wood Products: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. Medium-Density Fiberboard: ANSI A208.2, [**Grade 130**] **<Insert grade>** [, **made with binder containing no urea-formaldehyde resin**].
- G. Particleboard: ANSI A208.1, [**Grade M-2**] [**Grade M-2, made with binder containing no urea-formaldehyde resin**].
- H. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, Type I[, **made with materials containing no urea formaldehyde**].
- I. Solid Wood: Clear hardwood lumber of species indicated, free of defects, selected for compatible grain and color, and kiln dried to 7 percent moisture content.
- J. High-Pressure Decorative Laminate: NEMA LD 3.

- K. Solid-Surfacing Material: Homogenous solid sheets fabricated from reacted monomers and resins, mineral fillers, and pigments; in thickness indicated; complying with ISSFA-2.
- L. Adhesives: Do not use adhesives that contain urea formaldehyde.
- M. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 METAL CABINETS

- A. Steel Base Cabinets: Fabricate frames and sides from [0.036-inch (0.91-mm)] [0.030-inch (0.76-mm)] nominal-thickness, cold-rolled steel sheet; welded and reinforced with internal gussets and bracing; with baked-enamel finish.
 - 1. Door and Drawer Fronts: [0.036-inch (0.91-mm)] [0.030-inch (0.76-mm)] nominal-thickness, cold-rolled steel sheet, textured or smooth; welded, reinforced, and sound-deadened; with baked-enamel finish.
 - 2. Door and Drawer Fronts: 0.038-inch- (0.95-mm-) thick, stainless-steel sheet; welded, reinforced, and sound deadened.
- B. Stainless-Steel Base Cabinets: Fabricate frames and sides from 0.038-inch- (0.95-mm-) thick, stainless-steel sheet; welded and reinforced with internal gussets and bracing.
 - 1. Door and Drawer Fronts: 0.038-inch- (0.95-mm-) thick, stainless-steel sheet; welded, reinforced, and sound deadened.
- C. Undercounter Storage Cabinet: Same material and finish as base cabinets, with adjustable shelf and drawer or with two drawers.
- D. Wall Cabinets: Same material and finish as base cabinets, with flush double bottoms and adjustable shelves.
 - 1. Wall Shields: Fabricated from [textured, cold-rolled steel sheet with baked-enamel finish, color to match cabinets] [textured, cold-rolled steel sheet with baked-enamel finish, color to match countertop] [stainless-steel sheet]. Provide wall shields for back wall[and side walls] between countertop splash and wall cabinets.
- E. Shelves: Manufacturer's standard rolled-front shelves, [fixed,] [adjustable,] of same material and finish as cabinets.
- F. Wire Pulls: [Brushed-chrome] [Polished-chrome] [Brushed-brass] [Polished-brass] <Insert metal and type of finish> finish.

2.4 LAMINATE-CLAD CABINETS

- A. Framed-Style Base Cabinets:

1. Face Frames: **3/4-inch-** (19-mm-) thick plywood or solid wood.
 2. Back Panels: **3/8-inch-** (10-mm-) thick particleboard with melamine bonded to inside surface.
 3. Top, Bottom, and End Panels: **3/8-inch-** (10-mm-) thick particleboard with melamine bonded to both sides.
 4. Door and Drawer Fronts: **3/4-inch-** (19-mm-) thick, medium-density fiberboard with **16-mil-** (0.4-mm-) thick vinyl film (Thermofoil) bonded to exposed surfaces and melamine bonded to inside surfaces.
 5. Door and Drawer Fronts: **5/8-inch-** (16-mm-) thick particleboard with melamine bonded to both sides.
 6. Drawers: Four sided, with **1/2-inch-** (13-mm-) thick particleboard fronts, backs, and sides, and **1/4-inch-** (6-mm-) thick particleboard bottom.
 7. Shelves: **5/8-inch-** (16-mm-) thick particleboard with melamine bonded to both sides and PVC edges.
- B. Frameless-Style Base Cabinets:
1. Back Panels: **1/4-inch-** (6-mm-) thick plywood or particleboard with melamine bonded to inside surface.
 2. Top and Bottom Panels: **3/4-inch-** (19-mm-) thick particleboard with melamine bonded to both sides.
 3. End Panels: **5/8-inch-** (16-mm-) thick particleboard with melamine bonded to both sides.
 4. Door and Drawer Fronts: **3/4-inch-** (19-mm-) thick plywood with Grade HGS high-pressure decorative laminate bonded to front and edges, and Grade CLS high-pressure decorative laminate bonded to inside surface.
 5. Door and Drawer Fronts: **5/8-inch-** (16-mm-) thick particleboard with melamine bonded to both sides.
 6. Door and Drawer Fronts: **5/8-inch-** (16-mm-) thick particleboard with melamine bonded to both sides. Provide continuous bevel edge at tops and bottoms of doors and bottom of drawer fronts in **[wood-grain laminate] [solid wood]**.
 7. Drawers: Four sided, with **1/2-inch-** (13-mm-) thick particleboard fronts, backs, and sides, and **1/4-inch-** (6-mm-) thick particleboard bottom.
 8. Shelves: **3/4-inch-** (19-mm-) thick particleboard with melamine bonded to both sides and PVC edges.
- C. Wall Cabinets: Same material and finish as base cabinets, with adjustable shelves.
1. Wall Shields: Fabricated from **[high-pressure decorative laminate of grade and color to match cabinets] [high-pressure decorative laminate of grade and color to match countertop] [stainless-steel sheet]**. Provide wall shields for back wall **[and side walls]** between countertop splash and wall cabinets.
- D. Scribe Strips for Recessed Cabinets: Same material, finish, and color as cabinet.
- E. Wire Pulls: **[Brushed-chrome] [Polished-chrome] [Brushed-brass] [Polished-brass]** **<Insert metal and type of finish>** finish.

2.5 WOOD CABINETS

- A. Base Cabinets: **[Birch] [Maple] [Oak] [Cherry] [Ash]**.
1. Face Frames: **3/4-inch-** (19-mm-) thick, hardwood-veneer plywood or solid wood.
 2. Back Panels: **3/8-inch-** (10-mm-) thick particleboard with melamine bonded to inside surface.
 3. Top, Bottom, and End Panels: **3/8-inch-** (10-mm-) thick particleboard with melamine bonded to both sides.
 4. Shelves: **5/8-inch-** (16-mm-) thick particleboard with melamine bonded to both sides and PVC edges.
 5. Door and Drawer Fronts: **5/8-inch-** (16-mm-) thick, hardwood-veneer plywood with matching hardwood edges.
 6. Door and Drawer Fronts: **3/4-inch-** (19-mm-) thick, solid wood stiles and rails, with solid wood center panels.
- B. Wall Cabinets: Same material and finish as base cabinets, with adjustable shelves.
1. Wall Shields: Fabricated from **[high-pressure decorative laminate of grade and color to match countertop] [stainless-steel sheet]**. Provide wall shields for back wall[**and side walls**] between countertop splash and wall cabinets.
- C. Scribe Strips for Recessed Cabinets: Same material, finish, and color as cabinet.
- D. Wire Pulls: **[Brushed-chrome] [Polished-chrome] [Brushed-brass] [Polished-brass]** **<Insert metal and type of finish>** finish.

2.6 COUNTERTOPS

- A. Countertop and Integral Sink: Seamless, one-piece countertop and sink with integral embossed drainboard and backsplash[**and side splashes**].
1. Stainless Steel: **0.038-inch-** (0.95-mm-) thick sheet bonded to **3/4-inch** (19-mm) plywood.
 2. Porcelain-Enamel-Finished Steel: **0.0677 inch** (1.7 mm) thick.
 3. Solid-Surfacing Material: Minimum **1/2 inch** (13 mm) thick.
- B. Countertop[**for Drop-in Sink**]: Seamless, one-piece countertop with integral backsplash[**and side splashes**].
1. Stainless Steel: **0.038-inch-** (0.95-mm-) thick sheet bonded to **3/4-inch** (19-mm) plywood.
 2. High-Pressure Decorative Laminate: Grade HGS, bonded to **3/4-inch** (19-mm) plywood.
 3. High-Pressure Decorative Laminate: Grade HGP, post formed, bonded to **3/4-inch** (19-mm) particleboard with Grade BKL unfinished backing sheet bonded to reverse side.

- C. Countertop[**for Undercounter-Mounted Sink**]: Seamless, one-piece countertop with integral backsplash[**and side splashes**]; fabricated from **1/2-inch-** (13-mm-) thick, solid-surfacing material.

2.7 FIXTURES

- A. Stainless-Steel Drop-in Sinks: [0.050 inch (1.27 mm)] [0.038 inch (0.95 mm)] thick; seamless; single compartment.
- B. Porcelain-Enamel-Finished Steel Drop-in Sinks: **0.043 inch** (1.09 mm) thick; seamless; single compartment.
- C. Undercounter-Mounted Sinks: Solid-surfacing material; seamless; single compartment.
- D. Supplies: [**NPS 3/8** (DN 12)] [**NPS 1/2** (DN 15)] chrome-plated copper with stops.
- E. Sink Faucet: Single-lever control; [**polished chrome-plated mixing**] [**European-style, pull-out spray**] faucet with limited-swing spout and aerator.
- F. Sink Faucet: Separate hot and cold controls[**with wrist-blade handles**]; polished chrome-plated mixing faucet with limited-swing [**spout**] [**gooseneck spout**] and aerator.
- G. Sink Outlet with Disposer: **3-1/2-inch-** (89-mm-) diameter outlet.
- H. Sink Outlet without Disposer: **3-1/2-inch-** (89-mm-) diameter outlet with stainless-steel cup strainer and **1-1/2-inch-** (38-mm-) diameter tailpiece.
- I. Drain Piping: **NPS 1-1/2** (DN 40) chrome-plated cast-brass trap, tubular brass waste to wall, and wall escutcheon.
- J. Bar Sink Outlet: **2-inch-** (51-mm-) diameter outlet with stainless-steel grid strainer.
- K. Disposers: Continuous-feed, household, food-waste disposers. Include 115-V ac, 1725-rpm, 1/2-hp motor with overload protection and reset button; three-conductor, grounded power cord; wall switch; corrosion-resistant chamber with jam-resistant, cutlery- or stainless-steel grinder or shredder; **NPS 1-1/2** (DN 40) outlet; quick-mounting, stainless-steel sink flange; antisplash guard; and combination cover/stopper.
- L. Hot-Water Dispensers: Household type with instant on-off control; insulated, corrosion-resistant-metal storage tank that is open to atmosphere; electric, 115-V ac, heating element; three-conductor, grounded power cord; chrome-plated faucet or spout; removable strainer; thermostat control for water temperature up to **190 deg F** (88 deg C); thermal-overload protection; and minimum **1/2-gal.** (1.9-L) tank capacity dispensing approximately **60 cups** (240 mL) of water per hour.

2.8 APPLIANCES

- A. ENERGY STAR Rating: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.
- B. Built-in Refrigerators: Fabricated with one-piece seamless steel or ABS plastic inner liner; refrigerator compartment with slide-out or removable shelves and meat tray; adjustable automatic temperature control; door with magnetic gaskets and storage shelves; interior light; closed compartment for **25-lb** (11-kg) minimum storage of prefrozen food and two ice cube trays; 115-V ac.
1. Minimum Capacity: [3.2 cu. ft. (0.091 cu. m)] [5.5 cu. ft. (0.156 cu. m)] [6.0 cu. ft. (0.169 cu. m)] **<Insert dimensions>**.
 2. Defrost System: [Automatic defrost timer] [Push button or manual].
 3. Compressor: Cushion-mounted, self-oiling, and hermetically sealed compressor; fan or gravity cooled.
 4. Finish Panel: Manufacturer's standard door trim kit with filler panel or integral finish panel; match material and finish of base cabinets.
- C. Freestanding, Upright Refrigerator-Freezers: Two-door combination unit with one-piece seamless steel or ABS plastic inner liner; automatic defrost; closed freezer compartment with two adjustable shelves[**and two ice cube trays**]; full-width vegetable crisper; dairy compartment; interior light; adjustable automatic temperature control; door with magnetic gaskets and storage shelves; 115-V ac, with three-conductor, grounded power cord.
1. Minimum Capacity: [12-cu. ft. (0.340-cu. m) **refrigerator capacity with 100-lb (45-kg) freezer capacity**] [14-cu. ft. (0.396-cu. m) **refrigerator capacity with 125-lb (57-kg) freezer capacity**] **<Insert refrigerator and freezer capacities>**.
 2. Icemaker: Built-in automatic unit.
 3. Finish Panel: Manufacturer's standard door trim kit with filler panel or integral finish panel; match material and finish of base cabinets.
- D. Automatic Icemakers: Built-in undercounter unit; capable of producing [22 lb (10 kg) **of ice per day; with 12-lb (5.4-kg)**] [35 lb (15.9 kg) **of ice per day; with 26-lb (11.8-kg)**] [50 lb (22.6 kg) **of ice per day; with 35-lb (15.9-kg)**] storage bin; 115-V ac, with three-conductor, grounded power cord; with plumbed water supply.
- E. Electric Cooktops: Porcelain-enamel-finished steel; coil-element burners with removable rings and reflector bowls, infinitely adjustable heating controls, and individual signal lights; with wiring terminated at factory-installed junction box.
1. Cooktop Burner: One element rated at [900 W; 115] [1250 W; 208/240]-V ac.
 2. Cooktop Burners: One element rated at 550 W and one element rated at 950 W; 115-V ac.
 3. Cooktop Burners: Two elements, each rated at 1250 W; [115] [208/240]-V ac.
 4. Cooktop Burners: Two elements rated at 1250 W and one element rated at 2100 W; 208/240-V ac.

- F. Built-in Electric Ovens: Porcelain-enamel-finished steel exterior surfaces; coil-element burners with removable rings and reflector bowls, infinitely adjustable heating controls, and individual signal lights. Oven interior fabricated from one-piece porcelain-enamel-finished steel with rounded corners, with "Bake" and "Broil" oven elements, automatic heat control, signal light, and removable wire oven rack; textured baked-enamel- or porcelain-enamel-finished steel oven door; 208/240-V ac, with wiring terminated at factory-installed junction box.
1. Cooktop Burners: Three elements, each rated at 1250 W.
 2. Oven Elements: [**1500 W bake; 2000 W broil**] [**Manufacturer's standard**].
- G. Gas Cooktops: Porcelain-enamel-finished steel; surface burners with removable cast-iron grates, lift-out burner bowls, and 115-V ac electronic ignition; with wiring terminated at factory-installed junction box, and burner control panel mounted at front of unit.
1. Cooktop Burners: Two elements, each rated at [8000 Btu/h (8440 kJ)] [**10,000 Btu/h (10 550 kJ)**] for natural gas.
- H. Built-in Gas Ovens: [**Stainless-steel**] [**Porcelain-enamel-finished steel**] exterior surfaces; surface burners with removable cast-iron grates, lift-out burner bowls, and 115-V ac electronic ignition; with wiring terminated at factory-installed junction box. Oven interior fabricated from porcelain-enamel-finished steel with rounded corners; removable wire oven rack, automatic heat control, and combination surface burner and oven control panel mounted above oven door at front of unit.
1. Cooktop Burners: Three elements, each rated at 5000 Btu/h (5275 kJ) for natural gas.
 2. Cooktop Burners: Four elements, each rated at 9000 Btu/h (9495 kJ) for natural gas.
 3. Oven Burner: Rated at [9000 Btu/h (9495 kJ)] [**18,000 Btu/h (18 990 kJ)**] for natural gas.
- I. Freestanding Microwave Ovens: [**0.7-cu. ft. (0.020-cu. m) capacity with 600 W**] [**0.8-cu. ft. (0.023-cu. m) capacity with 700 W**] <Insert capacity and power> cooking power; electronic touch controls, variable power control, digital clock timer, interior light, turntable, and tempered glass door; 115-V ac, with three-conductor, grounded power cord.
- J. Built-in Microwave Ovens with Exhaust Hood: Undercabinet mounted, minimum **1.0-cu. ft. (0.028-cu. m)** capacity with 800-W cooking power; electronic touch controls, variable power control, digital clock timer, interior light, turntable, tempered glass door, and exhaust hood with integral light and two-speed fan control; 115-V ac, with three-conductor, grounded power cord.
1. Exhaust Hood: Recirculating, nonventing type, with replaceable charcoal filter.
 2. Exhaust Hood: Ventilating type, with permanent washable filter. Provide exhaust duct and [**wall**] [**roof**] cap and shutter. See Section 233113 "Metal Ducts."

- K. Built-in Microwave/Convection Ovens with Exhaust Hood: Undercabinet mounted, minimum **1.0-cu. ft.** (0.028-cu. m) capacity with 800-W cooking power; electronic touch controls, variable power control, digital clock timer, interior light, turntable, convection rack, tempered glass door, and exhaust hood with integral light and two-speed fan control; 115-V ac, with three-conductor, grounded power cord.
1. Exhaust Hood: Recirculating, nonventing type, with replaceable charcoal filter.
 2. Exhaust Hood: Ventilating type, with permanent washable filter. Provide exhaust duct and **[wall] [roof]** cap and shutter. See Section 233113 "Metal Ducts."
 3. Retain first paragraph below if ducted exhaust hood is required; retain second paragraph if recirculating hood is required. Verify acceptability of recirculating hoods with authorities having jurisdiction.
- L. Ventilating Exhaust Hoods: Undercabinet mounted, **24 inches** (610 mm) wide, **[stainless] [baked-enamel]** steel; two-speed fan control, permanent washable filter, and built-in lighting; 115-V ac, with wiring terminated at factory-installed junction box.
1. Provide exhaust duct and **[wall] [roof]** cap and shutter. See Section 233113 "Metal Ducts."
- M. Recirculating, Nonventilating Exhaust Hoods: Undercabinet mounted, **24 inches** (610 mm) wide, **[stainless] [baked-enamel]** steel; two-speed fan control, replaceable charcoal filter, and built-in lighting; 115-V ac, with wiring terminated at factory-installed junction box.
- N. Dishwashers: Built-in undercounter unit, **[18 inches (457 mm) wide] [24 inches (610 mm) wide] [width as indicated]**; multiple wash cycles, coated roll-out racks, detergent dispenser, and insulated cavity walls and door; 115-V ac, with wiring terminated at factory-installed junction box.
- O. Automatic Coffeemakers: Stainless steel, with capacity for three pots of coffee; automatic brewing, nonstick warmer plates, and lighted on-off switch; 115-V ac, with three-conductor, grounded power cord; designed for permanent installation in countertop, with plumbed water supply. Provide glass coffee decanters in number to match capacity.

2.9 ACCESSORIES

- A. Hardware: Manufacturer's standard concealed adjustable hinges; steel drawer slides with nylon rollers; metal, plastic, or chrome-plated pulls as indicated; and catches and rubber bumpers on doors and drawers. Furnish plated steel for concealed hinges, and chromium-plated metal or satin-finished stainless steel for exposed hardware.
- B. Locks: Brass-cylinder type; furnish two keys per lock. Provide **[where indicated] [on base cabinet doors] [on refrigerator]**.
- C. Fluorescent Light Fixtures: Surface mounted to underside of overhead cabinet; with 15-W lamp, on-off switch, grounded convenience receptacle, and translucent plastic lens.

- D. Protective Panels: Manufacturer's standard panels to enclose plumbing under countertop, of same material and finish as cabinets.
- E. Cutlery Drawers: Concealed drawer in undercounter storage compartment with pull-out divided tray.
- F. Cutting Boards: Pull-out hardwood board.
- G. Heat Shields: Minimum **12 inches high by 24 inches** (305 mm high by 610 mm) wide, **0.025-inch-** (0.64-mm-) thick stainless steel over **1/4-inch-** (6-mm-) thick board insulation.

2.10 FABRICATION

- A. General: Factory fabricate and assemble unit kitchens, with base cabinets[, **sink,**] [, **refrigerator,**] and countertop shipping as a one-piece assembly. Securely fasten components, fixtures, and appliances together.
 - 1. Provide manufacturer's standard hardware including concealed, adjustable plated-steel hinges; steel drawer slides with nylon rollers; and catches and rubber bumpers on doors and drawers. Unless otherwise indicated, provide chromium-plated metal or satin-finished stainless steel for exposed hardware.
- B. Accessible Units: Fabricate unit kitchens to comply with accessibility regulations as follows:
 - 1. Standard, Accessible Countertops: Fabricate unit kitchens with one-piece countertop located at height of **34 inches** (864 mm) above floor.
 - 2. Adjustable, Accessible Countertops: Fabricate unit kitchens with two-piece countertop that allows countertop over sink, including backsplash, side splashes, and sink assembly, to be adjusted between **29 and 36 inches** (735 and 915 mm) above finished floor.
 - 3. Removable, Accessible Cabinets: Fabricate cabinet under sink to allow removal for future accessibility conversion. Fabricate cabinet to allow access to plumbing and electrical connections after conversion.
 - 4. Knee and Toe Clearance: Provide minimum **30-inch-** (760-mm-) wide open space beneath countertop with a minimum clear height of **27 inches** (685 mm) above floor for first **8 inches** (205 mm) of depth, then reduce clearance at a rate of **1 inch** (25 mm) in depth for each **6 inches** (150 mm) in height, to a minimum clear height of **9 inches** (230 mm) above floor at a depth of **11 inches** (280 mm).
 - 5. Pipe Enclosure Panels: Provide manufacturer's standard panels to enclose plumbing under countertop, of same material and finish as cabinets. Install panel to prevent exposure of sharp or abrasive surfaces under countertop.
 - 6. Operable Parts: Locate operable parts no higher than **48 inches** (1219 mm) and no lower than **15 inches** (380 mm) above floor. Provide operable parts that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than **5 lbf** (22.2 N).
 - 7. Range or Cooktop: Provide top surface **34 inches** (865 mm) above floor, with controls that do not require reaching across burners. Provide knee and toe

clearance beneath range or cooktop; insulate underside of cooktop to prevent burns, shocks, or abrasions.

8. Refrigerator/Freezer: Provide 50 percent of freezer space no higher than 54 inches (1370 mm) off floor.
9. Oven: Provide work surface adjacent to one side of bottom-hinged doors. Locate controls on front panel.

2.11 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.12 FINISHES

- A. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 1. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat.
 - a. Color and Gloss: As indicated by manufacturer's designations.
 - b. Color and Gloss: Match DEN Project Manager's sample.
 - c. Color and Gloss: As selected by DEN Project Manager from manufacturer's full range.
 2. Porcelain-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, acid-resistant porcelain-enamel finish consisting of ground coat and cover coat.
 - a. Color and Gloss: As indicated by manufacturer's designations.
 - b. Color and Gloss: Match DEN Project Manager's sample.
 - c. Color and Gloss: As selected by DEN Project Manager from manufacturer's full range.
- B. Stainless-Steel Finishes: Remove tool and die marks and stretch lines, or blend into finish. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
 1. Bright, Directional Polish: No. 4 finish.
- C. Wood Finishes: Factory finished with manufacturer's standard stain, sealer, and clear finish coat. Defer only final touchup until after installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and floors, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Examine walls and partitions for proper backing for unit kitchens.
- D. Examine roughing-in for electrical power **[plumbing] [and] [mechanical]** system(s) to verify actual locations of connections before installation of unit kitchens.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install level, plumb, and true; shim as required, using concealed shims. Provide fasteners, clips, backing materials, brackets, anchors, fillers, scribes, trim, and accessories necessary for complete installation.
 - 1. Anchor unit kitchens at ends and at intervals recommended by manufacturer, but not more than **36 inches** (910 mm) o.c. Install anchors through backup reinforcing plates, channels, or blocking as required to prevent material distortion; use concealed fasteners.
 - 2. Freestanding Ranges: Install anti-tip anchors at locations recommended by manufacturer.
- B. Comply with requirements specified in Section 221116 "Domestic Water Piping," Section 221316 "Sanitary Waste and Vent Piping," and Section 221123 "Domestic Water Pumps" for connecting unit kitchens to **[plumbing] [and] [mechanical]** system(s).
- C. Comply with requirements for connecting unit kitchens to electrical power system.

3.3 FIELD QUALITY CONTROL

- A. Testing: Test, adjust, and verify operation of each appliance, plumbing fixture, and component of the unit kitchen. Repair or replace any item found to be defective or operating below rated capacity.

3.4 ADJUSTING AND CLEANING

- A. Verify that operating parts work freely and fit neatly and that clearances are adequate to properly and freely operate appliances.

- B. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. [**Verify that locking devices operate properly.**]
- C. After completing unit kitchen installation, remove protective coverings if any.
- D. Repair or replace damaged parts, dents, buckles, abrasions, and other defects affecting appearance or serviceability. Touch up factory-applied finishes to restore damaged or soiled areas.

3.5 UNIT KITCHEN SCHEDULE

A. Unit Kitchen <Insert drawing designation>:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Acme Kitchenettes Corp.; <Insert product name or designation>.
 - b. Cervitor Kitchens, Inc.; <Insert product name or designation>.
 - c. Dwyer Kitchens; <Insert product name or designation>.
 - d. Kitchen Systems, Inc.; <Insert product name or designation>.
 - e. <Insert manufacturer's name; product name or designation>.
 - f. or approved equal.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. <Insert manufacturer's name>.
 - b. or approved equal.
3. Cabinets: [Steel, with matching door and drawer fronts] [Steel, with laminate-clad door and drawer fronts] [Stainless steel] [Framed-style laminate clad] [Frameless-style laminate clad] [Wood].
 - a. Wall Cabinets: [Required] [Not required].
 - 1) Wall Shields: [High-pressure decorative laminate] [Stainless steel] on back[and sides].
 - b. Color: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range].
4. Countertop for Integral Sink: [Stainless steel] [Porcelain-enamel-finished steel] [Solid-surfacing material].
5. Countertop: [Stainless steel] [High-pressure decorative laminate] [Post-formed, high-pressure decorative laminate].
 - a. Drop-in Sink: [Stainless] [Porcelain-enamel] steel.
6. Countertop: Solid-surfacing material.

- a. Undercounter Sink: **[Stainless] [Porcelain-enamel]** steel.
 - b. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range]**.
7. Fixtures:
- a. Sink Faucet: **[Single-lever control, swing spout] [Single-lever control, European style with pull-out spray] [Separate hot and cold controls, swing spout] [Separate hot and cold controls, gooseneck spout]**.
 - b. Disposer.
 - c. Hot-water dispenser.
8. Appliances:
- a. Refrigerator: **[Built in] [Freestanding]**.
 - b. Automatic icemaker.
 - c. Cooktop: **[Electric] [Gas]**.
 - d. Built-in Oven: **[Electric] [Gas]**.
 - e. Freestanding Range: **[Electric] [Gas]**.
 - f. Microwave Oven: **[Freestanding] [Built in with exhaust hood] [Built-in microwave/convection with exhaust hood]**.
 - g. Exhaust Hood: **[Ventilating] [Recirculating, nonventilating]** type.
 - h. Dishwasher.
 - i. Automatic coffeemaker.
9. Accessories: **[Locks] [fluorescent light fixture] [cutlery drawer] [cutting board] [and] [heat shields]**.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 112600

SECTION 114000 - FOODSERVICE EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Fabricated equipment.
2. Food waste machines.
3. Cooking equipment.
4. Self-contained refrigeration equipment.
5. Walk-in refrigeration equipment.
6. Powered food-preparation equipment.
7. Warewashing equipment.
8. Serving equipment.
9. Utility distribution systems.

- B. Owner-Furnished Equipment: Where indicated, Owner will furnish equipment for installation by Contractor.

- C. Related Sections:

1. Section 055000 "Metal Fabrications" for custom equipment supports.
2. Division 06 Sections for wood casework and plastic-laminate substrates.
3. Section 233813 "Commercial-Kitchen Hoods" for ventilation hoods.
4. Refer to Division 23 Sections for related HVAC work including supply and exhaust fans; exhaust ductwork; service roughing-ins; drain traps; atmospheric vents; valves, pipes, and fittings; fire-extinguishing systems; and other materials required to complete food service equipment installation.
5. Refer to Division 21 and Division 26 Sections for connections to fire alarm systems, wiring, disconnects, and other electrical materials required to complete food service equipment installation.

- D. Allowances: Furnish food service equipment under the allowances indicated as specified in Section 012100 "Allowances."

- E. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. Terminology Standard: Refer to NSF 2, "Food Equipment" or other applicable NSF standards for definitions of food service equipment and installation terms not otherwise defined in this Section or in other referenced standards.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Manufacturer's model number.
 - 2. Accessories and components that will be included for Project.
 - 3. Clearance requirements for access and maintenance.
 - 4. Utility service connections for water, drainage, power, and fuel; include roughing-in dimensions.
 - 5. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For fabricated equipment not manufactured as standard production and catalog items by manufacturers.
 - 1. Include plans, elevations, sections, roughing-in dimensions, fabrication details, utility service requirements, and attachments to other work.
- C. Wiring Diagrams: Details of wiring for power, signal, and control systems and differentiating between manufacturer-installed and field-installed wiring.
- D. Piping Diagrams: Details of piping systems and differentiating between manufacturer-installed and field-installed piping.
- E. Samples for Initial Selection: For units with factory-applied color finishes showing the full range of colors available for exposed products with color finishes.
- F. Samples for Verification: For each factory-applied color finish required, in manufacturer's standard sizes, but minimum as follows:
 - 1. 4-inch- square or 6-inch- long sections of linear shapes and of same thickness and material indicated for work. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected. .

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For foodservice facilities.
 - 1. Indicate locations of foodservice equipment and connections to utilities.
 - 2. Key equipment using same designations as indicated on Drawings.
 - 3. Include plans and elevations; clearance requirements for equipment access and maintenance; details of equipment supports; and utility service characteristics.
 - 4. Include details of seismic bracing for equipment.

- B. Product Certificates: Signed by manufacturers of refrigeration systems or their authorized agents certifying that systems furnished comply with requirements and will maintain operating temperatures indicated in the areas or equipment that they will serve.
- C. Maintenance Data: Operation, maintenance, and parts data for food service equipment to include in the maintenance manuals specified in Division 01. Include a product schedule as follows:
- D. Product Schedule: For each food service equipment item, include item number and description indicated in Contract Documents, manufacturer's name and model number, and authorized service agencies' addresses and telephone numbers.
- E. Warranty: Samples of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For foodservice equipment to include in emergency, operation, and maintenance manuals. In addition to items specified in [**Section 017700 "Closeout Procedures"**] [**Section 017823 "Operation and Maintenance Data,"**] include the following:
 - 1. Product Schedule: For each foodservice equipment item, include the following:
 - a. Designation indicated on Drawings.
 - b. Manufacturer's name and model number.
 - c. List of factory-authorized service agencies including addresses and telephone numbers.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing food service equipment, who has completed installations similar in design and extent to that indicated for this Project, and who has a record of successful in-service performance.
- B. Manufacturer Qualifications: Engage a firm experienced in manufacturing food service equipment similar to that indicated for this Project and with a record of successful in-service performance.
- C. Source Limitations: Obtain each type of food service equipment through one source from a single manufacturer.
- D. Product Options: Drawings indicate food service equipment based on the specific products indicated. Other manufacturers' equipment with equal size and performance

characteristics may be considered. Refer to Section 016630 "Substitutions."

- E. NSF Standards: Provide equipment that bears NSF Certification Mark or UL Classification Mark certifying compliance with applicable NSF standards.
- F. BISSC Standards: Provide bakery equipment that complies with BISSC/Z50.2.
 - 1. Provide BISSC-certified equipment[, **with certification verified by a third-party agency**].
- G. UL Certification: Provide electric and fuel-burning equipment and components that are evaluated by UL for fire, electric shock, and casualty hazards according to applicable safety standards, and that are UL certified for compliance and labeled for intended use.
- H. Steam Equipment: Provide steam-generating and direct-steam heating equipment that is fabricated and labeled to comply with ASME Boiler and Pressure Vessel Code.
- I. Regulatory Requirements: Install equipment to comply with the following:
 - 1. ASHRAE 15, "Safety Code for Mechanical Refrigeration."
 - 2. NFPA 17, "Dry Chemical Extinguishing Systems."
 - 3. NFPA 17A, "Wet Chemical Extinguishing Systems."
 - 4. NFPA 54, "National Fuel Gas Code."
 - 5. NFPA 70, "National Electrical Code."
 - 6. NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations."
 - 7. **<Insert applicable code>**.
- J. Listing and Labeling: Provide electrically operated equipment or components specified in this Section that are listed and labeled.
- K. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
- L. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- M. AGA Certification: Provide gas-burning appliances certified by the American Gas Association (AGA).
- N. ASME Compliance: Fabricate and label steam-generating and closed steam-heating equipment to comply with ASME Boiler and Pressure Vessel Code.
- O. ASHRAE Compliance: Provide mechanical refrigeration systems complying with the American Society of Heating, Refrigerating and Air-Conditioning Engineers' ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- P. ANSI Standards: Comply with applicable ANSI standards for electric-powered and gas-burning appliances; for piping to compressed-gas cylinders; and for plumbing fittings, including vacuum breakers and air gaps, to prevent siphonage in water piping.

- Q. SMACNA Standard: Where applicable, fabricate food service equipment to comply with the Sheet Metal and Air Conditioning Contractors National Association's (SMACNA) "Kitchen Equipment Fabrication Guidelines," unless otherwise indicated.
- R. Seismic Restraints: Comply with SMACNA's "Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines," Appendix A, "Seismic Restraint Details," unless otherwise indicated.
- S. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.
1. Comply with requirements of Section 013119 "Project Meetings."
- T. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Section 013119 "Project Meetings." Review methods and procedures related to food service equipment including, but not limited to, the following:
1. Review access requirements for equipment delivery.
 2. Review equipment storage and security requirements.
 3. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
 4. Review structural loading limitations.
 5. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of construction contiguous with foodservice equipment by field measurements before fabrication. Indicate measurements on Coordination Drawings.

1.9 COORDINATION

- A. Coordinate foodservice equipment layout and installation with other work, including layout and installation of lighting fixtures, HVAC equipment, and fire-suppression system components.
- B. Coordinate locations and requirements of utility service connections.
- C. Coordinate sizes, locations, and requirements of the following:
1. Overhead equipment supports.
 2. Equipment bases.
 3. Floor depressions.
 4. Insulated floors.
 5. Floor areas with positive slopes to drains.
 6. Floor sinks and drains serving foodservice equipment.
 7. Roof curbs, equipment supports, and penetrations.

8. <Insert requirements>.

1.10 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Refrigeration Compressor Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace compressors that fail in materials or workmanship within specified warranty period.
 - 1. Failure includes, but is not limited to, the following:
 - a. Inability to maintain set temperature.
 - b. Breakage.
 - c. Faulty operation
 - 2. Warranty Period: Minimum [five (5)] <Insert number> years from date of Substantial Completion.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless-Steel Sheet, Strip, Plate, and Flat Bar: ASTM A 666, Type 304, stretcher leveled, and in finish specified in "Stainless-Steel Finishes" Article.
- B. Stainless-Steel Tube: ASTM A 554, Grade MT-304, and in finish specified in "Stainless-Steel Finishes" Article.
- C. Zinc-Coated Steel Sheet: ASTM A 653, G115 coating designation; commercial quality; cold rolled; stretcher leveled; and chemically treated.
- D. Zinc-Coated Steel Shapes: ASTM A 36, zinc-coated according to ASTM A 123 requirements.
- E. Plastic Laminate: Complying with NEMA LD 3 and NSF 35 requirements; NSF certified for end-use application indicated; 0.050 inch thick for horizontal and vertical surfaces and 0.042 inch thick for post-formed surfaces; smooth texture; and easily cleanable.

1. Color: As selected by DEN Project Manager from manufacturer's full range of colors.
- F. Plywood and Lumber: Provide plywood and lumber as specified in Division 06 Sections.
- G. Sealant: ASTM C 920; Type S, Grade NS, Class 25, Use NT. Provide elastomeric sealant NSF certified for end-use application indicated. Provide sealant that, when cured and washed, meets requirements of Food and Drug Administration's 21 CFR, Section 177.2600 for use in areas that come in contact with food.
1. Color: As selected by DEN Project Manager from manufacturer's full range of colors.
 2. Backer Rod: Closed-cell polyethylene, in diameter larger than joint width.
- H. Tempered Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent), Class 1 (clear), Quality q3 (glazing select). Provide products complying with ANSI Z97.1, manufactured by horizontal (roller-hearth) process, and 6 mm thick, unless otherwise indicated. Provide exposed safety edges, if any, seamed before tempering.
- I. Plastic: Except for plastic laminate, provide plastic materials and components complying with NSF 51.
- J. Sound Dampening: NSF-certified, nonabsorbent, hard-drying, sound-deadening coating. Provide coating compounded for permanent adhesion to metal in 1/8-inch thickness that does not chip, flake, or blister.
- K. Gaskets: NSF certified for end-use application indicated; of resilient rubber, neoprene, or PVC that is nontoxic, stable, odorless, nonabsorbent, and unaffected by exposure to foods and cleaning compounds.

2.2 FABRICATION, GENERAL

- A. Fabricate food service equipment according to NSF 2 requirements. Factory assemble equipment to greatest extent possible.
- B. Plastic-Laminate and Wood Casework: Fabricate according to requirements specified in Division 6 Section "Interior Architectural Woodwork."
- C. Welding: Use welding rod of same composition as metal being welded. Use methods that minimize distortion and develop strength and corrosion resistance of base metal. Provide ductile welds free of mechanical imperfections such as gas holes, pits, or cracks.
1. Welded Butt Joints: Provide full-penetration welds for full-joint length. Make joints flat, continuous, and homogenous with sheet metal without relying on straps under seams, filling in with solder, or spot welding.
 2. Grind exposed welded joints flush with adjoining material and polish to match adjoining surfaces.

3. Where fasteners are welded to underside of equipment, finish reverse side of weld smooth and undepressed.
 4. Coat unexposed stainless-steel welded joints with suitable metallic-based paint to prevent corrosion.
 5. After zinc-coated steel is welded, clean welds and abraded areas and apply SSPC-Paint 20, high-zinc-dust-content, galvanizing repair paint to comply with ASTM A 780.
- D. Fabricate field-assembled equipment prepared for field-joining methods indicated. For metal butt joints, comply with referenced SMACNA standard, unless otherwise indicated.
- E. Where stainless steel is joined to a dissimilar metal, use stainless-steel welding material or fastening devices.
- F. Form metal with break bends that are not flaky, scaly, or cracked in appearance; where breaks mar uniform surface appearance of material, remove marks by grinding, polishing, and finishing.
- G. Sheared Metal Edges: Finish free of burrs, fins, and irregular projections.
- H. Provide surfaces in food zone, as defined in NSF 2, free from exposed fasteners.
- I. Cap exposed fastener threads, including those inside cabinets, with stainless-steel lock washers and stainless-steel cap (acorn) nuts.
- J. Provide pipe slots on equipment with turned-up edges and sized to accommodate service and utility lines and mechanical connections.
- K. Provide enclosures, including panels, housings, and skirts, to conceal service lines, operating components, and mechanical and electrical devices including those inside cabinets, unless otherwise indicated.
- L. Seismic Restraints: Fabricate to comply with referenced SMACNA standard, unless otherwise indicated.

2.3 STAINLESS-STEEL EQUIPMENT

- A. Edges and Backsplashes: Provide equipment edges and backsplashes indicated complying with referenced SMACNA standard, unless otherwise indicated.
- B. Apply sound dampening to underside of metal work surfaces, including sinks and similar units. Provide coating with smooth surface and hold coating 1 inch back from open edges for cleaning.
- C. Tables: Fabricate with reinforced tops, legs, and reinforced undershelves or cross bracing to comply with referenced SMACNA standard, unless otherwise indicated, and as follows:
1. Tops: Minimum 0.0781-inch- thick stainless steel, unless otherwise indicated.

2. Legs: 1-5/8 inch OD, minimum 0.0625-inch- thick stainless steel with stainless-steel gusset and adjustable insert bullet-type feet with minimum adjustment of 1 inch up or down without exposing threads, unless otherwise indicated.
 3. Undershelves: Minimum 0.625-inch- thick stainless steel, unless otherwise indicated.
 4. Top and Undershef Reinforcement: Provide minimum 0.0781-inch- thick, stainless-steel reinforcing, unless otherwise indicated.
 5. Cross Bracing: 1-1/4 inch OD, minimum 0.0625-inch- thick stainless steel, unless otherwise indicated.
- D. Sinks: Fabricate of minimum 0.0781-inch- thick stainless steel with fully welded, 1-piece construction. Construct 2 sides and bottom of sink compartment from 1 stainless-steel sheet with ends welded integral and without overlapping joints or open spaces between compartments. Provide double-wall partitions between compartments with 1/2-inch- radius rounded tops that are welded integral with sink body. Cove horizontal, vertical, and interior corners with 3/4-inch radius. Pitch and crease sinks to waste for drainage without pooling. Seat wastes in die-stamped depressions without solder, rivets, or welding.
1. Wastes: 2-inch nickel-plated bronze, rotary-handle waste assembly with stainless-steel strainer plate and nickel-plated brass, connected overflow.
 2. Drainboards: Minimum 0.0781-inch- thick stainless steel, pitched to sink at 1/8 inch/12 inches of length. Reinforce drainboards with minimum 0.0781-inch- thick stainless steel, unless otherwise indicated.
 3. Legs: 1-5/8 inch OD, minimum 0.0625-inch- thick stainless steel with stainless-steel gusset welded to 0.1094-inch- thick, stainless-steel support plate. Provide adjustable insert bullet-type feet with minimum adjustment of 1 inch up or down without exposing threads, unless otherwise indicated.
 4. Drainboard Braces: 1 inch OD, minimum 0.0625-inch- thick stainless steel, unless otherwise indicated.
 5. Cross Bracing: 1-1/4 inch OD, minimum 0.0625-inch- thick stainless steel, unless otherwise indicated.
- E. Wall Shelves and Overshelves: Fabricate to comply with referenced SMACNA standard, unless otherwise indicated, and with minimum 0.0625-inch- thick, stainless-steel shelf tops.
- F. Drawers: Provide lift-out type, 1-piece, die-stamped drawer pan fabricated from 0.050-inch- thick stainless steel with inside corners radiused. Support drawer pan with 0.0625-inch- thick, stainless-steel channel frame welded to drawer front. Provide 1-inch- thick, double-wall front fabricated from 0.0625-inch- thick stainless steel and with integral recessed pull. Fill void in drawer front with semirigid fiberglass sound dampening. Mount drawers on NSF-certified, full-extension, stainless-steel drawer slides that have minimum 100-lb load capacity per pair, ball-bearing rollers, and positive stop. Mount drawer slides for self-closing on drawer housing as indicated.

2.4 EXHAUST HOOD FABRICATION

- A. General: Fabricate hoods indicated from minimum 0.050-inch- thick stainless steel, unless otherwise indicated. Comply with NFPA 96 and requirements of authorities having jurisdiction.
 - 1. Refer to Division 21 and Division 23 Sections for duct, fan, damper, and fire-extinguishing system requirements.
- B. Grease Removal: Provide removable, stainless-steel, baffle-type grease filters with spring-loaded fastening. Provide minimum 0.0781-inch- thick, stainless-steel filter frame and removable collection basins or troughs.
- C. Light Fixtures: Provide NSF-certified fixtures with lamps, vapor-tight sealed lenses, and wiring in stainless-steel conduit on hood exterior.
- D. Exhaust-Duct Collars: Minimum 0.0625-inch- thick stainless steel.

2.5 STAINLESS-STEEL FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
 - 1. Remove or blend tool and die marks and stretch lines into finish.
 - 2. Grind and polish surfaces to produce uniform, directional textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- B. Concealed Surfaces: No. 2B finish (bright, cold-rolled, unpolished finish).
- C. Exposed Surfaces: No. 4 finish (bright, directional polish).
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- E. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

2.6 FABRICATED EQUIPMENT

- A. Stainless-Steel Sinks: **<Insert drawing designation>**.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert manufacturer's name; product name or designation>**.
 - b. or approved equal.
 - 2. Description: **[One] [Two] [Three] [Four]**-compartment sink(s). Fabricate units of welded stainless steel, sound deadened.

- a. Bowls: Stainless steel, Type 304, [0.078 inch (1.98 mm)] [0.062 inch (1.59 mm)] thick.
 - b. Integral Drainboards: Stainless steel, Type 304, [0.078 inch (1.98 mm)] [0.062 inch (1.59 mm)] thick.
 - c. Body: Stainless steel, [Type 304, 0.078 inch (1.98 mm)] [Type 304, 0.062 inch (1.59 mm)] [Type 430, 0.062 inch (1.59 mm)] thick.
 - 1) Back Splash: [Manufacturer's standard height] [13 inches (330 mm)] [18 inches (457 mm)] <Insert height>.
 - 2) Side Splash: [Manufacturer's standard height] [13 inches (330 mm)] [18 inches (457 mm)] <Insert height>.
 - d. Legs and Feet: Stainless-steel tubing legs with adjustable bullet feet.
 - e. Accessories:
 - 1) Faucets and Spouts: <Insert requirements>.
 - 2) Prerinse Faucet: <Insert requirements>.
 - 3) Vacuum breaker.
 - 4) Lever waste[with overflow].
 - 5) Basket strainer.
 - 6) Continuous waste.
 - 7) Scrap trough.
 - 8) Control bracket for food waste disposer controls.
 - 9) Scrap block and hole.
 - 10) Stainless-steel pot rack.
 - 11) <Insert requirements>.
 3. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, type as indicated.
 4. Fabrication: Prepare sink for installation of the following equipment items:
 - a. Water heater.
 - b. Food waste disposer; weld disposer cone or collar into sink.
 - c. Undercounter dishwasher.
 - d. <Insert equipment>.
 5. Stainless-Steel Finish: [Directional satin finish, No. 4] <Insert finish>.
- B. Stainless-Steel Tables: <Insert drawing designation>.
1. Products: Subject to compliance with requirements, provide the following [provide one of the following]:
 - a. <Insert manufacturer's name; product name or designation>.
 - b. or approved equal.
 2. Description: [Flat-countertop] [Prep] [Equipment-stand] [Mixer-stand] [Dish] <Insert description> table.

- a. Tops: Stainless steel, [Type 304, 0.078 inch (1.98 mm)] [Type 304, 0.062 inch (1.59 mm)] [Type 430, 0.062 inch (1.59 mm)] thick, reinforced and sound deadened.
 - 1) Back Splash: [Manufacturer's standard height] [1-1/2 inches (38 mm)] [5 inches (127 mm)] <Insert height>.
 - 2) Edge: [Bullnose on four sides] [Bullnose on front edge, straight on sides and back] [Marine edge] <Insert requirements>.
 - b. [Welded] [Adjustable] Undershelf: [Stainless steel, Type 304, 0.050 inch (1.27 mm) thick] [Metallic-coated steel, 0.052-inch (1.32-mm) nominal thickness].
 - c. Crossbracing: [Stainless-steel] [Metallic-coated steel] tubing, [bolted] [welded] to legs.
 - d. Cabinet:
 - 1) Body: Stainless steel, Type 430, 0.050 inch (1.27 mm) thick.
 - 2) Doors: [Sliding] [Hinged], stainless steel, Type 304, 0.038 inch (0.95 mm) thick.
 - 3) Drawers: [Stainless-steel drawer and faceplate] [Galvanized-steel drawer and stainless-steel faceplate] [Stainless-steel front and liner] [Stainless-steel front and galvanized-steel liner] <Insert requirements>.
 - e. Sink: Stainless steel, Type 304, 0.078 inch (1.98 mm) thick, welded into tabletop and including the following:
 - 1) Faucet and Spout: <Insert requirements>.
 - 2) Vacuum breaker.
 - 3) Leverwaste[with overflow].
 - 4) Basket strainer.
 - 5) Tail piece.
 - 6) <Insert requirements>.
 - f. Legs: [Stainless-steel] [Metallic-coated steel] tubing.
 - g. Feet: [Stainless-steel adjustable bullets] [Plastic adjustable bullets] [Stainless-steel, flanged, adjustable bullets] [Casters] <Insert requirements>.
 - h. Accessories:
 - 1) Control panel.
 - 2) Control bracket for food waste disposer controls.
 - 3) Aluminum pan rack slides, [six] [three] slides each.
 - 4) Urn trough.
 - 5) Spice bins.
 - 6) <Insert requirements>.
3. Materials:

- a. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, type as indicated.
 - b. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum **G90 (Z275)** coating.
 4. Fabrication: Prepare table for installation of the following equipment items:
 - a. Food waste disposer; weld disposer cone or collar into sink.
 - b. Heat lamp.
 - c. **<Insert equipment>**.
 5. Stainless-Steel Finish: [**Directional satin finish, No. 4**] **<Insert finish>**.
- C. Stainless-Steel Shelf Units: **<Insert drawing designation>**.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert manufacturer's name; product name or designation>**.
 - b. or approved equal.
 2. Description: [**Table mounted, single deck**] [**Table mounted, double deck**] [**Wall mounted**] **<Insert description>**. Fabricate units of stainless steel, [**Type 304, 0.062 inch (1.59 mm)**] [**Type 304, 0.050 inch (1.27 mm)**] [**Type 430, 0.050 inch (1.27 mm)**] thick.
 3. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, type as indicated.
 4. Stainless-Steel Finish: [**Directional satin finish, No. 4**] **<Insert finish>**.
- D. Pot Racks: **<Insert drawing designation>**.
 1. Products: Subject to compliance with requirements, provide the following] [provide one of the following:
 - a. **<Insert manufacturer's name; product name or designation>**.
 - b. or approved equal.
 2. Description: [**Wall mounted**] [**Ceiling hung**] [**Corner**] **<Insert description>**. Fabricate units of [**stainless steel**] [**painted, cold-rolled steel**].
 - a. Bars: [**Double**] [**Single**].
 - b. Hooks: [**18**] **<Insert number>** per unit.
 3. Materials:
 - a. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, Type 304.
 - b. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
 4. Finishes:

- a. Stainless Steel: **[Directional satin finish, No. 4]** <Insert finish>.
- b. Cold-Rolled Steel: Powder-coat painted finish.

E. Stainless-Steel Hand Sinks: <Insert drawing designation>.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. <Insert manufacturer's name; product name or designation>.
 - b. or approved equal.
2. Description: **[Lavatory]** <Insert description> sink. Fabricate units of stainless steel, Type 304, **[0.050 inch (1.27 mm)]** **[0.038 inch (0.95 mm)]** thick.
 - a. Operation: **[Electronic]** **[Knee valve]** **[Foot pedal]** **[Wrist handle]** **[Handle]** <Insert description>.
 - b. Faucet and Spout: <Insert requirements>.
 - c. Accessories:
 - 1) Chrome-plated tail piece and P trap, **NPS 1-1/2 (DN 40)**, with **[0.045-inch (1.1-mm)]** <Insert dimension> minimum wall thickness.
 - 2) Strainer basket with metal post.
 - 3) Liquid soap dispenser, **[splash]** **[deck]** mounted.
 - 4) Liquid soap and towel dispenser.
 - 5) Towel dispenser.
 - 6) Tubular wall supports.
 - 7) Skirt assembly for support.
 - 8) Side splashes.
 - 9) <Insert requirements>.
3. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, type as indicated.
4. Stainless-Steel Finish: **[Directional satin finish, No. 4]** <Insert finish>.

F. Floor **[Troughs]** **[Water Receptacles]**: <Insert drawing designation>.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. <Insert manufacturer's name; product name or designation>.
 - b. or approved equal.
2. Description: **[4-inch (102-mm)]** **[2-inch (50-mm)]** <Insert dimension> nominal depth excluding tailpiece.
 - a. Body: Stainless steel, Type 304, **0.078 inch (1.98 mm)** thick.
 - b. Grate: **[Stainless-steel bar, Type 304]** **[Fiberglass]**.
 - c. Waste Connection: **NPS 3 (DN 80)**.
3. Materials:
 - a. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, type as indicated.

- b. Stainless-Steel Bars: ASTM A 276, austenitic stainless steel, type as indicated.
- 4. Stainless-Steel Finish: **[Directional satin finish, No. 4] <Insert finish>**.

2.7 FOOD WASTE MACHINES

A. Food Waste Disposer Units: **<Insert drawing designation>**.

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert manufacturer's name; product name or designation>**.
 - b. or approved equal.
- 2. Description: **[3] [5] [7]** hp, with dual-direction shredding elements, and the following:
 - a. **[Stainless-steel] [Corrosion-resistant]** housing.
 - b. Flow control.
 - c. Solenoid valve.
 - d. Vacuum breaker.
 - e. Fixed nozzle.
 - f. Control Panel:
 - 1) Autoreversing and internal timed water flush.
 - 2) Stainless-steel mounting bracket.
 - g. Prerinse: Backsplash mounted with hot- and cold-water mixing valve and with **[stainless-steel] [corrosion-resistant]** exposed metal parts and the following:
 - 1) Wall support bracket.
 - 2) Flexible, **3/8-inch** (10-mm) metal-encased hose with a minimum length of **29 inches** (737 mm) and supported by spiral spring.
 - 3) Spray-head assembly with lockable lever handle.
 - h. Accessories:
 - 1) Collar adaptor for **[sink] [trough]**.
 - 2) Cone with adaptor ring.
 - a) Size: **[12 inches (305 mm)] [15 inches (381 mm)] [18 inches (457 mm)]**.
 - 3) Cone cover in size that matches cone.
 - 4) Silver accumulator.
 - 5) **<Insert requirements>**.
 - i. Electrical Service: Equip unit for connection to **[service indicated on Drawings] <Insert requirements>**.

B. Food Waste Pulper and Water Extractor Systems: **<Insert drawing designation>**.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert manufacturer's name; product name or designation>**.
 - b. or approved equal.
2. Description: Stainless-steel pulper unit, extractor unit, and control panel with water-level control and push-button start.
 - a. Capacity: Not less than [600 lb (272 kg)] [700 lb (318 kg)] [900 lb (408 kg)] **<Insert value>** of waste per hour.
 - b. Accessories:
 - 1) Feed trough connection.
 - 2) Feed tray.
 - 3) Feed hood assembly.
 - 4) Under-dish-table lid.
 - 5) Remote Water Extractor:
 - a) Dam, to prevent siphoning of water from pulper tank.
 - b) Remote piping system, [**overhead**] [**below floor**].
 - 6) **<Insert requirements>**.
 - c. Electrical Service: Equip unit for connection to [**service indicated on Drawings**] **<Insert requirements>**.

C. Food Waste Grinder and Water Extractor Systems: **<Insert drawing designation>**.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert manufacturer's name; product name or designation>**.
 - b. or approved equal.
2. Description: Stainless-steel construction; with off and on controls on unit, food waste hopper, silver saver, internal disposer, removable water extraction auger with internal water sprays, and discharge chute.
 - a. Capacity: Not less than [600 lb (272 kg)] [700 lb (318 kg)] **<Insert value>** of waste per hour.
 - b. Accessories:
 - 1) Reel rinse unit with spray valve.
 - 2) Recirculation water pump.
 - 3) Trough mount.
 - 4) **<Insert requirements>**.
 - c. Electrical Service: Equip unit for connection to [**service indicated on Drawings**] **<Insert requirements>**.

- D. Undercounter Food Waste Grinder and Water Extractors: **<Insert drawing designation>**.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert manufacturer's name; product name or designation>**.
 - b. or approved equal.
 2. Description: Stainless-steel, undercounter, cleanable assembly including the following:
 - a. Capacity: Not less than [600 lb (272 kg)] [700 lb (318 kg)] **<Insert value>** of waste per hour.
 - b. Separate water-extractor and disposer units.
 - 1) Disposer: Corrosion-resistant housing, dual-direction shredding elements.
 - c. Piping between disposer and water extractor.
 - d. Vacuum breaker.
 - e. Solenoid valve.
 - f. Flow control.
 - g. Time-delayed relay.
 - h. Control Panel:
 - 1) Autoreversing and internal timed water flush.
 - 2) Stainless-steel mounting bracket.
 - i. Prerinse: Backsplash mounted with hot- and cold-water mixing valve and with **[stainless-steel] [corrosion-resistant]** exposed metal parts and the following:
 - 1) Wall support bracket.
 - 2) Flexible, **3/8-inch** (10-mm) metal-encased hose with a minimum length of **29 inches** (737 mm) and supported by spiral spring.
 - 3) Spray-head assembly with lockable lever handle.
 - j. Accessories:
 - 1) Cone with adaptor ring.
 - a) Size: [**12 inches** (305 mm)] [**15 inches** (381 mm)] [**18 inches** (457 mm)].
 - 2) Cone cover in size that matches cone.
 - 3) Silver sorter.
 - 4) Trough collar connection.
 - 5) **<Insert requirements>**.
 - k. Electrical Service: Equip unit for connection to **[service indicated on Drawings] <Insert requirements>**.

2.8 COOKING EQUIPMENT

A. Ranges: <Insert drawing designation>.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. <Insert manufacturer's name; product name or designation>.
- b. or approved equal.

2. Description:

a. Top Configuration:

1) Open-Burner Unit:

- a) Standard Burners: [Four] [Six] [Eight] [Four, step-up type] <Insert requirements>.
- b) [Wok] [Saute] Head: <Insert requirements>.

2) Griddle: [Flat] [Raised].

3) Radiant Broiler: <Insert requirements>.

b. Base Configuration:

1) Standard Oven(s): [One] [Two].

2) Convection Oven(s): [One] [Two].

3) Storage Base: One.

c. Accessories:

- 1) [High] [Double-deck] back shelf.
- 2) Stainless-steel sides.
- 3) Stainless-steel back.
- 4) Legs for curb base.
- 5) Toe Base: 4 inches (102 mm) high.
- 6) Casters: <Insert requirements>.
- 7) Oven Rack(s): [One] <Insert number> for each oven.
- 8) <Insert requirements>.

d. Electrical Service: Equip unit for connection to [service indicated on Drawings] <Insert requirements>.

e. Gas Service: [Natural] [Liquefied propane] gas.

B. Deep Fat Fryers: <Insert drawing designation>.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. <Insert manufacturer's name; product name or designation>
- b. or approved equal.

2. Description: **[Electric fryer, solid-state controls] [Electric, programmable computer controls] [Gas fryer]** <Insert description>.
 - a. Oil Capacity: **[40 lb (18 kg)] [85 lb (39 kg)]** <Insert value>.
 - b. Accessories:
 - 1) Stainless-steel sides.
 - 2) Stainless-steel fry tank.
 - 3) Stainless-steel fry tank cover.
 - 4) Casters: <Insert requirements>.
 - 5) Automatic basket lifts.
 - 6) Single Fry Baskets: <Insert quantity>.
 - 7) Twin Fry Baskets: <Insert quantity>.
 - 8) Triple Fry Baskets: <Insert quantity>.
 - 9) Quick gas-service disconnect and flexible hose.
 - 10) <Insert requirements>.
 - c. Electrical Service: Equip unit for connection to **[service indicated on Drawings]** <Insert requirements>.
 - d. Gas Service: **[Natural] [Liquefied propane]** gas.
- C. Steam Jacketed Kettles: <Insert drawing designation>.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. <Insert manufacturer's name; product name or designation>.
 - b. or approved equal.
 2. Description: Stainless steel, Type 304.
 - a. Type: **[Stationary] [Tilting]**.
 - b. Steam Source: **[Electrically heated, self-contained] [Direct]**.
 - 1) **[Maximum] [Operating]** Steam Pressure: **[50 psig (345 kPa)] [25 psig (172 kPa)]** <Insert value>.
 - c. Capacity: **[10 quarts (9.5 L)] [20 gal. (76 L)]** <Insert value>.
 - d. Accessories:
 - 1) Basket insert.
 - 2) Lift-off cover.
 - 3) **[Single] [Double]**-pantry water filler.
 - 4) Tangent Drawoff: **[2 inches (50 mm)] [3 inches (76 mm)]** <Insert requirements>.
 - 5) Disc Strainer: **1/8 inch (3 mm), [perforated] [solid]**.
 - 6) Interior Finish: **[Manufacturer's standard] [Stainless steel, Type 316]**.
 - 7) Cold-water jacket cooling.
 - 8) Steam trap assemblies.
 - 9) Kettle brush kit.

- 10) **<Insert requirements>**.
 - e. Electrical Service: Equip unit for connection to **[service indicated on Drawings] <Insert requirements>**.
 3. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, type as indicated.
 4. Stainless-Steel Finish: **[Directional satin finish, No. 4] <Insert finish>**.
- D. Ovens: **<Insert drawing designation>**.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert manufacturer's name; product name or designation>**.
 - b. or approved equal.
 2. Description: **[Electric convection] [Gas convection] [Rotisserie] <Insert description>**.
 - a. **[Single deck] [Double deck] [Single deck with open stand] <Insert requirements>**.
 - b. Accessories:
 - 1) Oven Rack(s): **[One] <Insert number>** per oven chamber.
 - 2) Stainless-steel drip pan.
 - 3) Down-draft flue diverter.
 - 4) Stacking kit.
 - 5) **<Insert requirements>**.
 - c. Electrical Service: Equip unit for connection to **[service indicated on Drawings] <Insert requirements>**.
 - d. Gas Service: **[Natural] [Liquefied propane]** gas.
- E. Microwave Ovens: **<Insert drawing designation>**.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert manufacturer's name; product name or designation>**.
 - b. or approved equal.
 2. Description: 1200-W cooking power.
 - a. Electrical Service: Equip unit with plug and cord for 120-V service.
- F. Coffee Urns: **<Insert drawing designation>**.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert manufacturer's name; product name or designation>**.
 - b. or approved equal.

2. Description: **[Single]** **[Twin]** **[Triple]** urn.
 - a. Capacity: **[3 gal. (11 L)]** **[6 gal. (23 L)]** **[10 gal. (38 L)]** per liner.
 - b. Type: **[Electric]** **[Gas]** **[Steam]** heated.
 - c. Agitator: **[Automatic]** **[Push button]**.
 - d. Spray Arm: **[With]** **[Without]** bypass.
 - e. Timer: **[Digital]** **[Electromechanical]**.
 - f. Accessories:
 - 1) Fill/Dispense: **<Insert requirements>**.
 - 2) Multiple Faucet: **<Insert requirements>**.
 - 3) Filtering: **[Permanent, stainless-steel, woven-wire cloth]** **[Disposable filter paper]**.
 - 4) Finish: **[Manufacturer's standard]** **[Brass body and trim]** **[Copper body and brass trim]** **<Insert finish>**.
 - 5) **<Insert requirements>**.
3. Electrical Service: Equip unit for connection to **[service indicated on Drawings]** **<Insert requirements>**.
4. Gas Service: **[Natural]** **[Liquefied propane]** gas.
5. Operating Steam Pressure: **[As indicated on Drawings]** **<Insert pressure>**.

2.9 SELF-CONTAINED REFRIGERATION EQUIPMENT

A. **[Refrigerators]** **[Freezers]**: **<Insert drawing designation>**.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert manufacturer's name; product name or designation>**.
 - b. or approved equal.
2. Description: **[Reach-in]** **[Roll-in]** **[Pass-through]** type.
 - a. Exterior Finish: Stainless steel.
 - b. Interior Finish: **[Stainless steel]** **[Manufacturer's standard]**.
 - c. Doors: **[Full length]** **[Half length]** **[In configuration shown on Drawings]**.
 - d. Accessories:
 - 1) Casters.
 - 2) Stainless-steel back with rear louvers.
 - 3) Re-hinging feature for doors.
 - 4) Hinged glass doors and fluorescent fixtures.
 - 5) Tray Slides: For **<Insert description>** sheet pans.
 - 6) **[Chrome-Plated]** **[Stainless-Steel]** Shelves: **<Insert quantity>**.
 - 7) Loading Rack: **<Insert requirements>**.
 - 8) Transfer Carriage: **<Insert requirements>**.
 - 9) **<Insert requirements>**.

- e. Electrical Service: Equip unit with plug and cord for **[service indicated on Drawings]** **<Insert requirements>**.
- B. Undercounter **[Refrigerators]** **[Freezers]**: **<Insert drawing designation>**.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert manufacturer's name; product name or designation>**.
 - b. or approved equal.
 - 2. Description: Compact unit with rear-mounted, self-contained refrigeration system.
 - a. Accessories:
 - 1) Stainless-steel top with backsplash.
 - 2) Stainless-steel back panel.
 - 3) Casters: **[6 inches (152 mm)] [4 inches (102 mm)] [3-1/2 inches (89 mm)]** high.
 - 4) Utility Base: **6 inches (152 mm)** high.
 - 5) Shelves: **<Insert description and quantity>**.
 - 6) Stacking kit.
 - 7) **<Insert requirements>**.
 - b. Electrical Service: Equip unit with plug and cord for **[service indicated on Drawings]** **<Insert requirements>**.
- C. Merchandiser Refrigeration Units: **<Insert drawing designation>**.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert manufacturer's name; product name or designation>**.
 - b. or approved equal.
 - 2. Description: **[Curved-glass, self-contained refrigerator]** **[Sliding-glass, self-contained refrigerator]** **[Sliding-glass, self-contained freezer]** **<Insert description>**.
 - a. Exterior Finish: **[Manufacturer's standard]** **[Stainless steel]** **<Insert requirements>**.
 - b. Interior Finish: **[Manufacturer's standard]** **[Stainless steel]** **[White]** **<Insert requirements>**.
 - c. Accessories:
 - 1) Door locks.
 - 2) Fluorescent Light Fixtures: **<Insert quantity>**.
 - 3) Base: **<Insert requirements>**.
 - 4) Casters: **<Insert requirements>**.
 - 5) Legs: **<Insert requirements>**.
 - 6) Chrome-Plated Shelves: **<Insert quantity>**.
 - 7) **<Insert requirements>**.

- d. Electrical Service: Equip unit with plug and cord for **[service indicated on Drawings]** **<Insert requirements>**.

D. Ice-Making Machine: **<Insert drawing designation>**.

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert manufacturer's name; product name or designation>**.
 - b. or approved equal.
- 2. Description: **[Undercounter]** **[Freestanding]** units.
 - a. Production: Ice **[cubes]** **[cubes, dice]** **[cubes, half dice]** **[flakes]** **[chipelets (compacted flake ice)]**.
 - b. Capacity: **<Insert lb (kg)>** per 24-hour period.
 - c. Accessories:
 - 1) Storage Bin: **<Insert requirements>**.
 - a) Storage Capacity: **<Insert lb (kg)>**.
 - 2) Stainless-steel stand and legs.
 - 3) Water filter.
 - 4) **<Insert requirements>**.
 - d. Electrical Service: Equip unit for connection to **[service indicated on Drawings]** **<Insert requirements>**.

2.10 WALK-IN REFRIGERATION EQUIPMENT

A. Walk-in Refrigeration Units: **<Insert drawing designation>**.

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert manufacturer's name; product name or designation>**.
 - b. or approved equal.
- 2. Description: **[Cooler]** **[Freezer]** **[Two-compartment unit, with cooler and freezer compartments]** **<Insert description>**.
 - a. Wall and Ceiling Panels: Interlocking insulating panels.
 - b. Floors: **[Insulated floor panels]** **[Field installed; provide manufacturer's standard insulated floor screed]** **<Insert requirements>**.
 - c. Doors:
 - 1) Hinges: **[Two per door]** **[Self-closing and spring loaded; three per door]** **<Insert requirements>**.
 - 2) Latch: **[Edge-mounted, positive-type latch with cylinder lock]** **<Insert requirements>**.

- 3) Include safety-release handle that opens door from inside when door is locked.
 - d. Door Accessories:
 - 1) Vision port.
 - 2) Pressure relief port.
 - 3) Threshold: Stainless steel, factory installed.
 - 4) Antic condensate heater at freezer doors.
 - 5) **<Insert requirements>**.
 - e. Vaporproof Lighting Fixtures: [**Incandescent fixture with 100-W lamp**] **<Insert requirements>**.
 - 1) Control: Neon pilot light and toggle switch located on exterior of door panel.
 - 2) Quantity: [**One per compartment, located on door panel**] **<Insert quantity>**.
 - f. Refrigeration System: [**Self-contained, mounted on unit**] [**Remote system with preassembled condensing unit and evaporator assemblies**] **<Insert requirements or manufacturer's refrigeration assembly designation>**.
 - 1) Exterior Condensing Units: Include winter control, crankcase heater, and enclosed weatherproof housing.
 - 2) Operating Temperature: **<Insert value(s)>**.
 - g. Temperature Monitoring System: [**Electronic monitoring and remote audible alarm system that warns when temperatures register 10 deg F (6 deg C) above or below set temperature**] **<Insert requirements>**.
 - h. Closure Panels and Trim: [**Include closure panels and trim**] **<Insert requirements>**.
 - i. Electrical Service: Equip unit for connection to [**service indicated on Drawings**] **<Insert requirements>**.
3. Finishes:
- a. Exposed Exterior Finish: [**Stucco-patterned aluminum**] [**Smooth, mill-finished aluminum**] [**White-painted aluminum**] **<Insert requirements>**.
 - b. Unexposed Exterior Finish: [**Stucco-patterned, metallic-coated steel**] **<Insert requirements>**.
 - c. Interior Finish: [**Stucco-patterned aluminum**] [**Smooth, mill-finished aluminum**] [**White-painted aluminum**] **<Insert requirements>**.
 - d. Closure Panels and Trim: [**Matched to exposed exterior finish of panels**] **<Insert requirements>**.

2.11 POWERED FOOD-PREPARATION EQUIPMENT

A. **[Mixers] [Slicers] [Meat Saws] [Peelers] <Insert description>: <Insert drawing designation>.**

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert manufacturer's name; product name or designation>.**
 - b. or approved equal.
2. Description: **<Insert requirements>.**
3. Accessories: **<Insert accessories>.**
4. Electrical Service: Equip unit with plug and cord for **[service indicated on Drawings] <Insert requirements>.**

2.12 WAREWASHING EQUIPMENT

A. Warewashing Machines: **<Insert drawing designation>.**

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert manufacturer's name; product name or designation>.**
 - b. or approved equal.
2. Description: **[Dishwashing, single tank] [Dishwashing, double tank] [Dishwashing, rackless conveyor] [Dishwashing, with circular conveyor table] [Pot and pan washing, two racks] [Pot and pan washing, one rack] <Insert description>.**
 - a. Capacity: **<Insert requirements>.**
 - b. Accessories: **<Insert accessories>.**
 - c. Electrical Service: Equip unit for connection to **[service indicated on Drawings] <Insert requirements>.**

2.13 SERVING EQUIPMENT

A. Modular Counters: **<Insert drawing designation>.**

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert manufacturer's name; product name or designation>.**
 - b. or approved equal.
2. Description: **[Hot food] [Refrigerated salad] [Ice-cooled salad] [Sliding-glass door refrigerated] [Frost-top] [Sandwich] [Pizza] [Refrigerated-chest] [Dual-temperature] [Tray-starter] [Storage] [Cashier] <Insert description> module.**
 - a. Cabinet Face Panels: **[Manufacturer's standard] <Insert requirements>.**

- b. Accessories:
 - 1) Tray slide.
 - 2) Work shelf.
 - 3) Casters.
 - 4) Electrical receptacle.
 - 5) Cam-action latch locks with trigger release to mate with adjoining modular counters.
 - 6) Tempered-glass, food-protector shield.
 - 7) **<Insert requirements>**.
- c. Electrical Service: Equip unit for connection to **[service indicated on Drawings] <Insert requirements>**.
- d. Color: **[As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.

2.14 UTILITY DISTRIBUTION SYSTEMS

A. Utility Distribution Systems: **<Insert drawing designation>**.

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Insert manufacturer's name; product name or designation>**.
 - b. or approved equal.
- 2. Description: **[Overhead] [Counter] [Island] [Tray-slide] [Steam] [Wall-mounted]** system.
- 3. Accessories: **<Insert accessories>**.

2.15 MISCELLANEOUS MATERIALS

A. Installation Accessories, General: NSF certified for end-use application indicated.

B. Elastomeric Joint Sealant: ASTM C 920; **[silicone] [urethane]**. Type S (single component), Grade NS (nonsag), Class 25, Use NT (nontraffic) related to exposure, and Use M, G, A, or O as applicable to joint substrates indicated.

- 1. Public Health and Safety Requirements:
 - a. Sealant is certified for compliance with NSF standards for end-use application indicated.
 - b. Washed and cured sealant complies with the FDA's regulations for use in areas that come in contact with food.
- 2. Cylindrical Sealant Backing: ASTM C 1330, Type C, closed-cell polyethylene, in diameter greater than joint width.

C. Cabinet Hardware: Provide NSF-certified, stainless-steel hardware for equipment items as indicated.

- D. Casters: NSF-certified, standard-duty, stainless-steel, swivel stem casters with 5-inch-diameter wheels, polyurethane tires with 1-inch tread width, and 200-lb load capacity per caster. Provide brakes on 2 casters per unit.

2.16 FINISHES

A. Stainless-Steel Finishes:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

- ### B. Powder-Coat Finishes: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard, baked-polymer, thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

- A. Deliver food service equipment as factory-assembled units with protective crating and covering.
- B. Store food service equipment in original protective crating and covering and in a dry location.

3.2 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions of food service equipment installation areas by field measurements before equipment fabrication and indicate measurements on Shop Drawings and Coordination Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish required dimensions and proceed with fabricating equipment without field measurements. Coordinate construction to ensure actual dimensions correspond to established dimensions.
 1. Contractor shall be responsible for equipment fitting properly into designated spaces, and shall be responsible for all corrections to ensure correct fit of equipment.

3.3 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, service-utility connections, and other conditions affecting installation and performance of food service equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine roughing-in for piping, mechanical, and electrical systems to verify actual locations of connections before installation.

3.4 INSTALLATION

- A. Install foodservice equipment level and plumb, according to manufacturer's written instructions.
 - 1. Connect equipment to utilities.
 - 2. Provide cutouts in equipment, neatly formed, where required to run service lines through equipment to make final connections.
- B. Complete equipment assembly where field assembly is required.
 - 1. Provide closed butt and contact joints that do not require a filler.
 - 2. Grind field welds on stainless-steel equipment until smooth and polish to match adjacent finish.
- C. Install equipment with access and maintenance clearances that comply with manufacturer's written installation instructions and with requirements of authorities having jurisdiction.
- D. Install cabinets and similar equipment on bases in a bed of sealant.
- E. Install closure-trim strips and similar items requiring fasteners in a bed of sealant.
- F. Install joint sealant in joints between equipment and abutting surfaces with continuous joint backing unless otherwise indicated. Produce airtight, watertight, vermin-proof, sanitary joints.
- G. Install hoods to comply with NFPA 96 requirements and to remain free from vibration when operating.
- H. Install seismic restraints according to referenced SMACNA standard.
- I. Install trim strips and similar items requiring fasteners in a bed of sealant. Fasten with stainless-steel fasteners at 48 inches o.c. maximum.
- J. Except for mobile and adjustable-leg equipment, securely anchor and attach items and accessories to walls, floors, or bases with stainless-steel fasteners, unless otherwise indicated.

3.5 CLEANING AND PROTECTING

- A. After completing installation of equipment, repair damaged finishes.
- B. Clean and adjust equipment as required to produce ready-for-use condition.
- C. Protect equipment from damage during remainder of the construction period.
 - 1. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure food service equipment is without damage or deterioration at the time of Substantial Completion.

3.6 COMMISSIONING

- A. Startup Services: Engage factory-authorized service representatives to perform startup services and to demonstrate and train Owner's maintenance personnel as specified below.
 - 1. Schedule commissioning and training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.
 - 2. Coordinate food service equipment startup with service-utility testing, balancing, and adjustments. Do not operate steam lines before they have been cleaned and sanitized.
 - 3. Remove protective coverings and clean and sanitize equipment, both inside and out, and relamp equipment with integral lighting. Where applicable, comply with manufacturer's written cleaning instructions.
 - 4. Test each equipment item for proper operation. Repair or replace equipment that is defective in operation, including units that operate below required capacity or that operate with excessive noise or vibration.
 - 5. Test refrigeration equipment's ability to maintain specified operating temperature under heavy-use conditions. Repair or replace equipment that does not maintain specified operating temperature.
 - 6. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 7. Test motors and rotating equipment for proper rotation and lubricate moving parts according to manufacturer's written instructions.
 - 8. Test water, drain, gas, steam, oil, refrigerant, and liquid-carrying components for leaks. Repair or replace leaking components.
 - 9. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance for each food service equipment item.
 - 10. Review data in the operation and maintenance manuals. Refer to Section 017720 "Contract Closeout."
 - 11. Review data in the operation and maintenance manuals. Refer to Division 01 Section "Operation and Maintenance Data."

3.7 FOOD SERVICE EQUIPMENT SCHEDULE

- A. Item [#] - Compartment Sink: Where items of this designation are indicated, provide products complying with the following:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Product name and model; MFR'S name.>**
 - b. or approved equal.
 2. Accessories: **<Insert accessories required. Compartment sinks are not supplied with faucets unless specified. Wastes may also need to be specified. These components may also be specified as separate items.>**
 3. Preparation Requirements: **<Insert preparation requirements for equipment installed on decks or backsplashes, such as disposal units or faucets>**
- B. Item [#] - Portable Hot-Food Counter: Where items of this designation are indicated, provide products complying with the following:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **<Product name and model; MFR'S name.>**
 - b. or approved equal.
 2. Cabinet Face Panels: **[Manufacturer's standard, in color selected by DEN Project Manager from manufacturer's full range of colors.] <Revise description or delete and insert other requirements to suit Project>**
 3. Accessories: **[Tray slide.] [Work shelf.] [Casters.] [Electrical receptacle.] [Cam-action latch locks with trigger release to mate with adjoining portable counters.] [Tempered-glass sneeze shield.] <Retain applicable accessories for products listed and insert others to suit Project>**
- C. Item [#] - Walk-in Cooler: Where items of this designation are indicated, provide products complying with the following:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. **<MFR'S name.>**
 - b. or approved equal.
 2. Wall and Ceiling Panels: **[Manufacturer's standard 4-inch- thick insulated panels for configuration indicated.] <Revise description or delete and insert other requirements to suit Project>**
 3. Floor Panels: **[Manufacturer's standard 4-inch- thick insulated panels for configuration indicated.] <Revise description to suit Project or delete if no floor panels>**
 4. Floor Screed: **[Manufacturer's standard insulated floor screed.] <Revise description to suit Project or delete if floor panels are required>**
 5. Door Panel: **[Manufacturer's standard 4-inch- thick, insulated door panel]**

- assembly with door in width and hand indicated.] <Revise description or delete and insert other requirements to suit Project. Indicate door size on drawings or by insert. Insert requirements for options such as vision ports.>**
- a. Hinges: **[Manufacturer's standard; 2 per door.] [Self-closing, spring-loaded hinges; 3 per door.] <Retain applicable requirement and delete other or revise to suit Project>**
 - b. Door Latch: **[Manufacturer's standard edge-mounted, positive-type latch with cylinder lock. Include safety-release handle to permit opening from inside when locked.] <Revise description or delete and insert other requirements to suit Project. Handles with cylinder locks but without positive latching are available.>**
6. Exposed Exterior Finish: **[Stucco-patterned aluminum.] [Smooth, mill-finished aluminum.] [White-painted aluminum.] <Retain applicable requirement or revise to suit Project>**
7. Unexposed Exterior Finish: **[Stucco-patterned galvanized steel.] <Revise description or delete and insert other requirements to suit Project>**
8. Interior Finish: **[Stucco-patterned aluminum.] [Smooth, mill-finished aluminum.] [White-painted aluminum.] <Retain applicable requirement or revise to suit Project>**
9. Vaporproof Lighting Fixtures: **[Manufacturer's standard fixture with lamp.]**
- a. **<Revise description to suit Project>**
 - b. Quantity: **[One, located on door panel.] [2; 1 located on door panel and 1 located as indicated.] [3; 1 located on door panel and 2 located as indicated.]**
 - c. **<Retain applicable requirement and delete others or revise to suit Project. MFRS generally provide one fixture on door panel as standard. Additional fixtures must be specified and are field installed.>**
10. Refrigeration System: **[Manufacturer's standard self-contained unit mounted on cooler and sized to maintain operating temperature indicated in cooler under heavy-use conditions.] [Manufacturer's standard remote system sized to maintain operating temperature indicated in cooler under heavy-use conditions and consisting of preassembled condensing unit and evaporator assemblies.] [For condensing unit located on exterior, provide winter control, crankcase heater, and enclosed weatherproof housing.]**
- a. **<Retain applicable requirements and delete others or revise to suit Project. Insert MFR'S assembly designation if applicable. If remote system is required, refrigeration piping between assemblies, and other accessories or components are field installed and must be specified separately. Verify requirements with MFRS.>**
 - b. Operating Temperature: **[35 deg F.] <Revise operating temperature indicated to suit Project.>**
11. Temperature Monitoring System: **[Electronic monitoring and remote audible**

alarm system that warns of temperatures that exceed 10 deg F above or below set temperature.] <Revise description or delete and insert other requirements to suit Project.>

12. Closure Panels and Trim: **[Match exposed exterior finish of panels.] <Revise description to suit Project>**
13. Accessories: **<Insert accessories required.>**

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 114000

SECTION 118226 - FACILITY WASTE COMPACTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes waste compactors[**and diverters**], component fittings, and accessories.
- B. Related Sections:
 - 1. Section 114000 "Foodservice Equipment" for food-waste shredding, pulping, grinding, and compacting machines in foodservice facilities.
 - 2. Section 149100 "Facility Chutes" for trash chutes servicing waste compactors.
 - 3. Section 211100 "Facility Fire-Suppression Water-Service Piping" for fire-suppression water-service connections to automatic sprinkler in hopper of each chute-fed compactor.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. General: See the "WASTEC 2007 Listing of Rated Stationary Compactors" for detailed definitions of waste-compactor terminology.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, furnished specialties and accessories, and finishes.
 - 1. Unit dimensions.
 - 2. Installed and operating weights.
 - 3. Furnished specialties and accessories.
 - 4. WASTEC rating and normal and maximum system pressures.
 - 5. Packing force and force ratings.
 - 6. Wiring Diagrams: Detail wiring for power and control systems. Differentiate between manufacturer-installed and field-installed wiring.
 - 7. Certified test reports on operation.

8. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Dimensions locating chutes that interface with waste compactors.
 3. Location and installation details of automatic sprinkler in hopper of each chute-fed compactor.
 4. Equipment access points and required space for equipment service and operation.
 5. Setting drawings, templates, and instructions for installing anchor bolts and other anchorages.
 6. Wiring Diagrams: For power, signal, and control wiring.
- C. Coordination Drawings: Drawn to scale and coordinating compactor installation. Show the following:
1. Roughing-in dimensions, service connection details, and locations of field connections.
 2. Required clearances for equipment service and operation.
 3. Setting drawings, templates, and directions for installing anchor bolts and other anchorages.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For qualified Installer.
 - B. Product Certificates: For each type of waste compactor, from manufacturer.
 - C. Field quality-control reports.
- 1.6 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For waste compactors to include in operation and maintenance manuals specified in Division 01. Include the following:
 1. Operating and maintenance instructions.
 2. Parts inventory list.
 3. Purchase source for operating and maintenance materials.
 4. Emergency information.
 5. Name, address, and telephone number of manufacturer's service representative whose location is nearest to Project site.
 - B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300

"Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project.
 - 1. Maintenance Proximity: Not more than **[one] [two] <Insert number>** hour(s') normal travel time from Installer's place of business to Project site.
- B. Manufacturer Qualifications: A firm experienced in manufacturing waste compactors similar to those indicated for this Project and with a record of successful in-service performance.
- C. Product Options: Drawings indicate performance, service-connection, and dimensional requirements of waste compactors and are based on the specific equipment indicated **[in Part 2] [on Drawings]**.
- D. Equipment of other manufacturers **[listed in Part 2]** that meets performance requirements might be considered if the equipment is compatible with service-connection locations, dimensions, and clearance requirements indicated.
- E. **[Refer to Division 01 Section "Substitutions."]**
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- G. Waste Compactor Standards: Comply with ANSI Z245.2, "Equipment Technology and Operations for Wastes and Recyclable Materials--Stationary Compactors--Safety Requirements," and NFPA 82, "Incinerators and Waste and Linen Handling Systems and Equipment."
- H. Waste Bin and Hopper Standard: Comply with ANSI Z245.30, "Refuse Collection, Processing, and Disposal Equipment--Waste Containers--Safety Requirements."
- I. Waste-Compactor Standards: ANSI Z245.21 **[including annexes]** and NFPA 82.
- J. Waste-Container Standards: ANSI Z245.30 and ANSI Z245.60.

1.8 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide **[12] <Insert number>** months' full maintenance by skilled employees of waste-compactor Installer.
 - 1. Schedule regular surveillance and preventive maintenance visits at seven-day intervals for three (3) months and then at one-month intervals for nine (9) months.

2. Repair or replace worn or defective components; and lubricate, clean, and adjust equipment as required for proper equipment operation. Use replacement parts and maintenance supplies that were used in the manufacture and installation of the original equipment.

B. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.9 CONSTRUCTION WASTE MANAGEMENT

A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 WASTE COMPACTORS

A. Waste Compactor <Insert drawing designation>: Manufacturer's standard [stationary-horizontal] [self-contained horizontal] [combination-container] [vertical] [pivoting-ram] <Insert type>-type stationary compactor, complying with requirements[, liquidtight], and with components, options, and accessories needed to provide a complete, functional system.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Accurate Industries.
- b. Bes-Pac, Inc.
- c. Chicago Trashpacker Company, LLC.
- d. Galbreath, Inc.; a Wastequip company.
- e. GPI/Harmony Enterprises, Inc.
- f. Harmony Enterprises, Inc.
- g. Holt Specialty Equipment, Inc.; a Wastequip company.
- h. J. V. Manufacturing, Inc.
- i. Kohlman Engineering Corp.
- j. K-PAC Equipment; Division of Krause Corporation.
- k. Marathon Equipment Company; a Dover company.
- l. McClain group/E-Z Pack.
- m. Precision Machinery Systems, Inc.
- n. PTR Baler & Compactor Company.
- o. Rudco Products, Inc.
- p. Sebright Products Inc.
- q. SP Industries, Inc.
- r. Wastequip, Inc.

- s. Western Chutes; Division of Buchanan Company, Inc.
 - t. Wilkinson Hi-Rise.
 - u. **<Insert manufacturer's name>**.
 - v. or approved equal.
2. WASTEC-Rated Size (Volume): Minimum [0.14 cu. yd. (0.11 cu. m)] [1.00 cu. yd. (0.77 cu. m)] [1.50 cu. yd. (1.15 cu. m)] [2.00 cu. yd. (1.53 cu. m)] [3.50 cu. yd. (2.68 cu. m)] [5.00 cu. yd. (3.82 cu. m)] [7.50 cu. yd. (5.73 cu. m)] [10.00 cu. yd. (7.65 cu. m)] **<Insert volume>**.
3. Minimum Infeed Opening (Length by Width): Minimum [20 by 28 inches (508 by 711 mm)] [24 by 36 inches (610 by 914 mm)] [30 by 48 inches (762 by 1219 mm)] [60 by 48 inches (1524 by 1219 mm)] [108 by 72 inches (2743 by 1829 mm)] **<Insert dimensions>**.
4. Cycle Time: Maximum [30] [40] [50] [60] [70] **<Insert number>** seconds.
5. Discharge Opening (Width by Height): Maximum **<Insert dimensions>**.
6. Ground Height: Minimum **<Insert dimension>**.
7. Ram Face: Minimum **<Insert dimensions>**.
8. Ram Penetration: Minimum **<Insert dimension>**.
9. Normal/Maximum Resultant Ram Forces: [20,000/22,000 lbf (89/98 kN)] [36,000/40,000 lbf (160/178 kN)] [70,000/80,000 lbf (311/356 kN)] [125,000/150,000 lbf (556/667 kN)] **<Insert values>**.
10. Normal/Maximum System Pressures: [1600/1800 psi (11.0/12.4 MPa)] [2000/2400 psi (13.8/16.5 MPa)] [2500/2800 psi (17.2/19.3 MPa)] **<Insert values>**.
11. Scale Weight: Maximum [2500 lb (1134 kg)] [6000 lb (2722 kg)] [12,000 lb (5443 kg)] [20,000 lb (9072 kg)] **<Insert value>**.
12. Motor Size: [3] [10] [15] [20] [30] [50] **<Insert number>** hp.
13. Electrical Power Supply: [120] [208] [240] [480] **<Insert value>** V, [1] [3] phase, 60 Hz.
14. Controls: **<Insert control features>**.
15. Finish: [Manufacturer's standard] [Manufacturer's standard primer for field painting] **<Insert requirement>**.
- a. Color: [White] [Black] [Gray] [Dark green] [Yellow] [As selected by DEN Project Manager from manufacturer's full range] **<Insert color>**.
16. Deodorizing Device: [Manufacturer's standard] **<Insert requirement>**.
17. **<Insert requirement>**.
- B. Diverter: [Compactor manufacturer's standard] **<Insert requirement>** coordinated with chute dimensions and designed to divert waste from one chute into [two (2)] **<Insert number>** compactors, with chute-relay controls located [where shown on Drawings] **<Insert requirement>**, and finished [to match compactor] **<Insert requirement>**.
- C. Number of Extra Storage Containers: [One (1)] [Two (2)] **<Insert number>**.

2.2 FABRICATION

- A. Fabricate waste compactors with smooth, eased, exposed edges to prevent injury to persons in vicinity of the equipment.
- B. Fabricate containers, hoppers, compaction chambers, unit bodies, and similar components of steel with welded joints. Reinforce with steel members sized and spaced to withstand impacts and pressures of normal operations and to prevent deformation.
- C. Fabricate equipment with replaceable parts at points of normal wear.
- D. Fabricate liquidtight compactor baffles to stop liquid from leaking out.
- E. Fabricate diverter to fit chute and properly align with compactor hoppers.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, clearances, service rough-ins, and other conditions affecting performance of waste-compactor work.
- B. Examine walls, floors, and chutes for suitable conditions where each waste compactor will be installed.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install each waste compactor according to manufacturer's written instructions, ANSI Z245.2, and ANSI Z245.21[**including annexes**].
- B. Install automatic sprinkler in hopper of each chute-fed compactor according to NFPA 82.
- C. Set waste compactors level, plumb, properly aligned, and securely in place. Anchor as required for secure operation.
- D. Complete field assembly with joining methods recommended in writing by manufacturer. Grind welds smooth and restore finishes.
- E. Install diverter to chute and properly align with compactor hoppers.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Perform installation and startup checks according to[**ANSI Z245.21, Annex D, "Tests for Evaluation of Equipment and Performance," and**] manufacturer's written instructions.
 - 2. Test and adjust controls, alarms, and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Verify unrestricted access to each firefighting access door or fire port required by ANSI Z245.21 and NFPA 82 for compactor container(s).
 - 4. Verify correct locations, color-coding, and legibility of caution, warning, and danger markings.
 - 5. Certify compliance with test parameters.
- C. A waste compactor will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. Startup Services: Provide startup service, equipment demonstration, and training of Owner's maintenance personnel.
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain waste compactors according to manufacturer's requirements and ANSI Z245.2.
 - 1. Demonstrate capacities, safety features, cleaning procedures, and proper methods for storing and handling raw and processed waste materials.
 - 2. Review data in maintenance manuals specified in Division 01.
 - 3. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 118226

SECTION 122113 - HORIZONTAL LOUVER BLINDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Horizontal louver blinds with [**aluminum**] [**wood**] [**polymer**] slats.
- 2. Motorized operators.

- B. Related Requirements:

- 1. Section 061053 "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting horizontal louver blinds and accessories.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ALLOWANCES

- A. Horizontal louver blinds are part of [**Window Covering Allowance**] <Insert name of allowance>.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include data substantiating that materials comply with requirements.

- B. Shop Drawings: Show fabrication and installation details for horizontal louver blinds.

- 1. Motorized Operators: Include details of installation in headrails and diagrams for power, signal, and control wiring.

- C. Samples: For each exposed product and for each color and texture specified, **12 inches** (300 mm) long.

- D. Samples for Initial Selection: For each type and color of horizontal louver blind.

1. Include similar Samples of accessories involving color selection.
- E. Samples for Verification: For each type and color of horizontal louver blind indicated.
1. Slat: Not less than **12 inches** (300 mm) long.
 2. Tapes: Full width, not less than **6 inches** (150 mm) long.
 3. Horizontal Louver Blind: Full-size unit, not less than **16 inches** (400 mm) wide by **24 inches** (600 mm) long.
 4. Valance: Full-size unit, not less than **12 inches** (300 mm) wide.
- F. Window-Treatment Schedule: For horizontal louver blinds. Use same designations indicated on Drawings.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Product Certificates: For each type of horizontal louver blind.
- B. Product Test Reports: For each type of horizontal louver blind, for tests performed by **[manufacturer and witnessed by a qualified testing agency] [a qualified testing agency]**.
- 1.6 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For horizontal louver blinds to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".
- 1.7 MAINTENANCE MATERIAL SUBMITTALS
- A. Furnish extra materials[, **from the same product run,**] that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Horizontal Louver Blinds: Full-size units equal to 5 percent of quantity installed for each size, color, texture, pattern, and gloss indicated, but no fewer than **[two]** **<Insert number>** units.
- 1.8 QUALITY ASSURANCE
- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver horizontal louver blinds in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where horizontal louver blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify DEN Project Manager of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain horizontal louver blinds from single source from single manufacturer.

2.2 HORIZONTAL LOUVER BLINDS, ALUMINUM SLATS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Hunter Douglas Contract.
 2. Levolor Contract; a Newell Rubbermaid company.
 3. Springs Window Fashions.
 4. **<Insert manufacturer's name>**.

5. or approved equal.
- B. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radius corners.
1. Width: [1/2 to 5/8 inch (13 to 16 mm)] [1 inch (25 mm)] [2 inches (51 mm)] <Insert width>.
 2. Thickness: [Manufacturer's standard] [Not less than 0.006 inch (0.15 mm)] [Not less than 0.008 inch (0.20 mm)] <Insert thickness>.
 3. Spacing: [Manufacturer's standard] <Insert dimension>.
 4. Finish: [Ionized antistatic, dust-repellent, baked polyester finish] [Reflective finish on outside-facing surface of slat to enhance reflection of solar energy] <Insert finish>.
 5. Features:
 - a. Lift-Cord Rout Holes: Minimum size required for lift cord and located near back (outside) edge of slat to maximize slat overlap and minimize light gaps between slats.
 - b. Perforated Slats: Openness factor of [6 to 7] <Insert number> percent.
 - c. <Insert feature>.
- C. Headrail: Formed steel or extruded aluminum; long edges returned or rolled. Headrails fully enclose operating mechanisms on three sides.
1. Capacity: [One blind] [Two blinds] per headrail unless otherwise indicated.
 2. Ends: [Manufacturer's standard] [Capped or plugged] <Insert description>.
 3. Motorized Operating Mechanisms: Coordinate headrail with motorized operator requirements. Provide headrail acceptable to blind and motorized operator manufacturers and suitable for applications indicated.
 4. Manual Lift Mechanism:
 - a. Lift-Cord Lock: [Variable; stops lift cord at user-selected position within blind full operating range] [Top locking; stops lift cord when blind is in fully opened or fully closed positions only; equipped with ring pull not more than 4 inches (100 mm) long].
 - b. Operator: Extension of lift cord(s) through lift-cord lock mechanism to form cord pull.
 5. Manual Tilt Mechanism: Enclosed worm-gear mechanism and linkage rod that adjusts ladders.
 - a. Tilt: Full.
 - b. Tilt: [One] [Two]-direction, positive stop or lockout limited at an angle of [20] [60] [80] <Insert number> degrees from horizontal[, both directions].
 - c. Operator: [Clear-plastic wand] [Corrosion-resistant steel rod] [Dual cord] <Insert description>.
 - d. Over-Rotation Protection: Manufacturer's detachable operator or slip clutch to prevent over rotation of gear.

6. Manual Lift-Operator and Tilt-Operator Lengths: **[Manufacturer's standard] [Full length of blind when blind is fully closed] [Length required to extend to 48 inches (1219 mm) above floor level when blind is fully closed] [As indicated on Drawings] <Insert length>**.
 7. Manual Lift-Operator and Tilt-Operator Locations: **[Manufacturer's standard] [Right side and left side of headrail, respectively] [Left side and right side of headrail, respectively] [Right side of headrail] [Left side of headrail] [Left side of headrail and center blind, respectively] [Right side of headrail and center blind, respectively]** unless otherwise indicated.
 8. Integrated Headrail/Valance: **[Curved face] <Insert description>**.
- D. Bottom Rail: Formed-steel or extruded-aluminum tube that secures and protects ends of ladders and lift cords and has plastic- or metal-capped ends.
1. Type: **[Manufacturer's standard] [Top contoured to match crowned shape of slat] [Bottom contoured to minimize light gaps] <Insert description>**.
- E. Lift Cords: Manufacturer's standard braided cord.
- F. Ladders: Evenly spaced across headrail at spacing that prevents long-term slat sag.
1. Type: **[Braided cord] [Reinforced vinyl tape, manufacturer's standard width] [Cloth tape, manufacturer's standard width] <Insert description>**.
- G. Valance: **[Two slats] [PVC strip] [Manufacturer's standard] <Insert description>**.
- H. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.
1. Type: **[Wall] [Overhead] [End] [Wall extension] [Two piece for pocket installation] [As indicated] <Insert description>**.
 2. Intermediate Support: Provide intermediate support brackets to produce support spacing recommended by blind manufacturer for weight and size of blind.
- I. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard.
- J. Side Channels and Perimeter Light Gap Seals: Manufacturer's standard.
- K. Colors, Textures, Patterns, and Gloss:
1. Slats: **[Match DEN Project Manager's samples] [Match DEN Project Manager's samples for custom color and other characteristics] [As selected by DEN Project Manager from manufacturer's full range] [As indicated on Drawings] <Insert description>**.
 2. Components: **[Provide rails, cords, ladders, and materials exposed to view matching or coordinating with slat color unless otherwise indicated] <Insert description>**.

2.3 HORIZONTAL LOUVER BLINDS, WOOD SLATS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Comfortex Window Fashions.
 2. Hunter Douglas Contract.
 3. Levolor Contract; a Newell Rubbermaid company.
 4. Springs Window Fashions.
 5. **<Insert manufacturer's name>**.
 6. or approved equal.
- B. Flame-Resistance Rating: Comply with NFPA 701; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- C. Slats: Hardwood, **[Manufacturer's standard species] [North American] [basswood] [poplar] [ramin] <Insert species>**.
1. Width: **[1 inch (25 mm)] [1-3/8 inches (35 mm)] [2 inches (51 mm)] [2-3/8 inches (60 mm)] <Insert width>**.
 2. Thickness: **[Manufacturer's standard] [0.115 inch (2.9 mm)] [0.125 inch (3.2 mm)] <Insert thickness>**.
 3. Spacing: **[Manufacturer's standard] <Insert dimension>**.
 4. Profile: **[Flat] [Flat with beaded edges] [Flat with double beaded edges] <Insert profile>**.
 5. Corners: **[Square] [Radius]**.
 6. Features:
 - a. Lift-Cord Rout Holes: **[Minimum size required for lift cord and located near back (outside) edge of slat to maximize slat overlap and minimize light gaps between slats] [None]**.
 - b. **<Insert feature>**.
- D. Headrail: Formed steel or extruded aluminum; long edges returned or rolled. Headrails fully enclose operating mechanisms on three sides and ends.
1. Capacity: **[One blind] [Two blinds]** per headrail unless otherwise indicated.
 2. Motorized Operating Mechanisms: Coordinate headrail with motorized operator requirements. Provide headrail acceptable to blind and motorized operator manufacturers and suitable for applications indicated.
 3. Manual Lift Mechanism:
 - a. Lift-Cord Lock: **[Variable; stops lift cord at user-selected position within full operating range] [Top locking; stops lift cord when blind is in fully opened or fully closed positions only; equipped with ring pull not more than 4 inches (100 mm) long]**.
 - b. Operator: Extension of lift cord(s) through lift-cord lock mechanism to form cord pull.

4. Manual Tilt Mechanism: Enclosed worm-gear mechanism and linkage rod that adjusts ladders.
 - a. Tilt: Full.
 - b. Tilt: **[One]** **[Two]**-direction, positive stop or lockout limited at an angle of **[20]** **[60]** **[80]** **<Insert number>** degrees from horizontal[, **both directions**].
 - c. Operator: **[Clear-plastic wand]** **[Wood wand matching slats]** **[Corrosion-resistant steel rod]** **[Dual cord]** **<Insert description>**.
 - d. Over-Rotation Protection: Manufacturer's detachable operator or slip clutch to prevent over rotation of gear.

5. Manual Lift-Operator and Tilt-Operator Lengths: **[Manufacturer's standard]** **[Full length of blind when blind is fully closed]** **[Length required to extend to 48 inches (1219 mm) above floor level when blind is fully closed]** **[As indicated on Drawings]** **<Insert length>**.
6. Manual Lift-Operator and Tilt-Operator Locations: **[Manufacturer's standard]** **[Right side and left side of headrail, respectively]** **[Left side and right side of headrail, respectively]** **[Right side of headrail]** **[Left side of headrail]** **[Left side of headrail and center blind, respectively]** **[Right side of headrail and center blind, respectively]** unless otherwise indicated.

- E. Bottom Rail: Hardwood matching slats that secures and protects ends of ladders and lift cords.
 1. Type: **[Manufacturer's standard]** **[With trapezoid-shaped bottom angled to minimize light gaps]** **<Insert description>**.

- F. Lift Cords: Manufacturer's standard braided cord.

- G. Ladders: Evenly spaced across headrail at spacing that prevents long-term slat sag.
 1. Type: **[Braided cord]** **[Cloth tape, manufacturer's standard width]** **<Insert description>**.

- H. Valance: **[Manufacturer's standard]** **<Insert description>**.

- I. Tassels: Hardwood finished to match slats, **[manufacturer's standard]** **<Insert description>**.

- J. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.
 1. Type: **[Wall]** **[Overhead]** **[End]** **[Wall extension]** **[Two piece for pocket installation]** **[As indicated]** **<Insert description>**.
 2. Intermediate Support: Provide intermediate support brackets to produce support spacing recommended by blind manufacturer for weight and size of blind.

- K. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard.

- L. Colors, Finishes, and Gloss:

1. Slats: **[Match DEN Project Manager's samples] [Match DEN Project Manager's samples for custom color and other characteristics] [As selected by DEN Project Manager from manufacturer's full range] [As indicated on Drawings] <Insert description>**.
2. Components: **[Provide rails, cords, ladders, and materials exposed to view matching or coordinating with slat color unless otherwise indicated] <Insert description>**.

2.4 HORIZONTAL LOUVER BLINDS, POLYMER SLATS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Comfortex Window Fashions.
 2. Hunter Douglas Contract.
 3. Levolor Contract; a Newell Rubbermaid company.
 4. Springs Window Fashions.
 5. **<Insert manufacturer's name>**.
 6. or approved equal.
- B. Flame-Resistance Rating: Comply with NFPA 701; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- C. Slats: Polymers that are lead free, UV stabilized, integrally colored, opaque, and will not crack or yellow; antistatic, dust-repellent treated.
1. Formulation: **[Permanently flexible, extruded PVC] [Foam PVC] [Polymer/wood composite] [Manufacturer's standard] <Insert formulation>**.
 2. Width: **[2 inches (51 mm)] [2-1/2 inches (64 mm)] <Insert width>**.
 3. Thickness: **[0.125 inch (3.2 mm)] [0.150 inch (3.8 mm)] <Insert thickness>**.
 4. Spacing: **[Manufacturer's standard] <Insert dimension>**.
 5. Profile: **[Crowned] [Manufacturer's standard] <Insert profile>**.
 6. Features:
 - a. Lift-Cord Rout Holes: **[Minimum size required for lift cord and located near back (outside) edge of slat to maximize slat overlap and minimize light gaps between slats] [None]**.
 - b. Perforated Slats: Openness factor of **[6 to 7] <Insert number>** percent.
 - c. **<Insert feature>**.
- D. Headrail: Formed steel or extruded aluminum; long edges returned or rolled. Headrail fully encloses operating mechanisms on three sides and ends.
1. Capacity: **[One blind] [Two blinds]** per headrail unless otherwise indicated.
 2. Motorized Operating Mechanisms: Coordinate headrail with motorized operator requirements. Provide headrail acceptable to blind and motorized operator manufacturers and suitable for applications indicated.
 3. Manual Lift Mechanism:

- a. Lift-Cord Lock: **[Variable; stops lift cord at user-selected position within full operating range] [Top locking; stops lift cord when blind is in fully opened or fully closed positions only; equipped with ring pull not more than 4 inches (100 mm) long]**.
 - b. Operator: Extension of lift cord(s) through lift-cord lock mechanism to form cord pull.
4. Manual Tilt Mechanism: Enclosed worm-gear mechanism and linkage rod that adjusts ladders.
- a. Tilt: Full.
 - b. Tilt: **[One] [Two]-direction, positive stop or lockout limited at an angle of [20] [60] [80] <Insert number> degrees from horizontal[, both directions]**.
 - c. Operator: **[Clear-plastic wand] [Corrosion-resistant steel rod] [Dual cord] <Insert description>**.
 - d. Over-Rotation Protection: Manufacturer's detachable operator or slip clutch to prevent over rotation of gear.
5. Manual Lift-Operator and Tilt-Operator Lengths: **[Manufacturer's standard] [Full length of blind when blind is fully closed] [Length required to extend to 48 inches (1219 mm) above floor level when blind is fully closed] [As indicated on Drawings] <Insert length>**.
6. Manual Lift-Operator and Tilt-Operator Locations: **[Manufacturer's standard] [Right side and left side of headrail, respectively] [Left side and right side of headrail, respectively] [Right side of headrail] [Left side of headrail] [Left side of headrail and center blind, respectively] [Right side of headrail and center blind, respectively]** unless otherwise indicated.
- E. Bottom Rail: Secures and protects ends of ladders and lift cords.
1. Type: **[Manufacturers standard] [Formed-steel or extruded-aluminum tube, with plastic or metal capped ends] [Hardwood matching slats and trapezoid-shaped bottom angled for minimizing light gaps] <Insert type>**.
- F. Lift Cord: Manufacturer's standard braided cord.
- G. Ladders: Evenly spaced across headrail at spacing that prevents long-term slat sag.
1. Type: **[Braided cord] [Cloth tape, manufacturer's standard width] <Insert description>**.
- H. Valance: **[Manufacturer's standard] <Insert description>**.
- I. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.
1. Type: **[Wall] [Overhead] [End] [Wall extension] [Two piece for pocket installation] [As indicated] <Insert description>**.
 2. Intermediate Support: Provide intermediate support brackets to produce support spacing recommended by blind manufacturer for weight and size of blind.

- J. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard.
- K. Colors, Textures, Patterns, and Gloss:
 - 1. Slats: **[Match DEN Project Manager's samples] [Match DEN Project Manager's samples for custom color and other characteristics] [As selected by DEN Project Manager from manufacturer's full range] [As indicated on Drawings] <Insert description>.**
 - 2. Components: **[Provide rails, cords, ladders, and materials exposed to view matching or coordinating with slat color unless otherwise indicated] <Insert description>.**

2.5 HORIZONTAL LOUVER BLIND FABRICATION

- A. Product Safety Standard: Fabricate horizontal louver blinds to comply with WCMA A 100.1 including requirements for corded, flexible, looped devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at **74 deg F** (23 deg C):
 - 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which blind is installed less **1/4 inch** (6 mm) per side or **1/2 inch** (13 mm) total, plus or minus **1/8 inch** (3.1 mm). Length equal to head-to-sill dimension of opening in which blind is installed less **1/4 inch** (6 mm), plus or minus **1/8 inch** (3.1 mm).
 - 2. Outside of Jamb Installation: Width and length as indicated, with terminations between blinds of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- C. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.
 - 1. Lift-and-Tilt Mechanisms: With permanently lubricated moving parts.
- D. Mounting and Intermediate Brackets: Designed for removal and reinstallation of blind without damaging blind and adjacent surfaces, for supporting blind components, and for bracket positions and blind placement indicated.
- E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to brackets and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.
- F. Color-Coated Finish:
 - 1. Metal: For components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

2. Wood: Apply **[manufacturer's standard]** <Insert description> factory-applied finish complying with manufacturer's written instructions for surface preparation, application, and minimum dry film thickness.

2.6 MOTORIZED OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Am-Source International.
 2. BTX Window Automation Inc.
 3. SM Automatic, Inc.
 4. **<Insert manufacturer's name>**.
 5. or approved equal.
- B. General: Provide factory-assembled blind-operator systems of size and capacity and with features, characteristics, and accessories suitable for conditions indicated and recommended by motorized operator and blind manufacturers for use with blinds indicated, complete with electric motors and factory-prewired motor controls, power disconnect switches, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
 1. Headrail: As specified for blind(s) operated by motorized operator.
 2. Function: **[Lift]** **[and]** **[tilt]**.
 3. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6[**with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc**].
- D. Electric Motors: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 110513 "Common Motor Requirements for Equipment."
 1. Electrical Characteristics: Single phase, **[24]** **[110]** **[220]** **<Insert voltage rating>** V, 60 Hz.
- E. Remote Controls: Electric controls with NEMA ICS 6, Type 1 enclosure for **[surface]** **[recessed or flush]** **[within headrail]** **<Insert type>** mounting. Provide the following for remote-control activation of blinds:
 1. Keyed Control Stations: Keyed, **[maintained]** **[momentary]**-contact, three-position, switch-operated control station with open, close, and off functions. Provide two keys per station.
 2. Individual Switch Control Stations: **[Maintained]** **[Momentary]**-contact, **[three]** **[five]**-position, **[toggle]** **[rocker]**-style, wall-switch-operated control station with open, close, and center off functions.

3. Group Control Stations: **[Maintained] [Momentary]**-contact, three-position, rocker-style, wall-switch-operated control station with open, close, and center off functions for single-switch group control.
 4. Individual/Group Control Stations: **[Maintained] [Momentary]**-contact, three-position, rocker-style, wall-switch-operated control station with open, close, and center off functions for individual and group control.
 5. Sun Sensor Controls: Adjustable system consisting of LEDs detecting sun intensity and responding by automatically adjusting blinds.
 6. Infrared Controls: System consisting of concealed receiver complete with external eye and connecting modular cable and **[two] <Insert number>** portable, multiple-channel transmitters with separate buttons to open and close up to **[12] <Insert number>** individual blinds or groups of blinds, to open and close blinds simultaneously, **[to tilt forward,] [to tilt backward,]** and to stop.
 7. Timer Controls: Clock timer, **[24-hour] [seven-day] <Insert period>** programmable for regular events.
 8. Microprocessor Controls: Electronic programmable means for setting, changing, and adjusting control features; isolated from voltage spikes and surges.
 9. Color: **[Ivory] [White] [As indicated] <Insert color>**.
- F. Limit Switches: Adjustable switches, interlocked with motor controls and set to stop blind automatically at fully raised and fully lowered positions.
- G. Operating Features:
1. Group switching with integrated switch control; single faceplate for multiple switch cutouts.
 2. Capable of interface with **[audiovisual] [multiroom] <Insert description>** control system.
 3. Capable of accepting input from building automation control system.
 4. Override switch.
- H. Accessories:
1. Solar power unit.
 2. **<Insert accessory>**.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, **[locations of connections to building electrical system,]** and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install horizontal louver blinds level and plumb, aligned and centered on openings, and aligned with adjacent units according to manufacturer's written instructions.
 - 1. Locate so exterior slat edges are not closer than [1 inch (25 mm)] [2 inches (51 mm)] <Insert dimension> from interior faces of glass and not closer than [1/2 inch (13 mm)] [1-1/2 inches (38 mm)] <Insert dimension> from interior faces of glazing frames through full operating ranges of blinds.
 - 2. Install mounting and intermediate brackets to prevent deflection of headrails.
 - 3. Install with clearances that prevent interference with adjacent blinds, adjacent construction, and operating hardware of glazed openings, other window treatments, and similar building components and furnishings.
- B. Electrical Connections: Connect motorized operators to building electrical system.

3.3 ADJUSTING

- A. Adjust horizontal louver blinds to operate free of binding or malfunction through full operating ranges.

3.4 CLEANING AND PROTECTION

- A. Clean horizontal louver blind surfaces after installation according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer and that ensures that horizontal louver blinds are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged horizontal louver blinds that cannot be repaired in a manner approved by DEN Project Manager before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems.
 - 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 122113

SECTION 122116 - VERTICAL LOUVER BLINDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Vertical louver blinds with [**aluminum**] [**PVC**] [**PVC and fabric insert**] [**fabric**] vanes.
 - 2. Motorized operators.
- B. Related Requirements:
 - 1. Section 061053 "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting vertical louver blinds and accessories.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ALLOWANCES

- A. Vertical louver blinds are part of [**Window Covering Allowance**] <Insert name of allowance>.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: Show fabrication and installation details for vertical louver blinds[**and motorized operators**].
 - 1. Motorized Operators: Include details of installation and diagrams for power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified, **12 inches** (300 mm) long.

- D. Samples for Initial Selection: For each type of vertical louver blind.
 - 1. Include similar Samples of accessories involving color selection.
- E. Samples for Verification: For each type of vertical louver blind.
 - 1. Vane: Not less than **12 inches** (300 mm) long.
 - a. Fabric: **3-1/2 inches** (90 mm) wide from dye lot used for the Work. Mark top and face of material.
 - 2. Vertical Louver Blind: Full-size unit, not less than **36 inches** (900 mm) wide by **36 inches** (900 mm) long.
 - 3. Valance: Full-size unit, not less than **12 inches** (300 mm) wide.
- F. Window-Treatment Schedule: For vertical louver blinds. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of vertical louver blind.
- B. Product Test Reports: For each type of vertical louver blind, for tests performed by **[manufacturer and witnessed by a qualified testing agency] [a qualified testing agency]**.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For vertical louver blinds to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials[, **from the same product run,**] that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Vertical Louver Blinds: Full-size units equal to 5 percent of quantity installed for each size, color, texture, pattern, and finish indicated, but no fewer than **[two]** **<Insert number>** units.
 - 2. Vanes: Furnish quantity of full-size units equal to 5 percent of quantity installed for each type, size, texture, pattern, and finish indicated, but no fewer than **[two]** **<Insert number>** units.

1.8 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver vertical louver blinds in factory packages, marked with manufacturer and product name, and location of installation using same designations indicated on Drawings.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not install vertical louver blinds until construction and wet and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where vertical louver blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify DEN Project Manager of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain vertical louver blinds from single source from single manufacturer.

2.2 VERTICAL LOUVER BLINDS, ALUMINUM VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hunter Douglas Contract.
 2. **<Insert manufacturer's name>**
 3. or approved equal.
- B. Vanes: Aluminum, alloy, and temper recommended by producer for type of use and finish indicated; with crowned profile and not less than **3/8-inch** (9.5-mm) overlap when rotated fully closed.
1. Width: **3-1/2 inches** (89 mm).
- C. Headrail: Channel, extruded aluminum with long edges returned or rolled and ends capped. Headrail encloses operating mechanisms including carrier-spacing mechanism that provides uniform vane spacing when blinds are traversed fully across headrail (closed).
1. Motorized Operator Control: Coordinate headrail with motorized operator requirements. Provide headrail acceptable to blind and motorized operator manufacturers and suitable for applications indicated.
 2. Manual Traverse Control: [**Nickel-plated metal bead chain**] [**Cord**] [**Wand**].
 3. Manual Rotation Control: [**Nickel-plated metal bead chain**] [**Plastic bead chain**] [**Wand**] [**Automatic rotation mechanically activated by traverse control**].
 4. Manual Control Locations: [**Right**] [**Left**] [**As indicated on Drawings**].
 5. Draw and Stack: [**One way, stack left**] [**One way, stack right**] [**Two way, center split**] [**Two way, center stack**] [**As indicated on Drawings**].
 6. Cord-Tensioner Mounting: [**Wall**] [**Floor**] [**Sill**] [**Baseboard**] [**As indicated on Drawings**] **<Insert description>**.
- D. Carriers: Engineered plastic with gears to align and synchronize vane rotation and stems that allow vane removal and replacement. Lead carriers have self-lubricating wheels or elongated bearing surfaces; following carriers have self-lubricating wheels.
- E. Valance: [**Manufacturer's standard with vane insert**] **<Insert description>**.
- F. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.
1. Type: [**Wall**] [**Overhead**] [**For headrail recessed in pocket**] [**As indicated**] **<Insert description>**.
 2. Intermediate Support: Provide intermediate support brackets to produce support spacing recommended by blind manufacturer for weight and size of blind.
- G. Colors, Textures, and Patterns:
1. Vanes: [**Match DEN Project Manager's samples**] [**As selected by DEN Project**]

Manager from manufacturer's full range] [As indicated on Drawings] <Insert description>.

2. Components: **[Provide materials exposed to view matching or coordinating with vanes unless otherwise indicated] <Insert description>.**

2.3 VERTICAL LOUVER BLINDS, PVC VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Hunter Douglas Contract.
 2. Levolor Contract; a Newell Rubbermaid company.
 3. Springs Window Fashions.
 4. **<Insert manufacturer's name>.**
 5. or approved equal.
- B. Vanes: Lead-free, UV-stabilized, integrally colored, opaque, permanently flexible, extruded PVC that will not crack or yellow; with not less than **3/8-inch** (9.5-mm) overlap when vanes are rotated fully closed.
 1. Width: **[2 inches** (51 mm) **]** **[3-1/2 inches** (89 mm) **]**.
 2. Profile: **[Flat] [Crowned] [Narrow-ridged flat] [Narrow-ridged crowned] [Wide-ridged crowned] [Embossed] <Insert description>.**
 3. Perforated Vanes: Openness factor of **[3] [6] [8] [10] [12] <Insert number>** percent.
 4. Flame-Resistance Rating: Comply with NFPA 701; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 5. Features:
 - a. Bottom chain.
 - b. **<Insert feature>.**
- C. Headrail: Channel, formed steel or extruded aluminum with long edges returned or rolled and ends capped. Headrail encloses operating mechanisms including carrier-spacing mechanism that provides uniform vane spacing when blinds are traversed fully across headrail (closed).
 1. Motorized Operator Control: Coordinate headrail with motorized operator requirements. Provide headrail acceptable to blind and motorized operator manufacturers and suitable for applications indicated.
 2. Manual Traverse Control: **[Nickel-plated metal bead chain] [Cord] [Wand].**
 3. Manual Rotation Control: **[Nickel-plated metal bead chain] [Plastic bead chain] [Wand] [Automatic rotation mechanically activated by traverse control].**
 4. Manual Control Locations: **[Right] [Left] [As indicated on Drawings].**
 5. Draw and Stack: **[One way, stack left] [One way, stack right] [Two way, center split] [Two way, center stack] [As indicated on Drawings].**
 6. Stack Release: Permitting stacked vanes to be moved away from stacking position for access to glazed opening.

7. Cord-Tensioner Mounting: **[Wall] [Floor] [Sill] [Baseboard] [As indicated on Drawings] <Insert description>**.
- D. Carriers: Engineered plastic with gears to align and synchronize vane rotation and stems that allow vane removal and replacement. Lead carriers have self-lubricating wheels or elongated bearing surfaces; following carriers have self-lubricating wheels.
- E. Valance: **[Manufacturer's standard with vane insert] <Insert description>**.
- F. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.
1. Type: **[Wall] [Overhead] [For headrail recessed in pocket] [As indicated] <Insert description>**.
 2. Intermediate Support: Provide intermediate support brackets to produce support spacing recommended by blind manufacturer for weight and size of blind.
- G. Colors, Textures, and Patterns:
1. Vanes: **[Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] [As indicated on Drawings] <Insert description>**.
 2. Components: **[Provide materials exposed to view matching or coordinating with vanes unless otherwise indicated] <Insert description>**.
- 2.4 VERTICAL LOUVER BLINDS, PVC VANES WITH FABRIC VANE INSERTS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hunter Douglas Contract.
 2. Levolor Contract; a Newell Rubbermaid company.
 3. Springs Window Fashions.
 4. **<Insert manufacturer's name>**.
 5. or approved equal.
- B. Vanes: Lead-free, UV-stabilized, permanently flexible, extruded PVC that will not crack or yellow; with not less than **3/8-inch** (9.5-mm) overlap when vanes are rotated fully closed. Provide integrally colored, opaque vane with clear grooves for holding fabric insert.
1. Width: **3-1/2 inches** (89 mm).
 2. Fabric Insert: **[Manufacturer's standard] <Insert fabric description>**; stain and fade resistant.
- C. Headrail: Channel, formed steel or extruded aluminum with long edges returned or rolled and ends capped. Headrail encloses operating mechanisms including carrier-spacing mechanism that provides uniform vane spacing when blinds are traversed fully across headrail (closed).

1. Motorized Operator Control: Coordinate headrail with motorized operator requirements. Provide headrail acceptable to blind and motorized operator manufacturers and suitable for applications indicated.
 2. Manual Traverse Control: **[Nickel-plated metal bead chain] [Cord] [Wand]**.
 3. Manual Rotation Control: **[Nickel-plated metal bead chain] [Plastic bead chain] [Wand] [Automatic rotation mechanically activated by traverse control]**.
 4. Manual Control Locations: **[Right] [Left] [As indicated on Drawings]**.
 5. Draw and Stack: **[One way, stack left] [One way, stack right] [Two way, center split] [Two way, center stack] [As indicated on Drawings]**.
 6. Stack Release: Permitting stacked vanes to be moved away from stacking position for access to glazed opening.
 7. Cord-Tensioner Mounting: **[Wall] [Floor] [Sill] [Baseboard] [As indicated on Drawings] <Insert description>**.
- D. Carriers: Engineered plastic with gears to align and synchronize vane rotation and stems that allow vane removal and replacement. Lead carriers have self-lubricating wheels or elongated bearing surfaces; following carriers have self-lubricating wheels.
- E. Valance: **[Manufacturer's standard with vane insert] <Insert description>**.
- F. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.
1. Type: **[Wall] [Overhead] [For headrail recessed in pocket] [As indicated] <Insert description>**.
 2. Intermediate Support: Provide intermediate support brackets to produce support spacing recommended by blind manufacturer for weight and size of blind.
- G. Colors, Textures, and Patterns:
1. Vanes:
 - a. PVC: **[Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] [As indicated on Drawings] <Insert description>**.
 - b. Fabric Inserts: **[Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] [As indicated on Drawings] <Insert description>**.
 2. Components: **[Provide materials exposed to view matching or coordinating with PVC vanes unless otherwise indicated] <Insert description>**.
- 2.5 VERTICAL LOUVER BLINDS, FABRIC VANES
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hunter Douglas Contract.

2. Levolor Contract; a Newell Rubbermaid company.
 3. Silent Gliss USA, Inc.
 4. Solar Shading Systems.
 5. Springs Window Fashions.
 6. **<Insert manufacturer's name>**.
 7. or approved equal.
- B. Vanes: **[Manufacturer's standard] [PVC-coated fiberglass mesh] [PVC-coated polyester mesh] <Insert fabric description>** free-hanging fabric with hemmed, nonraveling edges; stain and fade resistant; with not less than **3/8-inch** (9.5-mm) overlap when vanes are rotated fully closed.
1. Width: **[2 inches** (51 mm)] **[3-1/2 inches** (89 mm)] **[5 inches** (125 mm)].
 2. Flame-Resistance Rating: Comply with NFPA 701; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 3. Features:
 - a. Weight, sewn in at bottom of vanes.
 - b. Bottom chain.
 - c. **<Insert feature>**.
- C. Headrail: Channel, formed steel or extruded aluminum with long edges returned or rolled and ends capped. Headrail encloses operating mechanisms including carrier-spacing mechanism that provides uniform vane spacing when blinds are traversed fully across headrail (closed).
1. Motorized Operator Control: Coordinate headrail with motorized operator requirements. Provide headrail acceptable to blind and motorized operator manufacturers and suitable for applications indicated.
 2. Manual Traverse Control: **[Nickel-plated metal bead chain] [Cord] [Wand]**.
 3. Manual Rotation Control: **[Nickel-plated metal bead chain] [Plastic bead chain] [Wand] [Automatic rotation mechanically activated by traverse control]**.
 4. Manual Control Locations: **[Right] [Left] [As indicated on Drawings]**.
 5. Draw and Stack: **[One way, stack left] [One way, stack right] [Two way, center split] [Two way, center stack] [As indicated on Drawings]**.
 6. Stack Release: Permitting stacked vanes to be moved away from stacking position for access to glazed opening.
 7. Cord-Tensioner Mounting: **[Wall] [Floor] [Sill] [Baseboard] [As indicated on Drawings] <Insert description>**.
- D. Carriers: Engineered plastic with gears to align and synchronize vane rotation and stems that allow vane removal and replacement. Lead carriers have self-lubricating wheels or elongated bearing surfaces; following carriers have self-lubricating wheels.
- E. Valance: **[Manufacturer's standard with vane insert] <Insert description>**.
- F. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.

1. Type: **[Wall] [Overhead] [For headrail recessed in pocket] [As indicated] <Insert description>**.
2. Intermediate Support: Provide intermediate support brackets to produce support spacing recommended by blind manufacturer for weight and size of blind.

G. Colors, Textures, and Patterns:

1. Vanes: **[Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] [As indicated on Drawings] <Insert description>**.
2. Components: **[Provide materials exposed to view matching or coordinating with vanes unless otherwise indicated] <Insert description>**.

2.6 VERTICAL LOUVER BLIND FABRICATION

- A. Product Safety Standard: Fabricate vertical louver blinds to comply with WCMA A 100.1 including requirements for corded, flexible, looped devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to cover window and other openings as follows, measured at **74 deg F** (23 deg C):
1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which blind is installed less **1/4 inch** (6 mm) per side or **1/2 inch** (13 mm) total, plus or minus **1/8 inch** (3.1 mm). Length equal to head-to-sill or -floor dimension of opening in which blind is installed less **1/4 inch** (6 mm), plus or minus **1/8 inch** (3.1 mm).
 2. Outside of Jamb Installation: Width and length as indicated, with terminations between blinds of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- C. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.
1. Rotation-and-Traverse Mechanisms: With permanently lubricated moving parts.
- D. Installation Brackets: Designed for easy removal and reinstallation of blind, for supporting headrail[, **valance**,] and operating hardware and for bracket positions and blind mounting method indicated.
- E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to brackets and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.
- F. Color-Coated Finish: For metal components exposed to view unless, anodized or plated finish is indicated. Apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

2.7 MOTORIZED OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Am-Source International.
 2. BTX Window Automation Inc.
 3. Silent Gliss USA, Inc.
 4. SM Automatic, Inc.
 5. **<Insert manufacturer's name>**.
 6. or approved equal.
- B. General: Provide factory-assembled blind-operator systems of size and capacity and with features, characteristics, and accessories suitable for conditions indicated and recommended by motorized operator and blind manufacturers for use with blinds indicated, complete with electric motors and factory-prewired motor controls, power disconnect switches, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
1. Headrail: As specified for blind(s) operated by motorized operator.
 2. Function: **[Rotation] [and] [traverse]**.
 3. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6 [**with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc**].
- D. Electric Motors: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 110513 "Common Motor Requirements for Equipment."
1. Electrical Characteristics: Single phase, **[24] [110] [220] <Insert voltage rating>** V, 60 Hz.
 2. Mounting: **[Above headrail, left side] [Above headrail, right side] [Behind headrail, left side] [Behind headrail, right side] [In location indicated on Drawings] <Insert description>**.
- E. Remote Controls: Electric controls with NEMA ICS 6, Type 1 enclosure for **[surface] [recessed or flush] [headrail] <Insert type>** mounting. Provide the following devices for remote-control activation of blinds:
1. Keyed Control Stations: Keyed, **[maintained] [momentary]**-contact, three-position, switch-operated control station with open, close, and off functions. Provide two keys per station.
 2. Individual Switch Control Stations: **[Maintained] [Momentary]**-contact, **[three] [five]**-position, **[toggle] [rocker]**-style, wall-switch-operated control station with open, close, and center off functions.

3. Group Control Stations: **[Maintained] [Momentary]**-contact, three-position, rocker-style, wall-switch-operated control station with open, close, and center off functions for single-switch group control.
 4. Individual/Group Control Stations: **[Maintained] [Momentary]**-contact, three-position, rocker-style, wall-switch-operated control station with open, close, and center off functions for individual and group control.
 5. Sun Sensor Controls: Adjustable system consisting of LEDs detecting sun intensity and responding by automatically adjusting blinds.
 6. Infrared Controls: System consisting of concealed receiver complete with external eye and connecting modular cable and **[two] <Insert number>** portable, multiple-channel transmitters with separate buttons to open and close up to **[12] <Insert number>** individual blinds or groups of blinds, to open and close blinds simultaneously, to rotate blinds, and to stop.
 7. Timer Controls: Clock timer, **[24-hour] [seven-day] <Insert period>** programmable for regular events.
 8. Microprocessor Controls: Electronic programmable means for setting, changing, and adjusting control features; isolated from voltage spikes and surges.
 9. Color: **[Ivory] [White] [As indicated] <Insert color>**.
- F. Limit Switches: Adjustable switches interlocked with motor controls and set to stop blind automatically at vanes fully traversed across headrail and rotated closed and vanes stacked and rotated open.
- G. Operating Features:
1. Group switching with integrated switch control; single faceplate for multiple switch cutouts.
 2. Capable of interface with **[audiovisual] [multiroom] <Insert description>** control system.
 3. Capable of accepting input from building automation control system.
 4. Override switch.
- H. Accessories:
1. Solar power unit.
 2. **<Insert accessory>**.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, **[locations of connections to building electrical system,]** and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install vertical louver blinds level and plumb, aligned and centered on openings, and aligned with adjacent units according to manufacturer's written instructions.
 - 1. Locate so exterior vane edges are not closer than [2 inches (51 mm)] <Insert dimension> from interior faces of glass and not closer than [1-1/2 inches (38 mm)] <Insert dimension> from interior faces of glazing frames through full operating ranges of blinds.
 - 2. Install mounting and intermediate brackets to prevent deflection of headrails.
 - 3. Install with clearances that prevent interference with adjacent blinds, adjacent construction, and operating hardware of glazed openings, other window treatments, and similar building components and furnishings.
- B. Electrical Connections: Connect motorized operators to building electrical system.

3.3 ADJUSTING

- A. Adjust vertical louver blinds to operate free of binding or malfunction through full operating ranges.

3.4 CLEANING AND PROTECTION

- A. Clean vertical louver blind surfaces after installation according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer and that ensures that vertical louver blinds are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged vertical louver blinds that cannot be repaired in a manner approved by Architect before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems.
- B. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 122116

SECTION 123200 - MANUFACTURED WOOD CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wood-faced cabinets of stock design.
2. Plastic-laminate-faced wood cabinets of stock design.
3. Plastic-laminate countertops.
4. Solid-surfacing-material countertops[, **including integral sinks**].
5. Stainless-steel countertops[, **including integral sinks**].
6. Wall shelving.
7. Polymer alloy cladding cabinets.
8. Stainless steel items incorporated into cabinets.

B. Related Sections:

1. Section 061000 "Rough Carpentry" for wood blocking for anchoring manufactured wood casework.
2. Section 064113 "Wood-Veneer-Faced Architectural Cabinets" for custom-fabricated wood cabinets.
3. Section 064116 "Plastic-Laminate-Faced Architectural Cabinets" for custom-fabricated plastic-laminate-faced cabinets.
4. Section 092216 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring manufactured wood casework.
5. Section 096513 "Resilient Base and Accessories" for resilient base applied to manufactured wood casework.
6. Section 123640 "Stone Countertops."

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. MDF: Medium-density fiberboard.

- B. Exposed Portions of Cabinets: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than **48 inches** (1220 mm) above floor, and surfaces visible in open cabinets.
- C. Semiexposed Portions of Cabinets: Surfaces behind opaque doors, such as interiors of cabinets, shelves, dividers, interiors and sides of drawers, and interior faces of doors. Tops of cases **78 inches** (1980 mm) or more above floor are defined as semiexposed.
- D. Concealed Portions of Cabinets: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, and ends and backs that are placed directly against walls or other cabinets.
- E. Hardwood Plywood: A panel product composed of layers or plies of veneer, or of veneers in combination with lumber core, hardboard core, MDF core, or particleboard core, joined with adhesive, and faced both front and back with hardwood veneers.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Submit manufacturer's product data for each product and process specified as work of this section and incorporated into items of architectural woodwork during fabrication, finishing, and installation.
 - 1. Include data substantiating that materials comply with requirements.
- B. Wood Treatment Data: Submit chemical treatment manufacturer's instructions for handling, storing, installation, and finish of treated material.
- C. Fire Retardant Treatment: Include certification by treating plant that treated materials comply with requirements.
- D. Quality Certification: Submit woodwork Manufacturer's (Fabricator's) certification, stating that fabricated woodwork complies with quality grades and other requirements indicated.
- E. Wall panel certificate: Submit certificate that wall panel backing adhesive and laminate comply with reference fire-resistance requirements.
- F. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Certificates for [**Credit MR 6**] [**Credit MR 7**]: Chain-of-custody certificates indicating that wood used to produce cabinets[**and countertops**] complies with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.

3. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that product contains no urea formaldehyde.
 4. Laboratory Test Reports for Credit IEQ 4: For **[adhesives] [and] [composite wood products]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- G. Shop Drawings: Include plans, elevations, sections, large-scale details, and attachments to other work. Show fabrication details, including types and locations of hardware. Show installation details, including field joints and filler panels. Indicate manufacturer's catalog numbers for casework.
1. Shop drawings shall be prepared as late as possible to meet the schedule. The drawings shall not be submitted for review until 242 days from the NTP.
- H. Samples for Initial Selection: For cabinet finishes and for each type of top material indicated.
- I. Samples for Verification: **8-by-10-inch** (200-by-250-mm) Samples for each type of finish, including top material and liner type[.] **[and the following:]**
1. Section of countertop showing top, front edge, and backsplash construction.
 2. One full-size finished base cabinet complete with hardware, doors, and drawers, but without countertop.
 3. One full-size finished wall cabinet complete with hardware, doors, and adjustable shelves.
 4. Maintain full-size Samples at Project site during construction in an undisturbed condition as a standard for judging the completed Work. Unless otherwise indicated, approved sample units may become part of the completed Work if in undisturbed condition at time of Substantial Completion. Notify DEN Project Manager of their exact locations.
- J. Exposed cabinet hardware, provide one (1) unit of each type and finish.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For qualified Installer.
 - B. Certificate from the fabricator providing proof of not less than five (5) years experience in the fabrication of the types of products specified.
 - C. Certificate from the installer providing proof of not less than five (5) years of successful experience in the installation of similar types of products and shall have completed at least three (3) jobs of similar size and scope.
 - D. Certificate from the manufacturer certifying that the polymer alloy cladding complies with the Denver Building Code for its intended use.

- E. Maintenance Data: Submit manufacturers care and maintenance data, including care and cleaning instructions.
- F. Warranty: Sample of special warranty.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish complete touchup kit for each type and finish of manufactured wood casework provided. Include scratch fillers, stains, finishes, and other materials necessary to perform permanent repairs to damaged casework finish.

1.7 MOCK-UP

- A. Fabricate one carcass for each type of cabinet required. DEN Project Manager is to review and approve carcass before remaining cabinet work can proceed. Contractor to pay for the expense of transporting the DEN Project Manager to carcass site and back.
- B. Complete fabrication of each carcass approved and deliver to job site for DEN Project Manager review. Once the mock-up for a type of cabinet is approved all remaining cabinets of that type may be fabricated. Approved cabinet mock-ups may be incorporated in the final work.
- C. Mock-up a minimum 200 sq. ft. of plastic-laminate-faced wall panel. Demonstrate panel removal to the DEN Project Manager.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- C. Source Limitations: Obtain manufactured wood casework from single source from single manufacturer.
- D. Quality Standard: Unless otherwise indicated, comply with requirements for modular cabinets in AWI's "Architectural Woodwork Quality Standards."
 - 1. Provide AWI Quality Certification Program [**labels**] [**certificate**] indicating that manufactured wood casework complies with requirements.
- E. Product Designations: Drawings indicate sizes, configurations, and finish material of manufactured wood casework by referencing designated manufacturer's catalog numbers. Other manufacturers' casework of similar sizes and door and drawer configurations, of same finish material, and complying with the Specifications may be considered. Refer to Section 016000 "Product Requirements."

- F. Coordination: Distribute copies of approved schedule for cabinet hardware specified in Section 087100, "Door Hardware" to manufacturer of architectural woodwork; coordinate cabinet shop drawings and fabrication with hardware requirements, including a cut sheet for all hardware items and typical fasteners.
- G. Distribute copies of casework shop drawings to stainless steel supplier and coordinate fabrication and installation.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soiling, and deterioration.
- B. Deliver manufactured wood casework only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified for installation areas and in "Project Conditions" Article.
- C. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.10 PROJECT CONDITIONS

- A. Conditioning: Woodwork Manufacturer and Installer shall advise Contractor of temperature and humidity requirements for woodwork installation and storage areas. Do not install woodwork until required temperature and relative humidity have been stabilized and will be maintained in installation areas.
- B. Maintain temperature and humidity in installation area as required to maintain moisture content of installed woodwork within a 1.0 percent tolerance of optimum moisture content, from date of installation through remainder of construction period. Require Woodwork Manufacturer to establish optimum moisture content and required temperature and humidity conditions.
- C. Environmental Limitations: Do not deliver or install manufactured wood casework until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- D. Environmental Limitations: Do not deliver or install manufactured wood casework until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between **60 and 90 deg F** (16 and 32 deg C) and relative humidity between **[25 and 55] [43 and 70] [17 and 50] <Insert humidity range>** percent during the remainder of the construction period.
- E. Field Measurements: Verify actual dimensions of construction contiguous with manufactured wood casework by field measurements before fabrication.

1.11 COORDINATION

- A. Coordinate layout and installation of framing and reinforcements in walls and partitions for support of manufactured wood casework.

1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of manufactured wood casework that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Delamination of components or other failures of glue bond.
 - b. Warping of components.
 - c. Failure of operating hardware.
 - d. Deterioration of finishes.
2. Warranty Period: Minimum **[five (5)]** <Insert number> years from date of Substantial Completion.

1.13 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Wood-Faced Manufactured Casework:
 - a. Architectural Cabinet Systems; a division of Windham Millwork, Inc.
 - b. CampbellRhea; a Sagas International company.
 - c. CIF Furniture Ltd.
 - d. Fisher Hamilton L.L.C.
 - e. Kewaunee Scientific Corporation.
 - f. Mid Canada Millwork Ltd.
 - g. R. C. Smith Company.
 - h. Terrill Manufacturing Company.
 - i. TMI Systems Design Corporation.
 - j. <Insert manufacturer's name>.
 - k. or approved equal.

2. Plastic-Laminate-Faced Manufactured Casework:
- a. Architectural Cabinet Systems; a division of Windham Millwork, Inc.
 - b. Cal-Dak Cabinets.
 - c. CampbellRhea; a Sagas International company.
 - d. Case Systems Inc.
 - e. CIF Furniture Ltd.
 - f. Diversified Fixture.
 - g. Fisher Hamilton L.L.C.
 - h. Goelst USA, LLC.
 - i. Hausmann Industries, Inc.
 - j. International Office Products Cooperative.
 - k. LSI Corporation of America; a Sagas International company.
 - l. Mid Canada Millwork Ltd.
 - m. R. C. Smith Company.
 - n. Sidney Millwork Company.
 - o. Stevens Industries, Inc.
 - p. Techline USA, LLC.
 - q. Terrill Manufacturing Company.
 - r. TMI Systems Design Corporation.
 - s. UCMI.
 - t. **<Insert manufacturer's name>**.
 - u. or approved equal.

2.2 MATERIALS, GENERAL

- A. Certified Wood: Fabricate cabinets[**and countertops**] from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- B. Low-Emitting Materials: Fabricate manufactured wood casework, including countertops, with adhesives and composite wood products containing no urea formaldehyde.
- C. Low-Emitting Materials: [**Adhesives**] [**and**] [**composite wood products**] shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.
- E. Hardwood Plywood: HPVA HP-1, either veneer core or particleboard core unless otherwise indicated.
- F. Softwood Plywood: DOC PS 1.
- G. Particleboard: ANSI A208.1, Grade M-2.

1. Recycled Content: Not less than **<Insert number>** percent preconsumer recycled content.
- H. Particleboard: Straw-based particleboard complying with ANSI A208.1, Grade M-2, except for density.
- I. MDF: ANSI A208.2, **[Grade 130] <Insert grade>**.
 1. Recycled Content: Not less than **<Insert number>** percent preconsumer recycled content.
- J. Hardboard: AHA A135.4, Class 1 Tempered.
 1. Recycled Content: Not less than **<Insert number>** percent preconsumer recycled content.
- K. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Abet Inc.
 - b. Arborite; a division of ITW Canada.
 - c. Formica Corporation.
 - d. Lamin-Art, Inc.
 - e. Nevamar Company, LLC; Decorative Products Div.
 - f. Panolam Industries International Incorporated.
 - g. Wilsonart International; Div. of Premark International, Inc.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.
- L. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
- M. Edgebanding for Plastic Laminate: **[Plastic laminate matching adjacent surfaces] [Rigid PVC extrusions, through color with satin finish, 3 mm thick at doors and drawer fronts, 1 mm thick elsewhere]**.
- N. Edgebanding for Wood-Veneered Construction: **[Minimum 1/8-inch- (3-mm-) thick, solid wood of same species as face veneer] [Wood veneer of same species as face veneer] [Rigid PVC extrusions, through color with satin finish, 3 mm thick at doors and drawer fronts, 1 mm thick elsewhere]**.
 1. Select wood edgebanding for grain and color compatible with face veneers.
- O. Edgebanding for Thermoset Decorative Panels: PVC or polyester edge banding complying with LMA EDG-1 and matching thermoset decorative panels.
- P. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, suitable for exposed applications.
- Q. Stainless-Steel Sheet: ASTM A 240 or ASTM A 666, Type 304, with No. 4 satin finish.

- R. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABA Industries.
 - b. Avonite Surfaces; Aristech Acrylics LLC.
 - c. E. I. du Pont de Nemours and Company.
 - d. Formica Corporation.
 - e. LG Solid Source, L.L.C.
 - f. Meganite Inc.; a division of The Pyrochem Group.
 - g. Nevamar Company, LLC; Decorative Products Div.
 - h. Samsung; Cheil Industries Inc.
 - i. Swan Corporation (The).
 - j. Transolid, Inc.
 - k. Wilsonart International; Div. of Premark International, Inc.
 - l. <Insert manufacturer's name>.
 - m. or approved equal.
 2. Type: Provide Standard type[**or Veneer type made from material complying with requirements for Standard type, as indicated**] unless Special Purpose type is indicated.
 3. Integral Sink Bowls: Comply with ISSFA-2 and ANSI Z124.3, Type 5 or Type 6, without a precoated finish.

2.3 CABINET MATERIALS

- A. Exposed Cabinet Materials:
1. Wood Species: [Red oak] [White birch] [Alder] [White maple] [Hickory] [Cherry] <Insert species>.
 2. Plywood: Hardwood plywood with face veneer of species indicated, selected for compatible color and grain. Grade A exposed faces at least **1/50 inch** (0.5 mm) thick, and Grade J crossbands. Provide backs of same species as faces.
 - a. Face Veneer Cut: [Plain sliced] [Quarter sliced] [Rift cut] [Rotary cut].
 3. Solid Wood: Clear hardwood lumber of species indicated[**and selected for grain and color compatible with exposed plywood**] [, **selected for compatible grain and color**].
 4. Plastic Laminate: [Grade HGS] [Grade HGL] [Grade VGS].
 5. Unless otherwise indicated, provide specified edgebanding on all exposed edges.
- B. Semiexposed Cabinet Materials:

1. Solid Wood: Sound hardwood lumber, selected to eliminate appearance defects, of **[any species similar in color and grain to] [same species as]** exposed wood.
2. Plywood: Hardwood plywood of **[any species similar in color and grain to] [same species as]** exposed wood. **[Grade B] [Grade C]** faces and Grade J crossbands. Provide backs of same species as faces.
3. Plastic Laminate: **[Grade VGS] [Grade CLS]**.
 - a. Provide plastic laminate for semiexposed surfaces unless otherwise indicated.
 - b. Provide plastic laminate for interior faces of doors and drawer fronts and where indicated.
4. Thermoset Decorative Panels: Provide thermoset decorative panels for semiexposed surfaces unless otherwise indicated.
5. Metal for Steel Drawer Pans: Cold-rolled, steel sheet.
6. Unless otherwise indicated, provide specified edgebanding on all semiexposed edges.

C. Concealed Cabinet Materials:

1. Solid Wood: Any hardwood or softwood species, with no defects affecting strength or utility.
2. Plywood: Hardwood plywood. Provide backs of same species as faces.
3. Plastic Laminate: Grade BKL.

2.4 DESIGN, COLOR, AND FINISH

A. Design: Provide manufactured wood casework of the following design:

1. Lipped overlay with radiused edges and **[wire] [semirecessed plastic]** pulls.
2. Reveal overlay with **[wire] [semirecessed plastic]** pulls.
3. Flush overlay with **[wire] [semirecessed plastic]** pulls.
4. Lipped overlay with radiused wood edges and full-width, recessed finger pulls machined into faces of doors and drawers.
5. Reveal overlay with recessed finger pulls machined into faces of doors and drawers.

B. Wood Colors and Finishes: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from casework manufacturer's full range]**.

C. Thermoset Decorative Panel Colors, Patterns, and Finishes: **[As indicated by manufacturer's designations] [As selected by DEN Project Manager from casework manufacturer's full range] [As selected by DEN Project Manager from thermoset decorative panel manufacturer's full range] [As selected by DEN Project Manager from thermoset decorative panel manufacturer's full range of solid colors] [As selected by DEN Project Manager from thermoset decorative panel manufacturer's full range of wood-grain patterns]**.

- D. Plastic-Laminate Colors, Patterns, and Finishes: **[As indicated by manufacturer's designations] [As selected by DEN Project Manager from casework manufacturer's full range] [As selected by DEN Project Manager from plastic-laminate manufacturer's full range] [As selected by DEN Project Manager from plastic-laminate manufacturer's full range of solid colors] [As selected by DEN Project Manager from plastic-laminate manufacturer's full range of wood-grain patterns].**
- E. Architectural Polymer Alloy Cladding: **[As indicated by manufacturer's designations] [As selected by DEN Project Manager from casework manufacturer's full range] [As selected by DEN Project Manager from plastic-laminate manufacturer's full range] [As selected by DEN Project Manager from plastic-laminate manufacturer's full range of solid colors] [As selected by DEN Project Manager from plastic-laminate manufacturer's full range of wood-grain patterns].**
- F. PVC Edgebanding Color: **[Casework manufacturer's standard] [As selected from casework manufacturer's full range] <Insert requirement>.**
- G. Solid-Surfacing Material Colors and Patterns: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range].**

2.5 FIRE RETARDANT MATERIALS

- A. Fire retardant treated lumber: All wall panels to be pressure impregnated with fire retardant chemicals, particle board with hardwood trim, unless otherwise noted, and comply with the following requirements:
 - 1. Fire Retardant Chemicals: Use chemicals of type and for applications indicated which do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated lumber.
 - a. Organic Resin Type: Organic resin solution, relatively insoluble in water, thermally set in wood by kiln drying.
 - 1) Available Products: Subject to compliance with requirements, provide one of the following:
 - a) "NCX"; Koppers Co., Inc.
 - b) or approved equal.
 - 2. Fire Performance Characteristics: Provide materials which are identical to those tested per ASTM methods and time periods indicated, are marked and listed for fire performance characteristics by Underwriters Laboratories, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction, and comply with the following requirements:
 - a. Mill lumber after treatment, within limits set for wood removal, which does

- not affect listed fire performance characteristics, using a woodworking plant certified by testing and inspecting agency.
- b. Mill lumber before treatment and institute special procedures during treatment and drying processes to prevent warping, discoloration from drying sticks or other causes, marring or other defects in appearance of treated woodwork.
 - c. At Contractor's option, mill treated lumber in either sequence indicated above.
 - d. Marking: Identify treated lumber with separable paper classification marking of inspecting and testing agency, unless otherwise indicated.
 - e. Kiln dry woodwork after treatment to levels required for non fire retardant treated woodwork materials. Maintain moisture content required by kiln drying, before, and after treatment.
 - f. Discard treated lumber that does not comply with requirements of referenced woodworking standard. Do not use twisted, warped, bowed, discolored, or otherwise damaged or defective lumber.
3. Fire-retardant particleboard: Provide panels with fire-retardant chemicals incorporated at time of manufacture to achieve surface-burning characteristics of 20 for flame spread and 25 for smoke developed when tested in accordance with ASTM E 84. Comply with ANSI A108.1 for Grade 1-M-1 panels with density of 45 lbs./cu. ft. for thicknesses of 3/4" and less and 44 lbs./cu. ft. for thicknesses of 13/16" to 1 1/4"; except as follows:
- a. Modulus of rupture and modulus of elasticity: 1600 psi and 350,000 psi, respectively, for 48 lb. density, 1300 psi, respectively, and 275,000 psi for 44 lb. density.
 - b. Linear expansion: 0.35% for 45 lb. density and 0.50% for 44 lb. density.
 - c. Screw-holding capacity, face and edge: 300 lbs. and 250 lbs., respectively, for 45 lb. density, and of 250 and 175 lbs., respectively, for 44 lb. density.

2.6 FABRICATION, GENERAL

- A. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber at time of fabrication and for relative humidity conditions in the installation areas.
- B. Fabricate woodwork to dimensions, profiles, and details indicated with openings and mortises precut, where possible, to receive hardware and other items and work.
- C. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- D. Pre Cut Openings: Fabricate architectural woodwork with precut openings, where possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately and use templates or roughing in diagrams

for proper size and shape. Smooth edges of cutoffs and, where located in countertops and similar exposures seal edges of cutouts with a water resistant coating.

- E. Measurements: Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain field measurements and verify dimensions and shop drawing details as required for accurate fit.

2.7 CABINET FABRICATION

- A. Wood-Faced Cabinet Construction:[**As required by referenced quality standard, but not less than the following:**]

1. Grade: Premium.
2. Bottoms of Cabinets and Tops of Wall Cabinets: **3/4-inch** (19-mm) [**veneer-core**] hardwood plywood.
3. Ends of Cabinets: **3/4-inch** (19-mm) hardwood plywood.
4. Shelves: **3/4-inch** (19-mm) veneer-core hardwood plywood.
5. Base Cabinet Top Frames: **3/4-by-2-inch** (19-by-51-mm) solid wood with mortise and tenon or doweled connections, glued and pinned or screwed.
6. Base Cabinet Stretchers: **3/4-by-4-1/2-inch** (19-by-114-mm) plywood, particleboard, or MDF strips or solid-wood boards at front and back of cabinet, glued and pinned or screwed.[**May be provided as an option to base cabinet top frames.**]
7. Base Cabinet Subtops: **3/4-inch** (19-mm) panel product glued and pinned or screwed.[**May be provided as an option to base cabinet top frames.**]
8. Backs of Cabinets: **3/4-inch** (19-mm) particleboard-core hardwood plywood where exposed, [**1/4-inch** (6.4-mm) **hardboard**] [**1/4-inch** (6.4-mm) **veneer-core hardwood plywood**] [**1/2-inch** (12.7-mm) **hardwood plywood**] dadoed into sides, bottoms, and tops where not exposed.
9. Drawer Fronts: **3/4-inch** (19-mm) particleboard-core hardwood plywood or solid hardwood.
10. Drawer Sides and Backs: **1/2-inch** (12.7-mm) solid-wood or [**veneer-core**] hardwood plywood, with glued dovetail or multiple-dowel joints.
11. Drawer Bottoms: **1/4-inch** (6.4-mm) veneer-core hardwood plywood glued and dadoed into front, back, and sides of drawers.[**Use 1/2-inch** (12.7-mm) **material for drawers more than 24 inches** (600 mm) **wide.**]
12. Drawer Bodies: Steel drawer pans formed from **0.0359-inch-** (0.9-mm-) thick metal, metallic phosphate treated, and finished with manufacturer's standard 2-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat with a minimum dry film thickness of **1 mil** (0.025 mm) for topcoat and **2 mils** (0.05 mm) for system.
13. Doors **48 Inches** (1220 mm) or Less in Height: **3/4 inch** (19 mm) thick, with[**solid hardwood stiles and rails,**] particleboard or MDF cores, and hardwood face veneers and crossbands.
14. Doors More Than **48 Inches** (1220 mm) in Height: **1-1/16 inches** (27 mm) thick, with solid hardwood stiles and rails, honeycomb cores, and hardwood face veneers and crossbands.
15. Doors More Than **48 Inches** (1220 mm) in Height: **1-1/8 inches** (29 mm) thick, with particleboard cores and hardwood face veneers and crossbands.

- B. Plastic-Laminate-Faced Cabinet Construction:[**As required by referenced quality standard, but not less than the following:**]
1. Grade: Premium.
 2. Laminate Grade for Exposed Surfaces:
 - a. HGS (.050" nominal thickness).
 3. Laminate Grade For Semi-Exposed Surfaces:
 - a. HGL (.039" nominal thickness).
 4. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: **3/4-inch** (19-mm) plywood not fire-retardant treated, complying with referenced standards, plastic-laminate faced[**on exposed surfaces, thermoset decorative panels on semiexposed surfaces**].
 5. Shelves: **3/4-inch** (19-mm) plywood, plastic-laminate faced.
 6. Backs of Cabinets: **1/2-inch** (12.7-mm) plywood not fire-retardant treated, complying with referenced standards, plastic-laminate faced[**on exposed surfaces, thermoset decorative panels on semiexposed surfaces**].
 7. Drawer Fronts: **3/4-inch** (19-mm) plywood not fire-retardant treated, complying with referenced standards, plastic-laminate faced.
 8. Drawer Sides and Backs: **1/2-inch** (12.7-mm) [**solid-wood or veneer-core hardwood plywood**] [**thermoset decorative panels**], with glued dovetail or multiple-dowel joints.
 9. Drawer Bottoms: **1/4-inch** (6.4-mm) [**hardwood plywood**] [**thermoset decorative panels**] glued and dadoed into front, back, and sides of drawers.[**Use 1/2-inch** (12.7-mm) **material for drawers more than 24 inches** (600 mm) **wide.**]
 10. Doors: **3/4-inch** (19-mm) particleboard or MDF[**with wood stiles and rails**], plastic-laminate faced.
 11. Provide dust panels of 1/4" plywood or tempered hardboard above compartments and drawers except where located directly under tops.
- C. Leg Shoes: Vinyl or rubber, black, open-bottom type.
- D. Filler Strips: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.

2.8 FINISH FOR WOOD-FACED MANUFACTURED CASEWORK

- A. Preparation: Sand lumber and plywood for manufactured wood casework construction before assembling. Sand edges of doors and drawer fronts and molded shapes with profile-edge sander. Sand casework after assembling for uniform smoothness at least equivalent to that produced by 220-grit sanding and without machine marks, cross sanding, or other surface blemishes.

- B. Staining: Remove fibers and dust and apply wash-coat sealer and stain to exposed and semiexposed surfaces as required to provide uniform color and to match approved samples.
- C. Finishing Closed-Grain Woods: Apply manufacturer's standard two-coat, baked, clear finish consisting of a thermosetting catalyzed sealer and a thermosetting catalyzed conversion varnish. Sand and wipe clean between applications of sealer and topcoat. Topcoat may be omitted on concealed surfaces.
- D. Finishing Open-Grain Woods: Apply manufacturer's standard three-coat, baked, clear finish consisting of a thermosetting catalyzed sealer and two coats of a thermosetting catalyzed conversion varnish. Sand and wipe clean between applications of sealer and topcoat and between topcoats. Topcoats may be omitted on concealed surfaces.

2.9 CASEWORK HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items that are specified in Section 087100, "Door Hardware".
- B. Cabinet Hardware Schedule: Refer to schedule at end of this Section for cabinet hardware required for architectural cabinets.
- C. Hardware Standard: Comply with ANSI/BHMA A156.9 "American National Standard for Cabinet Hardware" for items indicated by reference to BHMA numbers or referenced to this standard.
- D. Hardware Finishes: Comply with BHMA 1301 for finishes indicated by BHMA Code Numbers or if not otherwise indicated, provide finishes complying with requirements indicated below:
 - 1. For exposed hardware comply with requirements indicated for finish and base indicated by BHMA Code Number below:
 - a. 630 (Satin stainless steel).
 - 2. For concealed hardware provide manufacturer's standard finish which complies with product class requirements of ANSI/BHMA A156.9.
- E. Clear Tempered Float Glass for Doors: FS DD G 1403, grade B, style I, type I, quality q3, class 1; manufactured by horizontal (roller hearth) process; 1/4" thick, unless otherwise indicated.
- F. Hardware, General: Unless otherwise indicated, provide manufacturer's standard [**satin-finish**], commercial-quality, heavy-duty hardware.
 - 1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.

- G. Butt Hinges: **[Stainless-steel]** , semiconcealed, 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide 2 hinges for doors less than **48 inches** (1220 mm) high and 3 hinges for doors more than **48 inches** (1220 mm) high.
- H. Frameless Concealed Hinges (European Type): BHMA A156.9, Type B01602, **[100]** **[135]** **[170]** degrees of opening[, **self-closing**].
- I. Pulls: Solid **[stainless-steel]** wire pulls, fastened from back with two screws. For sliding doors, provide recessed **[stainless-steel]** flush pulls. Provide 2 pulls for drawers more than **24 inches** (600 mm) wide.
- J. Drawer Slides: BHMA A156.9, Type B05091.
1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; **[full]** **[full-overtravel]**-extension type; zinc-plated, steel ball-bearing slides.
 2. Box Drawer Slides: **[Grade 1HD-100]**, for drawers not more than **6 inches** (150 mm) high and **24 inches** (600 mm) wide.
 3. File Drawer Slides: **[Grade 1HD-100]** **[Grade 1HD-200]**, for drawers more than **6 inches** (150 mm) high or **24 inches** (600 mm) wide.
 4. Pencil Drawer Slides: **[Grade 2]** **[Grade 1]**, for drawers not more than **3 inches** (75 mm) high and **24 inches** (600 mm) wide.
 5. Keyboard Slides: **[Grade 1HD-100]**, for computer keyboard shelves.
 6. Trash Bin Slides: **[Grade 1HD-100]** **[Grade 1HD-200]**, for trash bins not more than **20 inches** (500 mm) high and **16 inches** (400 mm) wide.
- K. Label Holders: **[Stainless steel]** , sized to receive standard label cards approximately **1 by 2 inches** (25 by 51 mm), attached with screws or brads.
1. Provide label holders **[where indicated]** **[on all drawers]**.
- L. Drawer and Hinged Door Locks: **[Cylindrical (cam)]** **[Mortise]** type, 5-pin tumbler, brass with chrome-plated finish, and complying with BHMA A156.11, Grade 1.
1. Provide a minimum of two keys per lock and six master keys.
 2. Provide locks **[where indicated]** **[on all doors and drawers]**.
- M. Sliding-Door Hardware Sets: Manufacturer's standard, to suit type and size of sliding-door units.
- N. Adjustable Shelf Supports: **[2-pin locking plastic shelf rests complying with BHMA A156.9, Type B04013]** **[Single-pin metal shelf rests complying with BHMA A156.9, Type B04013]**.
- O. Adjustable Shelf Supports: Mortise-type, **[zinc-plated]** **[powder-coated]** steel standards and shelf rests complying with BHMA A156.9, Types B04071 and B04091.
- P. Grommets for Cable Passage through Countertops: **[1-1/4-inch (32-mm)]** **[2-inch (51-mm)]** **<Insert size>** OD, **[brown]** **[black]** **<Insert color>**, molded-plastic grommets and matching plastic caps with slot for wire passage.

- Q. Paper Slots: [12 inches (305 mm)] [17 inches (432 mm)] long by 1-3/4 inches (45 mm) wide by 1 inch (25 mm) deep; [brown] [black] <Insert color>, molded-plastic, paper-slot liner with 1/4-inch (6.4-mm) lip.

2.10 COUNTERTOPS

- A. Countertops, General: Provide smooth, clean exposed tops and edges in uniform plane free of defects. Provide front and end overhang of 1 inch (25 mm) over base cabinets.
- B. Grade: Premium.
- C. Plastic-Laminate Tops: Plastic-laminate sheet, shop bonded to both sides of [3/4-inch (19-mm)] [1-1/8-inch (29-mm)] plywood . Sand surfaces to which plastic laminate is to be bonded.
1. Plastic Laminate for Flat Tops: [Grade HGS] .
 2. Plastic Laminate for Formed Tops: Grade HGP.
 3. Plastic Laminate for Backing: Grade BKL.
 4. Provide [plastic-laminate edgings of the same material as top] [2-mm PVC edging] [3-mm PVC edging] on front edge of top, on top edges of backsplashes and end splashes, and on ends of tops and splashes.
 5. Construct top and backsplash from one piece of plastic laminate with rolled edges and coved intersection. Where indicated, provide separate end splashes fitted to top.
 6. Use exterior plywood for countertops containing sinks.
- D. Solid-Surfacing-Material Tops: [1/2-inch- (12.7-mm-)] [3/4-inch- (19-mm-)] thick, solid-surfacing material[with front edge built up with same material].
1. Front: [Straight, slightly eased at top] [Bevel] [3/4-inch (19-mm) bullnose] [Radius edge with apron, 2 inches (51 mm) high with 3/8-inch (9.5-mm) radius] [1-1/2-inch (38-mm) laminated bullnose] [1-inch (25-mm) laminated bullnose].
 2. Backsplashes: [1/2-inch- (12.7-mm-)] [3/4-inch- (19-mm-)] thick, solid-surfacing material; [slightly eased at edge] [beveled edge] [radiused edge with 3/8-inch (9.5-mm) radius].
- E. Solid-Surfacing-Material Tops: 1/4-inch- (6.4-mm-) thick, solid-surfacing material laminated to 3/4-inch- (19-mm-) thick particleboard with front edge built up with 3/4-inch- (19-mm-) thick, solid-surfacing material.
1. Front: [Radius edge with apron, 2 inches (51 mm) high with 3/8-inch (9.5-mm) radius] [1-inch (25-mm) laminated bullnose].
 2. Backsplashes: [1/2-inch- (12.7-mm-)] [3/4-inch- (19-mm-)] thick, solid-surfacing material; [slightly eased at edge] [beveled edge] [radiused edge with 3/8-inch (9.5-mm) radius].
- F. Stainless-Steel Tops: Made from 0.0625-inch- (1.6-mm-) thick, stainless-steel sheet.

1. Weld shop-made joints, and grind and polish surfaces to produce uniform, directional, textured, polished finish indicated, free of cross scratches. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
2. Sound deaden undersurface with heavy-build mastic coating.
3. Extend top down to provide a **1-inch-** (25-mm-) thick edge with a **1/2-inch** (12.7-mm) return flange.
4. Form backsplash coved to and integral with top surface, with a **1/2-inch-** (12.7-mm) thick edge and **1/2-inch** (12.7-mm) return flange.
5. Provide raised marine edge around perimeter of tops containing sinks; pitch two ways to sink to provide drainage without channeling or grooving.
6. Where stainless-steel sinks occur in stainless-steel tops, factory weld into one integral unit, grind welds smooth, and polish, passivate, and rinse.
7. Fabricate stainless-steel sinks with corners rounded and coved to at least a **5/8-inch** (16-mm) radius. Slope sink bottoms to outlet. Provide double-wall construction for sink partitions with top edge rounded to at least a **1/2-inch** (12.7-mm) diameter.

2.11 WALL SHELVING

- A. Plastic-Laminate Shelving: Plastic-laminate sheet, Grade HGL or HGP, shop bonded to both sides of plywood. Sand surfaces to which plastic laminate is to be bonded.
1. Shelf Thickness: [**5/8 inch** (16 mm)] [**3/4 inch** (19 mm)] [**1 inch** (25 mm)] [**As indicated**].
 2. Edge Treatment: Finish both edges with [**plastic laminate that matches faces**] [**rigid PVC T-molding, through color with satin finish**] [**rigid PVC extrusion, through color with satin finish, 3 mm thick**] [**minimum 1/8-inch-** (3-mm-) **thick, solid-wood edging applied before plastic laminate**].
- B. Adjustable Shelf Supports: [**Zinc-plated**] [**Powder-coated**] steel standards and shelf brackets, complying with BHMA A156.9, Types B04102 and B04112, surface mounted.

2.12 ARCHITECTURAL POLYMER ALLOY CLADDING

- A. Thickness: As indicated on drawings.
- B. Impact Resistance: No fracture per NEMA LD3-3.03, 1/2 lb. ball.
- C. Hardness: 52-56, Barcol Impressor.
- D. Tensile Strength: 3900 psi, per ASTM D-638.
- E. Tensile Modulus: 1.0 x 10(6) psi per ASTM D-638.
- F. High temperature, boiling water and conductive heat resistance: No change per NEMA LD3-3.06, LD3-3.05 and LD3-3.08 respectively.

- G. Abrasion resistance: .08g/100 cycles per CS 221-66.
- H. Cigarette resistance: No lasting effect, NEMA LD3-3.07.
- I. Color stability: No change per NEMA LD3-3.10.
- J. Weight: 4.4 lbs./SF for a 1/2" thickness.
- K. Stain and chemical resistance: No lasting effect when exposed to acetone, Ethanol, gasoline, Methanol, 99.5% Acetic acid, 37% hydrochloric acid, 85% Phosphoric acid, 77% sulphuric acid, 1% ammonia, 1% lye, nail polish remover, coffee and ammonium Hydroxide.
- L. Surface burning characteristics:
 - 1. Flame spread: 10.
 - 2. Smoke developed: 95-175.
- M. Finish: Matte, as obtained by light sanding with 320-350 grid sandpaper, glass level 5-18.
- N. Sealants and adhesives:
 - 1. Color-matched seam adhesive for joint seams. Match bowl color for seaming to sink bowls.
 - 2. Sealants to match polymer alloy in color, to be silicone and to comply with requirements of Section 079200, "Joint Sealants".

2.13 STAINLESS STEEL

- A. Bar Stock: ASTM A 276, Type 302 or 304.
- B. Plate: ASTM A 167, Type 302 or 304.
- C. Stainless steel finish: AISI number 4, brushed, directional with grain oriented along the length of the material or vertical on planar surfaces or as denoted by the DEN Project Manager.
- D. Gauge: As noted on drawings.
- E. Fasteners: Stainless steel, conceal to greatest extent possible.
- F. Hinges: Stainless steel, concealed from view.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of manufactured wood casework.
- B. Condition woodwork to average prevailing humidity conditions in installation areas prior to installing.
- C. Prior to installation of architectural woodwork, examine shop fabricated work for completion, and complete work as required, including back priming and removal of packing
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CASEWORK INSTALLATION

- A. Install level, plumb, and true; shim as required, using concealed shims. Where manufactured wood casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- B. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.
- C. Pressure Treated Wood: Handle, store, and install pressure treated wood in compliance with recommendations of chemical treatment manufacturer including those for adhesives, where required for installation.
- D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fasteners heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork.
- E. Cabinets, General: Install without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated. Maintain veneer sequence matching (if any) of cabinets with transparent finish.
- F. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within **1/16 inch** (1.5 mm) of a single plane. Fasten cabinets to masonry or framing, wood blocking, or reinforcements in walls and partitions with fasteners spaced **24 inches** (600 mm) o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of **1/16 inch** (1.5 mm).

1. Where base cabinets are not installed adjacent to walls, fasten to floor at toe space with fasteners spaced [16 inches (400 mm)] [24 inches (600 mm)] o.c. Secure sides of cabinets to floor, where they do not adjoin other cabinets, with not less than two fasteners.
- G. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch (1.5 mm) of a single plane. Fasten to hanging strips, masonry, or framing, blocking, or reinforcements in walls or partitions. Align similar adjoining doors to a tolerance of 1/16 inch (1.5 mm).
1. Fasten through back, near top and bottom, at ends, and not more than [16 inches (400 mm)] <Insert spacing> o.c.
 2. Use toggle bolts at hollow masonry.
 3. Use expansion anchors at solid masonry.
 4. Use No. 10 wafer-head screws sized for 1-inch (25-mm) penetration at wood hanging strips.
 5. Use No. 10 wafer-head screws sized for 1-inch (25-mm) penetration into wood framing or blocking at wood-framed partitions.
 6. Use [No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish] [toggle bolts through metal backing or metal framing behind wall finish] at metal-framed partitions.
 7. Use toggle bolts at plaster on metal lath.
- H. Paneling: Anchor paneling to supporting substrate with concealed panel hanger clips.
- I. Polymer alloy cladding: Comply with all manufacturer's recommendations for installation. All edges to be eased unless otherwise noted on drawings. Provide materials of thickness and profile shown. Provide blocking and bracing and ancillary support. Fabricate baby changing counter with an integral covered backsplash at factory. Tightly seam any joints. Factory fabricate to greatest extent possible. Joints shall be inconspicuous and flush. Provide factory cutouts for in-alloy devices. Reject defective work. Cut and finish edges with clean sharp returns.
- J. Installing Stainless Steel Items:
1. Coordinate work with work by other trades.
 2. Comply with the intent of details.
 3. External corners: Ease 1/32" unless otherwise noted.
- K. Anchor all items securely. Adhere stainless steel to plywood where indicated per Manufacturer's recommendations.
- L. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.
- M. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.3 INSTALLATION OF TOPS

- A. Field Jointing: Where possible make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within **6 inches** (150 mm) of front and back edges and at intervals not exceeding **24 inches** (600 mm). Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.
- B. Secure tops to cabinets with Z- or L-type fasteners or equivalent, using two or more fasteners at each front, end, and back.
- C. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.
- D. Secure **[backsplashes] [and] [end splashes]** to **[tops with concealed metal brackets at 16 inches** (400 mm) **o.c.] [and] [walls with adhesive]**.
- E. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.4 INSTALLATION OF SHELVING

- A. Securely fasten shelf standards to masonry, partition framing, wood blocking, or reinforcements in partitions.
1. Fasten shelf standards at ends and not more than **[12 inches** (300 mm)] **<Insert spacing>** o.c.
 2. Use toggle bolts at hollow masonry.
 3. Use expansion anchors at solid masonry.
 4. Use **[self-tapping sheet metal screws] [toggle bolts]** in metal framing or metal backing at metal-framed partitions. Do not use wall anchors in gypsum board.
 5. Use wood screws sized for **1-inch** (25-mm) penetration into wood framing or blocking at wood-framed partitions.
 6. Use toggle bolts at plaster on metal lath.
- B. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Space standards not more than **[30 inches** (750 mm)] **[36 inches** (900 mm)] **[42 inches** (1050 mm)] **[48 inches** (1200 mm)] **<Insert spacing>** o.c.
- C. Install shelving level and straight, closely fitted to other work where indicated.

3.5 CLEANING AND PROTECTING

- A. Repair damaged and defective woodwork where possible to eliminate defects

functionally and visually; where not possible to repair replace woodwork. Adjust joinery for uniform appearance.

- B. Complete the finishing work specified as work of this section, to whatever extent not completed at shop or prior to installation of woodwork.
 - 1. Provide final protection and maintain conditions, in a manner acceptable to Fabricator and Installer, which ensures architectural woodwork being without damage or deterioration at time of substantial completion.
- C. Clean, lubricate and adjust hardware.
- D. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by DEN Project Manager.
- E. Protection: Provide 6-mil (0.15-mm) plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48 inches (1220 mm) o.c. Remove protection at Substantial Completion.

3.6 HARDWARE SCHEDULE

- A. CH-1 Standard Box Drainer Slides: 100 pound/pair load rating with steel ball bearings, self-closing.
 - 1. Complying Example: Accuride Model No. 3005.
- B. Door Pivot/Slide : Vertical: Pivot/Slide device suitable for vertical installation, for door thickness shown and for weights of doors as required. Provide manufacturer's standard or recommended "European" concealed hinges for a complete installation.
 - 1. Complying Example: Accuride Model No. 1332.
- C. Door Pivot/Slide : Horizontal: Pivot/Slide device suitable for horizontal installation, for door thickness shown and for weights of doors as required. For doors wider than 42" and/or weighing more than 20 lbs. provide a centered third slide. Provide manufacturer's standard or recommended "European" concealed hinges for a complete installation.
 - 1. Complying Example: Accuride Model No. 115.
- D. CH-4 Standard Cabinet Hinges for Plastic-Laminate Clad Cabinets: Self closing concealed casework hinges, minimum 110 degree opening, built-in 3 dimensional adjustment. Provide complete "European" style nickel-plated steel half-overlay hinges at intermediate supports, and full-overlay hinges at ends of casework, sized to result in a 1/4" reveal or gap, unless otherwise shown. Provide 2 hinges for doors up to 30" in height or 20 pounds in weight; 3 hinges for doors 30" to 60" in height or 20-40 pounds in weight; and 4 hinges for doors 60" to 84" in height or 40-60 pounds in weight, whichever is greater.
 - 1. Complying Example: Blum Model 90

- a. Full Overlay = #91M350
 - b. Half Overlay = #91M360
- E. CH-5 Cabinet Locks: Refer to Section 08710, for lock to be supplied, this Contractor to coordinate and install lock.
- 1. Complying Example: Best 5E7-Series
- F. CH-6 Flush Mount Interlocking Cleats: .062 cold rolled steel, 1-1/2" x 1-3/4" 2 piece interlocking hanger. System consisting of 2 identical pieces with a slightly raise tongue.
- 1. Complying Example: #418 Flush Mount
- G. CH-7 Standard Magnetic Catches: Heavy duty catch, pull strength of 7 pounds (+1/2 pound) base size 1-15/16 x 27/31 with a brushed aluminum finish. Provide manufacturers standard matching strike plate with each catch.
- 1. Complying Example: Stanley Model No. SP46.
- H. CH-8 Bumper/Stop: Black rubber bumper and metal fastener.
- 1. Complying Example: Stanley Hardware No. 2891.
- I. CH-9 Adjustable Shelving Support for Cabinets: 5/8" x 3/16" slotted steel standard with mounting brackets gained in flush.
- 1. Complying Example: Knape and Vogt. 255 standards with No. 256 brackets.
- J. C-10 Closet Rods: 1-1/2" diameter stainless steel, #4 finish, unless otherwise indicated.
- K. C-11 Ventilation Screen: 18 x 16 or 18 x 14 mesh of plastic-coated glass fiber threads, woven and fused to form fabric mesh resistant to corrosion, shrinkage, stretch, impact damage and weather deterioration, in black color.
- L. C-12 Undercarriage Mount Shelf Slide: Full travel shelf slide. Use 3 slides per shelf, minimum 130# capacity @ 25" extension. Maximum slide height = 1-3/4".
- 1. Complying Example: Accuride Model #C301-1590-24.
- M. C-13 Recessed Cabinet Pulls: Recessed drawer and door pulls, flush mortise mounted. Normal dimensions exposed to view - 4" long x 1" high. Black anodized finish.
- 1. Complying Example: EPCO Co. Model #DP-414.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 123200

SECTION 123619 - WOOD COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Wood countertops.
 - 2. Shop finishing of wood countertops.
- B. Related Requirements:
 - 1. Section 123200 "Manufactured Wood Casework".
 - 2. Section 123623.13 "Plastic-Laminate-Clad Countertops."
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product[, **including**] [**panel products**] [**fire-retardant-treated materials**] [**and**] [**finishing materials and processes**].
 - 1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
 - 2. Include data substantiating that materials comply with requirements.
- B. Wood Treatment Data: Submit chemical treatment manufacturer's instructions for handling, storing, installation, and finish of treated material.
- C. Quality Certification: Submit woodwork Manufacturer's (Fabricator's) certification, stating that fabricated woodwork complies with quality grades and other requirements indicated.
- D. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and

- preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
 3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured[**and regionally extracted and manufactured**] materials. Include statement indicating cost for each regionally manufactured material.
 - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
 - b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
 4. Certificates for [**Credit MR 6**] [**Credit MR 7**]: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.
 5. Product Data for Credit IEQ 4.1: For installation adhesives, including printed statement of VOC content.
 6. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 7. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that products contain no urea formaldehyde.
 8. Laboratory Test Reports for Credit IEQ 4.4: For composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
1. Show locations and sizes of cutouts and holes for [**plumbing fixtures**] [**faucets**] [**soap dispensers**] [**electrical switches and outlets**] [**and other items**] installed in wood countertops.
 2. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
 3. Apply AWI Quality Certification Program label to Shop Drawings.

- F. Samples for Initial Selection: For shop-applied transparent finishes.
- G. Samples for Verification:
 - 1. Lumber for transparent finish, not less than **[5 inches (125 mm) wide by 12 inches (300 mm) long] [5 inches (125 mm) wide by 24 inches (600 mm) long]**, for each species and cut, finished on one side and one edge.
 - 2. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[Installer] [fabricator]**.
- B. Certificate from the fabricator providing proof of not less than five (5) years experience in the fabrication of the types of products specified.
- C. Certificate from the installer providing proof of not less than five (5) years of successful experience in the installation of similar types of products and shall have completed at least three (3) jobs of similar size and scope.
- D. Product Certificates: For **[each type of product.] [the following:]**
 - 1. Composite wood and agrifiber products.
 - 2. Adhesives.
- E. Woodwork Quality Standard Compliance Certificates: **[AWI Quality Certification Program certificates] [WI Certified Compliance Program certificates]**.
- F. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Submit manufacturers' care and maintenance data, including care and cleaning instructions.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. **[Shop is a certified participant in AWI's Quality Certification Program.][Shop is a licensee of WI's Certified Compliance Program.]**

- B. Installer Qualifications: [**Fabricator of products**] [**Certified participant in AWI's Quality Certification Program**] [**Licensee of WI's Certified Compliance Program**].
- C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
- D. Mockup: Build mockup to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
 - 1. Build mockup of typical countertop as shown on Drawings. Fabricate one carcass for each type of wood countertop required. DEN Project Manager is to review and approve mockup before remaining cabinet work can proceed. Contractor to pay for the expense of transporting the DEN Project Manager to site and back.
 - 2. Complete fabrication of each countertop approved and deliver to job site for DEN Project Manager review. Once the mockup for a type of countertop is approved all remaining countertops of that type may be fabricated.
 - 3. Subject to compliance with requirements, approved mockup may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soiling and deterioration.
- B. Do not deliver wood countertops until painting and similar operations that could damage wood countertops have been completed in installation areas. If wood countertops must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

- A. Conditioning: Woodwork Manufacturer and Installer shall advise Contractor of temperature and humidity requirements for woodwork installation and storage areas. Do not install woodwork until required temperature and relative humidity have been stabilized and will be maintained in installation areas.
- B. Maintain temperature and humidity in installation area as required to maintain moisture content of installed woodwork within a 1.0 percent tolerance of optimum moisture content, from date of installation through remainder of construction period. Require Woodwork Manufacturer to establish optimum moisture content and required temperature and humidity conditions.
- C. Environmental Limitations: Do not deliver or install wood countertops until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

- D. Environmental Limitations: Do not deliver or install wood countertops until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between **60 and 90 deg F** (16 and 32 deg C) and relative humidity between **[25 and 55] [43 and 70] [17 and 50] <Insert humidity range>** percent during the remainder of the construction period.
- E. Field Measurements: Where wood countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- F. Established Dimensions: Where wood countertops are indicated to fit to other construction, establish dimensions for areas where wood countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of wood countertops that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Delamination of components or other failures of glue bond.
 - b. Warping of components.
 - c. Deterioration of finishes.
 - 2. Warranty Period: Minimum **[five (5)] <Insert number>** years from date of Substantial Completion.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 WOODWORK FABRICATORS

- A. Fabricators: Subject to compliance with requirements, provide products by one of the following:
 - 1. **<Insert, in separate subparagraphs, names and possibly contact information for preapproved woodworking firms>**.
 - 2. or approved equal.

2.2 WOOD COUNTERTOPS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades indicated for construction, finishes, installation, and other requirements.
1. Provide **[labels] [and] [certificates]** from **[AWI]** certification program indicating that woodwork[, **including installation,**] complies with requirements of grades specified.
 2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.
- B. Grade: **[Premium] [Custom]**.
- C. Regional Materials: Wood countertops shall be manufactured within **500 miles** (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** (800 km) of Project site.
- D. Regional Materials: Wood countertops shall be manufactured within **500 miles** (800 km) of Project site.
- E. Certified Wood: Wood countertops shall be produced from wood certified as "FSC Pure"[**or "FSC Mixed Credit"**] according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- F. Type of Top: Solid wide width for transparent finish. Solid wood, edge glued, with crown direction reversed in adjacent boards, to produce widths indicated. Select boards for similarity of color and grain and arrange boards for optimum match between adjacent boards.
1. Wood Species and Cut:**[As indicated.]**
 - a. Species: **[Red oak] [White oak] [White ash] [White birch] <Insert species>**.
 - b. Cut: **[Plain sawn] [Rift sawn] [Quarter sawn]**.
- G. Type of Top: Solid butcher block for transparent finish. Narrow strips of lumber glued together. Arrange strips for random mix of color and grain.
1. Wood Species: **[Red oak] [Hard maple] [Teak] [As indicated] <Insert species>**.
 2. Strip Thickness: **[3/4 inch (19 mm)] [1-1/2 inches (38 mm)] [As indicated]**.
- H. Type of Top: Panel product for transparent finish (wood veneer laminated over core) as follows:
1. Wood Species and Cut:**[As indicated.]**

- a. Species: **[Red oak] [White oak] [White ash] [White birch] <Insert species>**.
 - b. Cut: **[Plain sliced] [Rift cut] [Quarter cut]**.
2. Matching of Adjacent Veneer Leaves: **[Book] [slip] [random] [and] [end] match**.
 3. Veneer Matching within Panel Face: **[Running] [Balance] [Center-balance] match**.
 4. Edge Treatment: **[Solid wood matching face for species and cut] [Wood veneer matching face for species and cut] [As indicated]**.
 5. Core Material: **[Exterior-grade plywood]**.

2.3 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than **3 inches** (75 mm) wide.
 2. Wood Moisture Content: **[5 to 10] [8 to 13] [4 to 9]** percent.
 3. Softwood Plywood: DOC PS 1.

2.4 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
1. Use treated materials that comply with requirements of referenced woodworking standard. Do not use materials that are warped, discolored, or otherwise defective.
 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 feet** (3.2 m) beyond the centerline of the burners at any time during the test.
1. Kiln dry lumber and plywood after treatment to a maximum moisture content of

- 19 and 15 percent, respectively.
 2. For items indicated to receive a stained or natural finish, use organic resin chemical formulation.
 3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
 4. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
- C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.
1. For panels **3/4 inch** (19 mm) thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, **1600 psi** (11 MPa); modulus of elasticity, **300,000 psi** (2070 MPa); internal bond, **80 psi** (550 kPa); and screw-holding capacity on face and edge, **250 and 225 lbf** (1100 and 1000 N), respectively.
 2. For panels **13/16 to 1-1/4 inches** (20 to 32 mm) thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, **1300 psi** (9 MPa); modulus of elasticity, **250,000 psi** (1720 MPa); linear expansion, 0.50 percent; and screw-holding capacity on face and edge, **250 and 175 lbf** (1100 and 780 N), respectively.
 3. Products: Subject to compliance with requirements, provide one of the followin:
 - a. Flakeboard Company Limited; Duraflake FR.
 - b. SierraPine; Encore FR.
 - c. **<Insert manufacturer's name; product name or designation>**.

2.5 ACCESSORIES

- A. Grommets for Cable Passage through Countertops: [**1-1/4-inch** (32-mm)] [**2-inch** (51-mm)] **<Insert dimension>** OD, [**brown**] [**black**] **<Insert color>**, molded-plastic grommets and matching plastic caps with slot for wire passage.
1. Product: Subject to compliance with requirements, provide "[**OG**] [**SG**] series" by Doug Mockett & Company, Inc.
- B. Paper Slots: [**12 inches** (305 mm)] [**17 inches** (432 mm)] long by **1-3/4 inches** (45 mm) wide by **1 inch** (25 mm) deep; [**brown**] [**black**] **<Insert color>**, molded-plastic, paper-slot liner with **1/4-inch** (6.4-mm) lip.

2.6 MISCELLANEOUS MATERIALS

- A. Adhesives: Do not use adhesives that contain urea formaldehyde.

- B. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. VOC Limits for Installation Adhesives and Sealants: Use products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Wood Glues: 30 g/L.
 - 2. Multipurpose Construction Adhesives: 70 g/L.
 - 3. Structural Wood Member Adhesive: 140 g/L.
 - 4. Architectural Sealants: 250 g/L.

2.7 FABRICATION

- A. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber at time of fabrication and for relative humidity conditions in the installation areas.
- B. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- C. Measurements: Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain field measurements and verify dimensions and shop drawing details as required for accurate fit.
- D. Fabricate wood countertops to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 - 1. Solid-Wood (Lumber) Members: **1/16 inch** (1.5 mm) unless otherwise indicated.
 - 2. Edges of Members More Than **3/4 Inch** (19 mm) Thick: **1/8 inch** (3 mm).
- E. Complete fabrication, including assembly[, **finishing,**] and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify DEN Project Manager seven days in advance of the dates and times woodwork fabrication will be complete.
 - 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- F. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and

use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.

G. SHOP FINISHING

H. General: Finish architectural wood countertops at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

I. Finish Materials: Use finish materials that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

J. Shop Priming: Shop apply the prime coat including backpriming, if any, for items specified to be field finished. Refer to Section 099300 "Staining and Transparent Finishing" for material and application requirements.

K. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood countertops. Apply two coats to end-grain surfaces.

L. Transparent Finish:

1. Grade: **[Premium]**.
2. Finish: System - 1, nitrocellulose lacquer.
3. Finish: System - 2, precatalyzed lacquer.
4. Finish: System - 3, postcatalyzed lacquer.
5. Finish: System - 4, water-based latex acrylic.
6. Finish: System - 5, conversion varnish.
7. Finish: System - 6, synthetic penetrating oil.
8. Finish: System - 7, catalyzed vinyl.
9. Finish: System - 8, water-based cross linking acrylic.
10. Finish: System - 9, UV curable acrylated epoxy, polyester, or urethane.
11. Finish: System - 10, water-based UV curable.
12. Finish: System - 11, catalyzed polyurethane.
13. Finish: System - 12, water-based polyurethane.
14. Finish: System - 13, catalyzed polyester.
15. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
16. Staining: **[None required] [Match approved sample for color] [Match DEN Project Manager's sample]**.
17. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
18. Filled Finish for Open-Grain Woods: **[After staining, apply wash-coat sealer and allow to dry.]** Apply paste wood filler and wipe off excess. Tint filler to match stained wood.

19. Sheen: **[Flat, 15-30] [Satin, 31-45] [Semigloss, 46-60] [Gloss, 61-100]** gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition wood countertops to average prevailing humidity conditions in installation areas.
- B. Before installing wood countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Grade: Install wood countertops to comply with same grade as item to be installed.
- B. Assemble wood countertops and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Install wood countertops level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of **1/8 inch in 96 inches** (3 mm in 2400 mm).
- D. Scribe and cut wood countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- F. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Install countertops with no more than **1/8 inch in 96-inch** (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 - 2. Secure backsplashes **[to tops with concealed metal brackets at 16 inches** (400 mm) **o.c.] [and] [to walls with adhesive]**.
 - 3. Calk space between backsplash and wall with sealant specified in Section 079200 "Joint Sealants."
- G. Touch up finishing work specified in this Section after installation of wood countertops. Fill nail holes with matching filler where exposed.
 - 1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are applied in shop.

- H. Refer to [**Section 099123 "Interior Painting"**] [**and**] [**Section 099300 "Staining and Transparent Finishing"**] for final finishing of installed wood countertops[**not indicated to be shop finished**].

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective wood countertops, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Complete the finishing work specified as work of this section, to whatever extent not completed at shop or prior to installation of woodwork.
1. Provide final protection and maintain conditions, in a manner acceptable to Fabricator and Installer, which ensures wood countertops being without damage or deterioration at time of substantial completion.
- C. Clean wood countertops on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 123619

SECTION 123623.13 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes plastic-laminate countertops.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product[, **including**] [**panel products**] [**high-pressure decorative laminate**] [**adhesive for bonding plastic laminate**] [**and**] [**fire-retardant-treated materials**].
 - 1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
 - 2. Include data substantiating that materials comply with requirements.
- B. Wood Treatment Data: Submit chemical treatment manufacturer's instructions for handling, storing, installation, and finish of treated material.
- C. Quality Certification: Submit woodwork Manufacturer's (Fabricator's) certification, stating that fabricated woodwork complies with quality grades and other requirements indicated.
- D. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured[**and regionally extracted and manufactured**] materials. Include statement indicating cost for each regionally manufactured material.
 - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
 - b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
 4. Certificates for [**Credit MR 6**] [**Credit MR 7**]: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.
 5. Product Data for Credit IEQ 4.1: For installation adhesives, including printed statement of VOC content.
 6. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 7. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that products contain no urea formaldehyde.
 8. Laboratory Test Reports for Credit IEQ 4.4: For composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
1. Show locations and sizes of cutouts and holes for [**plumbing fixtures**] [**faucets**] [**soap dispensers**] [**electrical switches and outlets**] [**and other items**] installed in plastic-laminate countertops.
 2. Apply AWI Quality Certification Program label to Shop Drawings.
- F. Samples for Initial Selection:
1. Plastic laminates.
- G. Samples for Verification:
1. Plastic laminates, [**8 by 10 inches** (200 by 250 mm)] [**12 by 12 inches** (300 by 300 mm)], for each[**type,**] color, pattern, and surface finish[, **with one sample applied to core material**] [**and specified edge material applied to one edge**].

2. Wood-grain plastic laminates, [12 by 24 inches (300 by 600 mm)] [24 by 24 inches (600 by 600 mm)], for each[**type,**] pattern and surface finish[, **with one sample applied to core material**] [**and specified edge material applied to one edge**].

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For [**Installer**] [**fabricator**].
- B. Certificate from the fabricator providing proof of not less than five (5) years experience in the fabrication of the types of products specified.
- C. Certificate from the installer providing proof of not less than five (5) years of successful experience in the installation of similar types of products and shall have completed at least three (3) jobs of similar size and scope.
- D. Product Certificates: For [**each type of product.**] [**the following:**]
 1. Composite wood and agrifiber products.
 2. High-pressure decorative laminate.
 3. Chemical-resistant, high-pressure decorative laminate.
 4. Adhesives.
- E. Woodwork Quality Standard Compliance Certificates: [**AWI Quality Certification Program certificates**] [**WI Certified Compliance Program certificates**].
- F. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Submit manufacturers care and maintenance data, including care and cleaning instructions.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. [**Shop is a certified participant in AWI's Quality Certification Program.**][**Shop is a licensee of WI's Certified Compliance Program.**]
- B. Installer Qualifications: [**Fabricator of products**] [**Certified participant in AWI's Quality Certification Program**] [**Licensee of WI's Certified Compliance Program**].

- C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
- D. Mockup: Build mockup to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
 - 1. Build mockup of typical countertop as shown on Drawings. Fabricate one carcass for each type of plastic-laminate-clad countertop required. DEN Project Manager is to review and approve mockup before remaining cabinet work can proceed. Contractor to pay for the expense of transporting the DEN Project Manager to site and back.
 - 2. Complete fabrication of each countertop approved and deliver to job site for DEN Project Manager review. Once the mockup for a type of countertop is approved all remaining countertops of that type may be fabricated.
 - 3. Subject to compliance with requirements, approved mockup may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect woodwork during transit, delivery, storage and handling to prevent damage, soiling and deterioration.
- B. Do not deliver countertops until painting and similar operations that could damage countertops have been completed in installation areas. If countertops must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

- A. Conditioning: Woodwork Manufacturer and Installer shall advise Contractor of temperature and humidity requirements for woodwork installation and storage areas. Do not install woodwork until required temperature and relative humidity have been stabilized and will be maintained in installation areas.
- B. Maintain temperature and humidity in installation area as required to maintain moisture content of installed woodwork within a 1.0 percent tolerance of optimum moisture content, from date of installation through remainder of construction period. Require Woodwork Manufacturer to establish optimum moisture content and required temperature and humidity conditions.
- C. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

- D. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between **60 and 90 deg F** (16 and 32 deg C) and relative humidity between **[25 and 55] [43 and 70] [17 and 50] <Insert humidity range>** percent during the remainder of the construction period.
- E. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- F. Established Dimensions: Where countertops are indicated to fit to other construction, establish dimensions for areas where countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of plastic-laminate-clad countertops that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Delamination of components or other failures of glue bond.
 - b. Warping of components.
 - c. Deterioration of finishes.
 - 2. Warranty Period: Minimum **[five (5)] <Insert number>** years from date of Substantial Completion.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE COUNTERTOPS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades indicated for construction, installation, and other requirements.

1. Provide **[labels] [and] [certificates]** from AWI certification program indicating that countertops[, **including installation,**] comply with requirements of grades specified.
 2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.
- B. Grade: **[Premium] [Custom]** .
- C. Regional Materials: Plastic-laminate countertops shall be manufactured within **500 miles** (800 km) of Project site.
- D. Certified Wood: Plastic-laminate countertops shall be made from wood products certified as "FSC Pure"[**or "FSC Mixed Credit"**] according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- E. High-Pressure Decorative Laminate: NEMA LD 3, **[Grade HGS]** .
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Abet Laminati, Inc.
 - b. Formica Corporation.
 - c. Lamin-Art, Inc.
 - d. Panolam Industries International, Inc.
 - e. Wilsonart International; Div. of Premark International, Inc.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
- F. Chemical-Resistant, High-Pressure Decorative Laminate: NEMA LD 3, Grade HGP, and as follows:
1. Laminate has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.9.5:
 - a. Nitric Acid (30 Percent): Moderate effect.
 - b. Sulfuric Acid (77 Percent): Moderate effect.
 - c. Hydrochloric Acid (37 Percent): Moderate effect.
 - d. Phosphoric Acid (75 Percent): No effect.
 - e. Acetic Acid (98 Percent): No effect.
 - f. Formaldehyde: No effect.
 - g. Ethyl Acetate: No effect.
 - h. Ethyl Ether: No effect.
 - i. Phenol (85 Percent): Moderate effect.
 - j. Benzene: No effect.
 - k. Xylene: No effect.
 - l. Butyl Alcohol: No effect.
 - m. Furfural: No effect.

- n. Methyl Ethyl Ketone: No effect.
 - o. Sodium Hydroxide (25 Percent): No effect.
 - p. Sodium Sulfide (15 Percent): No effect.
 - q. Ammonium Hydroxide (28 Percent): No effect.
 - r. Zinc Chloride: No effect.
 - s. Gentian Violet: No effect.
 - t. Methyl Red: No effect.
2. Products: Subject to compliance with requirements, provide one of the following:
- a. Formica Corporation; Lab Grade 840 Black.
 - b. Panolam Industries International, Inc.; Pionite Chemguard.
 - c. Wilsonart International, Div. of Premark International, Inc.; Chemsurf.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
- G. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. As indicated by manufacturer's designations.
 2. Match DEN Project Manager's sample.
 3. As selected by DEN Project Manager from manufacturer's full range in the following categories:
 - a. Solid colors, **[gloss]** **[matte]** finish.
 - b. Solid colors with core same color as surface, **[gloss]** **[matte]** finish.
 - c. Wood grains, **[gloss]** **[matte]** finish.
 - d. Patterns, **[gloss]** **[matte]** finish.
 4. Grain Direction: Parallel to cabinet fronts.
- H. Edge Treatment: **[Same as laminate cladding on horizontal surfaces]** **[2-mm PVC edging]** **[3-mm PVC edging]** **[Lumber edge for transparent finish matching wood species and cut on cabinet surfaces]** **[As indicated]**.
- I. Core Material: **[Exterior-grade plywood]** .
- J. Core Material at Sinks: **[exterior-grade plywood]**.
- K. Core Thickness: **[3/4 inch (19 mm)]** **[1-1/8 inch (29 mm)]**.
1. Build up countertop thickness to **1-1/2 inches (38 mm)** at front, back, and ends with additional layers of core material laminated to top.
- L. Backer Sheet: Provide plastic-laminate backer sheet, NEMA LD 3, Grade BKL, on underside of countertop substrate.
- M. Paper Backing: Provide paper backing on underside of countertop substrate.

2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.
1. Wood Moisture Content: **[5 to 10] [8 to 13] [4 to 9]** percent.
 2. Softwood Plywood: DOC PS 1.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
1. Use treated materials that comply with requirements of referenced woodworking standard. Do not use materials that are warped, discolored, or otherwise defective.
 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 feet (3.2 m)** beyond the centerline of the burners at any time during the test.
1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
 2. For items indicated to receive a stained or natural finish, use organic resin chemical formulation.
 3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
 4. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
- C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.

1. For panels **3/4 inch** (19 mm) thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, **1600 psi** (11 MPa); modulus of elasticity, **300,000 psi** (2070 MPa); internal bond, **80 psi** (550 kPa); and screw-holding capacity on face and edge, **250 and 225 lbf** (1100 and 1000 N), respectively.
2. For panels **13/16 to 1-1/4 inches** (20 to 32 mm) thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, **1300 psi** (9 MPa); modulus of elasticity, **250,000 psi** (1720 MPa); linear expansion, 0.50 percent; and screw-holding capacity on face and edge, **250 and 175 lbf** (1100 and 780 N), respectively.
3. Products: Subject to compliance with requirements, provide one of the following:
 - a. Flakeboard Company Limited; Duraflake FR.
 - b. SierraPine; Encore FR.
 - c. **<Insert manufacturer's name; product name or designation>**.

2.4 ACCESSORIES

- A. Grommets for Cable Passage through Countertops: [**1-1/4-inch** (32-mm)] [**2-inch** (51-mm)] **<Insert dimension>** OD, [**brown**] [**black**] **<Insert color>**, molded-plastic grommets and matching plastic caps with slot for wire passage.
 1. Product: Subject to compliance with requirements, provide "[**OG**] [**SG**] series" by Doug Mockett & Company, Inc.
- B. Paper Slots: [**12 inches** (305 mm)] [**17 inches** (432 mm)] long by **1-3/4 inches** (45 mm) wide by **1 inch** (25 mm) deep; [**brown**] [**black**] **<Insert color>**, molded-plastic, paper-slot liner with **1/4-inch** (6.4-mm) lip.

2.5 MISCELLANEOUS MATERIALS

- A. Adhesives: Do not use adhesives that contain urea formaldehyde.
- B. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Adhesive for Bonding Plastic Laminate: [**Unpigmented contact cement**] [**Contact cement**] [**PVA**] [**Urea formaldehyde**] [**Resorcinol**].
 1. Adhesive for Bonding Edges: Hot-melt adhesive[**or adhesive specified above for faces**].
- D. VOC Limits for Installation Adhesives and Sealants: Use products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 1. Wood Glues: 30 g/L.

2. Multipurpose Construction Adhesives: 70 g/L.
3. Structural Wood Member Adhesive: 140 g/L.
4. Architectural Sealants: 250 g/L.

2.6 FABRICATION

- A. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber at time of fabrication and for relative humidity conditions in the installation areas.
- B. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- C. Measurements: Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain field measurements and verify dimensions and shop drawing details as required for accurate fit.
- D. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of **1 inch** (25 mm) over base cabinets. Ease edges to radius indicated for the following:
 1. Solid-Wood (Lumber) Members: **1/16 inch** (1.5 mm) unless otherwise indicated.
- E. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 1. Notify DEN Project Manager seven (7) days in advance of the dates and times woodwork fabrication will be complete.
 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- F. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 1. Seal edges of openings in countertops with a coat of varnish.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.
- B. Before installing countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Grade: Install countertops to comply with same grade as item to be installed.
- B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.
 - 1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items.
 - 2. Seal edges of cutouts by saturating with varnish.
- C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
 - 1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within **6 inches** (150 mm) of front and back edges and at intervals not exceeding **24 inches** (600 mm). Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.
- D. Install countertops level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of **1/8 inch in 96 inches** (3 mm in 2400 mm).
- E. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- F. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Install countertops with no more than **1/8 inch in 96-inch** (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 - 2. Secure backsplashes [**to tops with concealed metal brackets at 16 inches** (400 mm) **o.c.**] [**and**] [**to walls with adhesive**].

3. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Provide final protection and maintain conditions, in a manner acceptable to Fabricator and Installer, which ensures architectural woodwork being without damage or deterioration at time of substantial completion.
- C. Clean countertops on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 123623.13

SECTION 123640 - STONE COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes stone countertops.
- B. Related Requirements:
 - 1. Section 044200 "Exterior Stone Cladding" for descriptions of stone types required by this Section.
 - 2. Section 123200 "Architectural Woodwork" for cabinets.
 - 3. Section 123661 "Simulated Stone Countertops" for [**cultured-marble**] [**solid-surface**] [**and**] [**quartz-agglomerate**] countertops.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each[**variety of stone,**] stone accessory, and manufactured product.
 - 1. Include data substantiating that materials comply with requirements.
- B. Quality Certification: Submit stone countertop Manufacturer's (Fabricator's) certification, stating that fabricated stonework complies with quality grades and other requirements indicated.
- C. LEED Submittals:
 - 1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
 - 2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured[**and regionally extracted**

and manufactured] materials. Include statement indicating cost for each regionally manufactured material.

- a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
 - b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
3. Product Data for Credit IEQ 4.1: For **[adhesives] [and] [sealants]**, documentation including printed statement of VOC content.
4. Laboratory Test Reports for Credit IEQ 4.1: For **[adhesives] [and] [sealants]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Shop Drawings: Include plans, sections, large-scale details, and attachments to other work.
1. Show locations and details of joints.
 2. Show direction of veining, grain, or other directional pattern.
- E. Samples for Verification:
1. For each stone type indicated, in sets of Samples not less than **12 inches** (300 mm) square. Include **[two] [three]** or more Samples in each set and show the full range of variations in appearance characteristics expected in completed Work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Certificate from the fabricator providing proof of not less than five (5) years experience in the fabrication of the types of products specified.
- C. Certificate from the installer providing proof of not less than five (5) years of successful experience in the installation of similar types of products and shall have completed at least three (3) jobs of similar size and scope.
- D. Material Test Reports:
1. Stone Test Reports: For **[each]** stone variety proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, according to referenced ASTM standards. Base reports on testing done within previous **[three] [five] <Insert number>** years.
 2. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer indicating that sealants will not stain or damage stone.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For stone countertops to include in maintenance manuals. Include product data for stone-care products used or recommended by Installer, and names, addresses, and telephone numbers of local sources for products.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate stone countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of stone countertops.
- C. Mockup: Build mockup to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
 - 1. Build mockup of typical countertop as shown on Drawings. Fabricate one carcass for each type of stone countertop required. DEN Project Manager is to review and approve mockup before remaining cabinetwork can proceed. Contractor to pay for the expense of transporting the DEN Project Manager to site and back.
 - 2. Complete fabrication of each countertop approved and deliver to job site for DEN Project Manager review. Once the mockup for a type of countertop is approved all remaining countertops of that type may be fabricated.
 - 3. Subject to compliance with requirements, approved mockup may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Sealant Adhesion and Compatibility Testing: Submit to joint-sealant manufacturers, for compatibility and adhesion testing according to sealant manufacturer's standard testing methods and Section 079200 "Joint Sealants," Samples of materials that will contact or affect joint sealants.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.
 - 1. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.

2. Store stone on wood A-frames or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.

1.9 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of construction to receive stone countertops by field measurements before fabrication[**and indicate measurements on Shop Drawings**].

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Stone: Obtain[**each variety of**] stone, [**regardless of finish,**] from a single quarry[, **whether specified in this Section or in another Section of the Specifications,**] with resources to provide materials of consistent quality in appearance and physical properties.

1. For stone types that include same list of varieties and sources, provide same variety from same source for each.

2. Make stone slabs available for examination by DEN Project Manager.

- a. DEN Project Manager will select aesthetically acceptable slabs[**and will indicate aesthetically unacceptable portions of slabs**].
- b. Segregate slabs selected for use on Project and mark backs indicating approval.
- c. Mark and photograph aesthetically unacceptable portions of slabs as directed by DEN Project Manager.

- B. Varieties and Sources: Subject to compliance with requirements, provide stone of varieties and from sources complying with Section 044200 "Exterior Stone Cladding."

2.2 GRANITE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 615.

- B. Regional Materials: Granite shall be fabricated within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.

- C. Regional Materials: Granite shall be fabricated within 500 miles (800 km) of Project site.
- D. Description: Uniform, [fine] [medium]-grained, [white] [pink] [gray] [black] <Insert color> stone[without veining].
- E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 - 1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
 - 2. or approved equal.
- F. Cut: [Vein] [Fleuri].
- G. Cut stone from contiguous, matched slabs in which natural markings occur.
- H. Finish: [Polished] [Honed] [Thermal] [As indicated] [Match DEN Project Manager's sample] <Insert finish>.
- I. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.3 MARBLE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 503[, Classification I Calcite] [, Classification II Dolomite] [, Group A] [, Group B] [, Group C] [, Group D].
 - 1. Stone Abrasion Resistance: Minimum value of [10] <Insert value>, based on testing according to ASTM C 241/C 241M or ASTM C 1353.
- B. Regional Materials: Marble shall be fabricated within 500 miles (800 km) of Project site from stone that has been extracted within 500 miles (800 km) of Project site.
- C. Regional Materials: Marble shall be fabricated within 500 miles (800 km) of Project site.
- D. Description: Uniform, fine- to medium-grained, [white] <Insert color> stone with only slight veining.
- E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 - 1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
 - 2. or approved equal.
- F. Cut: [Vein] [Fleuri].
- G. Cut stone from contiguous, matched slabs in which natural markings occur.

- H. Finish: [**Polished**] [**Honed**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish>.
- I. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.4 SERPENTINE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 1526[, **Classification I Exterior**] [, **Classification II Interior**].
 - 1. Stone Abrasion Resistance: Minimum value of [**10**] <Insert value>, based on testing according to ASTM C 241/C 241M or ASTM C 1353.
- B. Regional Materials: Serpentine shall be fabricated within 500 miles (800 km) of Project site from stone that has been extracted within 500 miles (800 km) of Project site.
- C. Regional Materials: Serpentine shall be fabricated within 500 miles (800 km) of Project site.
- D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
 - 1. <Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.
 - 2. or approved equal.
- E. Cut stone from contiguous, matched slabs in which natural markings occur.
- F. Finish: [**Polished**] [**Honed**] [**As indicated**] [**Match DEN Project Manager's sample**] <Insert finish>.
- G. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.5 SLATE <Insert drawing designation>

- A. Material Standard: Comply with ASTM C 629[, **Classification I Exterior**] [, **Classification II Interior**].
 - 1. Stone Abrasion Resistance: Minimum value of [**8**] <Insert value>, based on testing according to ASTM C 241/C 241M or ASTM C 1353.
- B. Regional Materials: Slate shall be fabricated within 500 miles (800 km) of Project site from stone that has been extracted within 500 miles (800 km) of Project site.
- C. Regional Materials: Slate shall be fabricated within 500 miles (800 km) of Project site.

- D. Description: [**Black**] [**Blue-black**] [**Gray**] [**Blue-gray**] [**Green**] [**Purple**] [**Mottled purple and green**] [**Red**] slate with a fine, even grain[**and unfading color,**] from clear, sound stock.
- E. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.**
 2. or approved equal.
- F. Finish: [**Honed**] [**Sand rubbed**] [**Natural cleft**] [**As indicated**] [**Match DEN Project Manager's sample**] **<Insert finish>.**
- G. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.6 OTHER STONE **<Insert drawing designation>**

- A. Material Standards:
1. Maximum Absorption per ASTM C 97/C 97: **<Insert value>.**
 2. Minimum Compressive Strength per ASTM C 170/C 170M: **<Insert value>.**
 3. Minimum Flexural Strength per ASTM C 880/C 880: **<Insert value>.**
 4. Minimum Stone Abrasion Resistance per ASTM C 241/C 241M or ASTM C 1353: **[10] <Insert value>.**
- B. Regional Materials: Stone shall be fabricated within **500 miles (800 km)** of Project site from stone that has been extracted within **500 miles (800 km)** of Project site.
- C. Regional Materials: Stone shall be fabricated within **500 miles (800 km)** of Project site.
- D. Varieties and Sources: Subject to compliance with requirements, provide one of the following:
1. **<Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers>.**
 2. or approved equal.
- E. Finish: [**Polished**] [**Honed**] [**Sand rubbed**] [**Natural cleft**] [**As indicated**] [**Match DEN Project Manager's sample**] **<Insert finish>.**
- F. Match DEN Project Manager's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.7 ADHESIVES, GROUT, SEALANTS, AND STONE ACCESSORIES

- A. General: Use only adhesives formulated for stone and ceramic tile and that are recommended by their manufacturer for the application indicated.

- B. Water-Cleanable Epoxy Adhesive: ANSI A118.3[.][, with a VOC content of 65 g/L or less.][, that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. Boiardi Products; a QEP company.
 - b. Bonstone Materials Corporation.
 - c. Bostik, Inc.
 - d. C-Cure.
 - e. Custom Building Products.
 - f. Jamo Inc.
 - g. Laticrete International, Inc.
 - h. MAPEI Corporation.
 - i. Mer-Krete Systems; ParexLahabra, Inc.
 - j. Prospec; Bonsal American; a division of Oldcastle Architectural Products Group.
 - k. Summitville Tiles, Inc.
 - l. TEC, Specialty Construction Brands, Inc.; an H. B. Fuller company.
 - m. **<Insert manufacturer's name>.**
 - n. or approved equal.
- C. Water-Cleanable Epoxy Grout: ANSI A118.3, chemical-resistant, water-cleanable, tile-setting and -grouting epoxy.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. Boiardi Products; a QEP company.
 - b. Bostik, Inc.
 - c. C-Cure.
 - d. Custom Building Products.
 - e. Jamo Inc.
 - f. Laticrete International, Inc.
 - g. MAPEI Corporation.
 - h. Mer-Krete Systems; ParexLahabra, Inc.
 - i. Prospec; Bonsal American; a division of Oldcastle Architectural Products Group.
 - j. Summitville Tiles, Inc.
 - k. TEC, Specialty Construction Brands, Inc.; an H. B. Fuller company.
 - l. **<Insert manufacturer's name>.**
 - m. or approved equal.
- D. Stone Adhesive: Two-part [epoxy] [or] [polyester] adhesive, formulated specifically for bonding stone to stone, with an initial set time of not more than two hours at 70 deg F (21 deg C)[.][, and with a VOC content of 65 g/L or less.][, that complies with the testing and product requirements of the California Department of Health

Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."]

1. Color: **[Clear] [Match stone]**.
 2. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. Epoxy Adhesive: **Akemi**; Akepox.
 - b. Epoxy Adhesive: **Axson North America, Inc., Wood & Stone Company**; Akabond Epoxy.
 - c. Epoxy Adhesive: **Bonstone Materials Corporation**; Touchstone Last Patch.
 - d. Epoxy Adhesive: **Bonstone Materials Corporation**; Touchstone Ratio Pac Clear Gel Epoxy.
 - e. Epoxy Adhesive: **<Insert manufacturer's name; product name or designation>**.
 - f. Polyester Adhesive: **Akemi**; Platinum Clear Polyester Adhesive.
 - g. Polyester Adhesive: **Axson North America, Inc., Wood & Stone Company**; Wood & Stone Polyester.
 - h. Polyester Adhesive: **Bonstone Materials Corporation**; Gripstone L-200KG.
 - i. Polyester Adhesive: **<Insert manufacturer's name; product name or designation>**.
 - j. or approved equal.
- E. Sealant for Countertops: Manufacturer's standard sealant of characteristics indicated below that complies with applicable requirements in Section 079200 "Joint Sealants" and will not stain the stone it is applied to.
1. Mildew-Resistant Joint Sealant: **[Mildew resistant, single component, nonsag, neutral curing, silicone] [Single component, nonsag, mildew resistant, acid curing, silicone] <Insert joint sealant>**.
 2. Joint Sealant: **[Latex] [Single component, nonsag, neutral curing, silicone; Class 25] <Insert joint sealant>**.
 3. Color: **[Clear] [As selected by DEN Project Manager from manufacturer's full range]**.
 4. Sealants shall have a VOC content of **[250] <Insert value>** g/L or less.
 5. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. Stone Joint Splines: Stainless-steel or brass washers approximately **1 inch (25 mm)** in diameter and of thickness to fit snugly in saw-cut kerf in edge of stone units.
- G. Stone Cleaner: Specifically formulated for stone types, finishes, and applications indicated, as recommended by stone producer **[and, if a sealer is specified, by sealer manufacturer]**. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.
- H. Stone Sealer: Colorless, stain-resistant sealer that does not affect color or physical properties of stone surfaces, as recommended by stone producer for application indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Bostik, Inc.](#)
 - b. [Custom Building Products.](#)
 - c. [Hillyard, Inc.](#)
 - d. [HMK Stone Care System.](#)
 - e. [Miracle Sealants Company.](#)
 - f. [Stone Care International Inc.](#)
 - g. [Summitville Tiles, Inc.](#)
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.

2.8 STONE FABRICATION, GENERAL

- A. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that could impair structural integrity or function.
 1. Repairs that are characteristic of the varieties specified are acceptable provided they do not impair structural integrity or function and are not aesthetically displeasing, as judged by DEN Project Manager.
- B. Grade and mark stone for final locations to produce assembled countertop units with an overall uniform appearance.
- C. Measurements: Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain field measurements and verify dimensions and shop drawing details as required for accurate fit.
- D. Fabricate stone countertops in sizes and shapes required to comply with requirements indicated.
 1. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."
 2. For [**marble**] [**and**] [**serpentine**], comply with recommendations in MIA's "Dimension Stone - Design Manual VI."
 3. Clean sawed backs of stones to remove rust stains and iron particles.
 4. Dress joints straight and at right angle to face unless otherwise indicated.
 5. Cut and drill sinkages and holes in stone for anchors, supports, and attachments.
 6. Provide openings, reveals, and similar features as needed to accommodate adjacent work.
 7. Fabricate molded edges with machines having abrasive shaping wheels made to reverse contour of edge profile to produce uniform shape throughout entire length of edge and with precisely formed arris slightly eased to prevent snipping, and matched at joints between units. Form corners of molded edges as indicated with outside corners slightly eased unless otherwise indicated.
 8. Finish exposed faces of stone to comply with requirements indicated for finish of each stone type required and to match approved Samples and mockups. Provide matching finish on exposed edges of countertops, splashes, and cutouts.

- E. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.

2.9 STONE COUNTERTOPS

- A. General: Comply with recommendations in MIA's "Dimension Stone - Design Manual VI."
- B. Nominal Thickness: Provide thickness indicated, but not less than [3/4 inch (20 mm)] [7/8 inch (22 mm)] [1-1/4 inches (32 mm)]. Gage backs to provide units of identical thickness.
- C. Edge Detail: [**Straight, slightly eased at top**] [3/8-inch (10-mm) bevel] [3/4-inch (20-mm) full bullnose] [1-1/4-inch (20-mm) full bullnose] [3/8-inch (10-mm) radius with 2-inch (50-mm) apron] [1-1/2-inch (40-mm) laminated bullnose] [**As indicated**].
- D. Splashes: Provide 3/4-inch- (20-mm-) thick [**backsplashes**] [**and**] [**end splashes**] unless otherwise indicated.
1. Height: [4 inches (100 mm)] [**As indicated**] <Insert dimension>.
 2. Top-Edge Detail: [**Straight, slightly eased at corner**] [3/8-inch (10-mm) bevel] [3/4-inch (20-mm) radius] [3/8-inch (10-mm) radius] [**As indicated**].
- E. Joints: Fabricate countertops without joints.
- F. Joints: Fabricate countertops in sections for joining in field, with joints at locations indicated and as follows:
1. Bonded Joints: 1/32 inch (0.8 mm) or less in width.
 2. Grouted Joints: 1/16 inch (1.5 mm) in width.
 3. Sealant-Filled Joints: 1/16 inch (1.5 mm) in width.
 4. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints[**where indicated**]. Make width of cuts slightly more than thickness of splines to provide snug fit.[**Provide at least three splines in each joint.**]
- G. Cutouts and Holes:
1. Undercounter Fixtures: Make cutouts for undercounter fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
 - a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch (5 mm) into fixture opening.
 - b. Provide vertical edges, rounded to 3/8-inch (10-mm) radius at juncture of cutout edges with top surface of countertop, slightly eased at bottom, and projecting 3/16 inch (5 mm) into fixture opening.

- c. Provide **3/4-inch (20-mm)** full bullnose edges projecting **3/8 inch (10 mm)** into fixture opening.
2. Counter-Mounted Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive stone countertops and conditions under which stone countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone countertops.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of stone countertops.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Advise installers of other work about specific requirements for placement of inserts and similar items to be used by stone countertop Installer for anchoring stone countertops. Furnish installers of other work with Drawings or templates showing locations of these items.
- B. Before installing stone countertops, clean dirty or stained stone surfaces by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives. Allow stone to dry before installing.

3.3 CONSTRUCTION TOLERANCES

- A. Variation from Level: Do not exceed **1/8 inch in 96 inches (3 mm in 2400 mm)**, **1/4 inch (6 mm)** maximum.
- B. Variation in Joint Width: Do not vary joint thickness more than one-fourth of nominal joint width.
- C. Variation in Plane at Joints (Lipping): Do not exceed **1/64-inch (0.4-mm)** difference between planes of adjacent units.

- D. Variation in Line of Edge at Joints (Lipping): Do not exceed **1/64-inch (0.4-mm)** difference between edges of adjacent units, where edge line continues across joint.

3.4 INSTALLATION OF COUNTERTOPS

- A. General: Install countertops over plywood subtops with full spread of water-cleanable epoxy adhesive.
- B. General: Install countertops by adhering to supports with water-cleanable epoxy adhesive.
- C. Do not cut stone in field unless otherwise indicated. If stone countertops or splashes require additional fabrication not specified to be performed at Project site, return to fabrication shop for adjustment.
- D. Do necessary field cutting as stone is set. Use power saws with diamond blades to cut stone. Cut lines straight, true, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- E. Set stone to comply with requirements indicated. Shim and adjust stone to locations indicated, with uniform joints of widths indicated and with edges and faces aligned according to established relationships and indicated tolerances. **[Install anchors and other attachments indicated or necessary to secure stone countertops in place.]**
- F. Bond joints with stone adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
1. Install metal splines in kerfs in stone edges at joints **[where indicated]**. Fill kerfs with stone adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
 2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.
- G. Space joints with **1/16-inch (1.5-mm)** gap for filling with **[grout] [sealant]**. Use temporary shims to ensure uniform spacing.
1. Install metal splines in kerfs in stone edges at joints **[where indicated]**. Fill kerfs with **[setting adhesive] [sealant]** before inserting splines and remove excess immediately after adjoining units are drawn into position.
 2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.
- H. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Use power saws with diamond blades to cut stone. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

- I. Install backsplashes and end splashes by adhering to wall with water-cleanable epoxy adhesive and to countertops with stone adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- J. Install backsplashes and end splashes by adhering to countertops with stone adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Leave **1/16-inch (1.5-mm)** gap between splashes and wall for filling with sealant. Use temporary shims to ensure uniform spacing.
- K. Install backsplashes and end splashes by adhering to wall with water-cleanable epoxy adhesive. Leave **1/16-inch (1.5-mm)** gap between countertop and splashes for filling with sealant. Use temporary shims to ensure uniform spacing.
- L. Grout joints to comply with ANSI A108.10. Remove temporary shims before grouting. Tool grout uniformly and smoothly with plastic tool.
- M. Apply sealant to **[joints] [and] [gaps specified for filling with sealant]**; comply with Section 079200 "Joint Sealants." Remove temporary shims before applying sealant.

3.5 ADJUSTING AND CLEANING

- A. In-Progress Cleaning: Clean countertops as work progresses. Remove adhesive, grout, mortar, and sealant smears immediately.
- B. Remove and replace stone countertops of the following description:
 - 1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by DEN Project Manager.
 - 2. Defective countertops.
 - 3. Defective joints, including misaligned joints.
 - 4. Interior stone countertops and joints not matching approved Samples and mockups.
 - 5. Interior stone countertops not complying with other requirements indicated.
- C. Replace in a manner that results in stone countertops matching approved Samples and mockups, complying with other requirements, and showing no evidence of replacement.
- D. Provide final protection and maintain conditions, in a manner acceptable to Fabricator and Installer, which ensures stone countertops being without damage or deterioration at time of substantial completion.
- E. Clean stone countertops no fewer than six days after completion of **[sealant installation] [installation]**, using clean water and soft rags. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage stone.
- F. Sealer Application: Apply stone sealer to comply with stone producer's and sealer manufacturer's written instructions.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 123640

SECTION 123661 - SIMULATED STONE COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cultured marble countertops [**and backsplashes**].
 - 2. Solid-surface-material countertops [**and backsplashes**].
 - 3. Quartz agglomerate countertops [**and backsplashes**].
- B. Related Sections:
 - 1. Section 123640 "Stone Countertops."
 - 2. Section 224100 "Residential Plumbing Fixtures" for [**nonintegral sinks**] [**sinks**] [**and**] [**plumbing fittings**].
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For countertop materials[**and sinks**].
 - 1. Include data substantiating that materials comply with requirements.
- B. Quality Certification: Submit simulated stone countertop Manufacturer's (Fabricator's) certification, stating that fabricated stonework complies with quality grades and other requirements indicated.
- C. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Certificates for [**Credit MR 6**] [**Credit MR 7**]: Chain-of-custody certificates indicating that wood products comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an

- FSC-accredited certification body. Include statement indicating cost for each certified wood product.
3. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that product contains no urea formaldehyde.
 4. Laboratory Test Reports for Credit IEQ 4: For **[adhesives] [sealants] [and] [composite wood and agrifiber products]**, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
- E. Samples for Initial Selection: For each type of material exposed to view.
- F. Samples for Verification: For the following products:
1. Countertop material, **6 inches** (150 mm) square.
 2. Wood trim, **8 inches** (200 mm) long.
 3. One full-size cultured marble countertop, with front edge[**and backsplash**], **8 by 10 inches** (200 by 250 mm), of construction and in configuration specified.
 4. One full-size solid-surface-material countertop, with front edge[**and backsplash**], **8 by 10 inches** (200 by 250 mm), of construction and in configuration specified.
 5. One full-size quartz agglomerate countertop, with front edge[**and backsplash**], **8 by 10 inches** (200 by 250 mm), of construction and in configuration specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Certificate from the fabricator providing proof of not less than five (5) years experience in the fabrication of the types of products specified.
- C. Certificate from the installer providing proof of not less than five (5) years of successful experience in the installation of similar types of products and shall have completed at least 3 jobs of similar size and scope.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For stone countertops to include in maintenance manuals. Include product data for stone-care products used or recommended by Installer, and names, addresses, and telephone numbers of local sources for products.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate simulated stone countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of simulated stone countertops.
- C. Mockup: Build mockup to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
 - 1. Build mockup of typical countertop as shown on Drawings. Fabricate one carcass for each type of simulated stone countertop required. DEN Project Manager is to review and approve mockup before remaining cabinetwork can proceed. Contractor to pay for the expense of transporting the DEN Project Manager to site and back.
 - 2. Complete fabrication of each countertop approved and deliver to job site for DEN Project Manager review. Once the mockup for a type of countertop is approved all remaining countertops of that type may be fabricated.
 - 3. Subject to compliance with requirements, approved mockup may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements[**after base cabinets are installed but**] before countertop fabrication is complete.

1.8 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.
- B. DELIVERY, STORAGE, AND HANDLING
- C. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.
 - 1. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
 - 2. Store stone on wood A-frames or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.

1.9 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of construction to receive simulated stone countertops by field measurements before fabrication[**and indicate measurements on Shop Drawings**].

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 CULTURED MARBLE COUNTERTOPS

- A. Configuration: Provide countertops with the following front and backsplash style:
1. Front: **[No drip (raised marine edge with rolled front)] [Straight, slightly eased at top] [1/2-inch (12.7-mm) bullnose] [Radius edge with apron, 2 inches (50 mm) high with 3/8-inch (9.5-mm) radius].**
 2. Backsplash: **[Coved, with 3/8-inch (9.5-mm) radius cove and top] [Straight, with 3/8-inch (9.5-mm) radius cove and slightly eased at top] [Straight, slightly eased at cove and top].**
 3. Endsplash: **[Matching backsplash] [None].**
- B. Countertops: **1/2-inch-** (12.7-mm-) thick, cultured marble.
- C. Backsplashes: **1/2-inch-** (12.7-mm-) thick, cultured marble.
- D. Fabrication: Fabricate tops in one piece with integral sink bowls and backsplashes unless otherwise indicated.

2.2 SOLID-SURFACE-MATERIAL COUNTERTOPS

- A. Configuration: Provide countertops with the following front and backsplash style:
1. Front: **[Straight, slightly eased at top] [Beveled] [3/4-inch (19-mm) bullnose] [Radius edge with apron, 2 inches (50 mm) high with 3/8-inch (9.5-mm) radius] [1-1/2-inch (38-mm) laminated bullnose] [1-inch (25-mm) laminated bullnose] [Wood-trimmed edge as indicated].**
 2. Backsplash: **[Straight, slightly eased at corner] [Beveled] [Radius edge with 3/8-inch (9.5-mm) radius].**
 3. Endsplash: **[Matching backsplash] [None].**
- B. Countertops: **[1/2-inch-** (12.7-mm-)] **[3/4-inch-** (19-mm-)] thick, solid surface material **[with wood-trimmed edges] [with front edge built up with same material].**
- C. Countertops: **1/4-inch-** (6.4-mm-) thick, solid surface material laminated to **3/4-inch-** (19-mm-) thick particleboard with **[wood-trimmed exposed edges] [exposed edges built up with 3/4-inch-** (19-mm-) **thick, solid surface material] [exposed edges faced with 1/4-inch-** (6.4-mm-) **thick, solid surface material].**

- D. Backsplashes: [1/2-inch- (12.7-mm-)] [3/4-inch- (19-mm-)] thick, solid surface material[**with wood-trimmed edges**].
- E. Fabrication: Fabricate tops in one piece with shop-applied edges[**and backsplashes**] unless otherwise indicated. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate with loose backsplashes for field assembly.
 - 2. Install integral sink bowls in countertops in the shop.

2.3 QUARTZ AGGLOMERATE COUNTERTOPS

- A. Configuration: Provide countertops with the following front and backsplash style:
 - 1. Front: [**Straight, slightly eased at top**] [**Beveled**] [3/4-inch (19-mm) **bullnose**] [**Radius edge with apron, 2 inches (50 mm) high with 3/8-inch (9.5-mm) radius**] [1-1/2-inch (38-mm) **laminated bullnose**] [1-inch (25-mm) **laminated bullnose**] [**Wood-trimmed edge as indicated**].
 - 2. Backsplash: [**Straight, slightly eased at corner**] [**Beveled**] [**Radius edge with 3/8-inch (9.5-mm) radius**].
 - 3. Endsplash: [**Matching backsplash**] [**None**].
- B. Countertops: [1/2-inch- (12.7-mm-)] [3/4-inch- (19-mm-)] thick, quartz agglomerate[**with wood-trimmed edges**] [**with front edge built up with same material**].
- C. Backsplashes: [1/2-inch- (12.7-mm-)] [3/4-inch- (19-mm-)] thick, quartz agglomerate[**with wood-trimmed edges**].
- D. Fabrication: Fabricate tops in one piece with shop-applied edges[**and backsplashes**] unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate with loose backsplashes for field assembly.

2.4 COUNTERTOP MATERIALS

- A. Certified Wood Materials: Fabricate countertops with wood and wood-based products produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.
- C. Adhesives: Adhesives shall not contain urea formaldehyde.
- D. Adhesives: Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile

Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- E. Cultured Marble: Gel-coated solid fabrication of filled plastic resin complying with ANSI Z124.3, Type 4, with precoated finish, and not less than 1/2 inch (12.7 mm) thick.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bathroom World Manufacturing Company.
 - b. Cameo Marble.
 - c. Cherry Marble Group.
 - d. Comar Products, Inc.
 - e. Craig Baker Marble Co., Inc.
 - f. Cultured Marble Products.
 - g. Custom Marble Products.
 - h. Custom Marble Products, Inc.
 - i. Imperial Marble Corp.
 - j. Marbleon, Inc.
 - k. MarCraft, Inc.
 - l. Princess Marble.
 - m. Roma Marble, Inc.
 - n. Rynone Manufacturing Corp.
 - o. Tiffany Marble.
 - p. <Insert manufacturer>.
 - q. or approved equal.
 2. Colors and Patterns: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range].**
- F. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Avonite Surfaces.
 - b. E. I. du Pont de Nemours and Company.
 - c. Formica Corporation.
 - d. LG Chemical, Ltd.
 - e. Meganite Inc.
 - f. Samsung Chemical USA, Inc.
 - g. Swan Corporation (The).
 - h. Transolid, Inc.
 - i. Wilsonart International.
 - j. <Insert manufacturer>.
 - k. or approved equal.

2. Type: Provide Standard Type[**or Veneer Type made from material complying with requirements for Standard Type, as indicated**] unless Special Purpose Type is indicated.
 3. Integral Sink Bowls: Comply with ISSFA-2 and ANSI Z124.3, Type 5 or Type 6, without a precoated finish.
 4. Colors and Patterns: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**].
- G. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with the "Physical Characteristics of Materials" Article of ANSI SS1.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cambria.
 - b. Cosentino USA.
 - c. E. I. du Pont de Nemours and Company.
 - d. LG Chemical, Ltd.
 - e. Meganite Inc.
 - f. Samsung Chemical USA, Inc.
 - g. Technistone USA, Inc.
 - h. Transolid, Inc.
 - i. **<Insert manufacturer>**.
 - j. or approved equal.
 2. Colors and Patterns: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's samples**] [**As selected by DEN Project Manager from manufacturer's full range**].
- H. Solid Wood Edges and Trim: Clear [**red oak**] [**white oak**] [**hard maple**] [**cherry**] **<Insert species>** lumber, free of defects, selected for compatible grain and color, and kiln dried to 7 percent moisture content.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install countertops level to a tolerance of **1/8 inch in 8 feet** (3 mm in 2.4 m).
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

1. Install [**backsplashes**] [**and**] [**endsplashes**] to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 2. Seal edges of cutouts in particleboard subtops by saturating with varnish.
- C. ADJUSTING AND CLEANING
- D. In-Progress Cleaning: Clean countertops as work progresses. Remove adhesive, grout, mortar, and sealant smears immediately.
- E. Remove and replace simulated stone countertops of the following description:
1. Broken, chipped, stained, or otherwise damaged stone. Simulated stone may be repaired if methods and results are approved by DEN Project Manager.
 2. Defective countertops.
 3. Defective joints, including misaligned joints.
 4. Interior stone countertops and joints not matching approved Samples and mockups.
 5. Interior stone countertops not complying with other requirements indicated.
- F. Replace in a manner that results in simulated stone countertops matching approved Samples and mockups, complying with other requirements, and showing no evidence of replacement.
- G. Provide final protection and maintain conditions, in a manner acceptable to Fabricator and Installer, which ensures simulated stone countertops being without damage or deterioration at time of substantial completion.
- H. Clean stone countertops no fewer than six (6) days after completion of [**sealant installation**] [**installation**], using clean water and soft rags. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage stone.
- I. Sealer Application: Apply stone sealer to comply with stone producer's and sealer manufacturer's written instructions.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 123661

SECTION 124813 - ENTRANCE FLOOR MATS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Roll-up rail mats.
 - 2. Resilient entrance mats.
 - 3. Resilient-tile entrance mats.
 - 4. **[Recessed] [Surface-mounted]** frames.
- B. Related Requirements:
 - 1. Section 124816 "Entrance Floor Grilles" for rigid floor grilles and frames.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 COORDINATION

- A. Coordinate size and location of recesses in concrete to receive floor mats and frames.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for floor mats and frames.
 - a. Include data substantiating that materials comply with requirements.
- B. Shop Drawings:
 - 1. Items penetrating floor mats and frames, including door control devices.
 - 2. Divisions between mat sections.
 - 3. Perimeter floor moldings.
 - 4. Custom Graphics: Scale drawing indicating colors.

C. Samples: For the following products, in manufacturer's standard sizes:

1. Floor Mat: Assembled sections of floor mat.
2. Tread Rail: Sample of each type and color.
3. Frame Members: Sample of each type and color.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For floor mats and frames to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Resilient-Tile Entrance Mats: Full-size tile units equal to [2] <Insert number> percent of amount installed, but no fewer than [10] <Insert number> units.

1.7 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 ENTRANCE FLOOR MATS AND FRAMES, GENERAL

- A. Structural Performance: Provide roll-up rail mats and frames capable of withstanding the following loads and stresses within limits and under conditions indicated:
 1. Uniform floor load of [300 lbf/sq. ft. (14.36 kN/sq. m)] <Insert value>.
 2. Wheel load of [350 lb (159 kg)] <Insert value> per wheel.
- B. Regulatory Requirements: Comply with applicable provisions in [the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities] [and] [ICC A117.1] <Insert regulation>.

2.2 ROLL-UP RAIL MATS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [American Floor Products Company, Inc.](#)
 2. [American Mat & Rubber Company.](#)
 3. [Arden Architectural Specialties, Inc.](#)
 4. [Balco, Inc.](#)
 5. [Cactus Mat Mfg. Co.](#)
 6. [Crowder, K. N. Manufacturing, Inc.](#)
 7. [C/S Group.](#)
 8. [Durable Corporation.](#)
 9. [J. L. Industries, Inc.](#)
 10. [Kadee Industries, Inc.](#)
 11. [Mats Inc.](#)
 12. [Musson Rubber Company.](#)
 13. [Pawling Corporation; Architectural Products Division.](#)
 14. [Reese Enterprises, Inc.](#)
 15. <Insert manufacturer's name>.
 16. or approved equal.
- B. Roll-up, Aluminum-Rail Hinged Mats: Extruded-aluminum tread rails [1-1/2 inches (38 mm)] [2 inches (50 mm)] <Insert dimension> wide by 3/8 inch (9.5 mm) thick, sitting on continuous vinyl cushions.
1. Tread Inserts: [Plain serrated aluminum treads] [Textured-surface, resilient vinyl] [Ribbed-design-surface, resilient vinyl] [Mineral abrasive particles bonded to or embedded in vinyl] [Aluminum-oxide or silicon-carbide grit in epoxy matrix] [1/4-inch- (6.4-mm-) high, 28-oz./sq. yd. (950-g/sq. m) weight, level-cut, nylon-pile, fusion-bonded carpet] <Insert tread inserts>.
 2. Colors, Textures, and Patterns of Inserts: [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors].
 3. Rail Color: [Mill finish] [Clear] [Light bronze] [Medium bronze] [Dark bronze] [Black] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors and color densities].
 4. Hinges: [Plastic] [Aluminum].
 5. Mat Size: [As indicated] <Insert size>.
- C. Roll-up, Vinyl-Rail Hinged Mats: Vinyl-acrylic tread rails [1-1/2 inches (38 mm)] [2 inches (50 mm)] <Insert dimension> wide by 3/8 inch (9.5 mm) thick, with slotted or perforated hinges.
1. Tread Inserts: [Textured-surface, resilient vinyl] [Ribbed-design-surface, resilient vinyl] [Mineral abrasive particles bonded to or embedded in vinyl] [Aluminum-oxide or silicon-carbide grit in epoxy matrix] [1/4-inch- (6.4-mm-) high, 28-oz./sq. yd. (950-g/sq. m) weight, level-cut, nylon-pile, fusion-bonded carpet] <Insert tread inserts>.

2. Colors, Textures, and Patterns of Inserts: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors].**
3. Rail Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors].**
4. Hinges: **[Vinyl] [Aluminum].**
5. Mat Size: **[As indicated] <Insert size>.**

2.3 RESILIENT ENTRANCE MATS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. [American Floor Products Company, Inc.](#)
2. [American Mat & Rubber Company.](#)
3. [Arden Architectural Specialties, Inc.](#)
4. [Balco, Inc.](#)
5. [Cactus Mat Mfg. Co.](#)
6. [Consolidated Plastics Company, Inc.](#)
7. [C/S Group.](#)
8. [Durable Corporation.](#)
9. [Flexco.](#)
10. [Mats Inc.](#)
11. [Musson Rubber Company.](#)
12. [Pawling Corporation; Architectural Products Division.](#)
13. [Sbemco International Inc.; Matting by Design.](#)
14. [Tennessee Mat Company, Inc.](#)
15. [Tepromark International, Inc.](#)
16. [U.S. Mat & Rubber Corporation.](#)
17. **<Insert manufacturer's name>.**
18. or approved equal.

- B. Resilient Link Mats: Reversible **[vinyl] [rubber] [rubber-tire]** link mats, **[3/8 inch (9.5 mm)] [or] [7/16 inch (11 mm)]** thick, with **[galvanized-spring] [stainless]-steel** wire link rods, vulcanized edge-nosing trim, steel-reinforced end trim, and links consisting of rectangular units or continuous strips in a **[heel-proof, solid-weave pattern with no openings between links] [heel-proof, close-weave pattern with openings between links not exceeding 1/8 inch (3.2 mm) wide by 1 inch (25.4 mm) long] [open-weave pattern].**

1. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors].**
2. Mat Size: **[As indicated] <Insert size>.**

- C. **[Rubber] [or] [Vinyl]** Mats: **[1/4-inch- (6.4-mm-)] [3/8-inch- (9.5-mm-)] [7/16-inch- (11-mm-)] [1/2-inch- (13-mm-)] <Insert dimension>** thick mats; with **[square edges for recessed installations] [beveled edges for surface applications]** and with

[**solid-sheet (no perforations) style**] [**perforated style, 1/4-inch (6.4-mm) diameter on standard spacing**] [**perforated style, 3/16 by 3/4 inch (5 by 19 mm) on standard spacing**], [**standard pyramid design**] [**standard wide-wale corrugated**] [**hi-rib, narrow-wale corrugated**] top profile, and [**low-rib, narrow-wale corrugated**] [**standard knob-base**] [**flat-base**] bottom surface.

1. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors**].
 2. Mat Size: [**As indicated**] <Insert size>.
- D. Cocoa Mats: Constructed from cocoa fiber yarn permanently bonded to PVC backing for dimensional stability and resistance to shedding; [**5/8- to 3/4-inch (16- to 19-mm) overall thickness; 1.5-lb/sq. ft. (7.3-kg/sq. m)**] [**1-inch (25.4-mm) overall thickness; 2.0-lb/sq. ft. (10-kg/sq. m)**] [**1-1/4-inch (32-mm) overall thickness; 2.5-lb/sq. ft. (12-kg/sq. m)**] weight.
1. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors**].
 2. Mat Size: [**As indicated**] <Insert size>.
- E. Rubber-Tire Mats: Units of edge-grain-laminated and chenille-buffed, rubber-tire wall cuts; bonded to sheet rubber or other durable flexible backing sheet to form **3/8- to 7/16-inch- (9.5- to 11-mm-)** thick, **12-inch- (300-mm-)** wide, continuous linear strip up to **25 feet (7.6 m)** long.
1. Mat Size: [**As indicated**] <Insert size>.
- F. Carpet-Type Mats: [**Nylon**] [**Polypropylene**] [**Olefin**] [**Polyester**] carpet bonded to **1/8- to 1/4-inch- (3.2- to 6.4-mm-)** thick, flexible vinyl backing to form mats **3/8 or 7/16 inch (9.5 or 11 mm)** thick with nonraveling edges.
1. Colors, Textures, and Patterns: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors**].
 2. Mat Size: [**As indicated**] <Insert size>.
- G. Loop Filament Mats: Loop filament vinyl material [**3/8 inch (9.5 mm)**] [**1/2 inch (13 mm)**] thick, with [**solid vinyl**] [**foam**] sheet backing and with built-in chemical agents to reduce fungus and mildew.
1. Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors**].
 2. Mat Size: [**As indicated**] <Insert size>.
- H. Graphics: Custom inlaid or woven-in graphic [**design,**] [**logo,**] [**emblem,**] [**characters,**] as indicated.

2.4 RESILIENT-TILE ENTRANCE MATS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [American Floor Products Company, Inc.](#)
 2. [American Mat & Rubber Company.](#)
 3. [Cactus Mat Mfg. Co.](#)
 4. [Consolidated Plastics Company, Inc.](#)
 5. [Durable Corporation.](#)
 6. [Flexco.](#)
 7. [Mats Inc.](#)
 8. [Musson Rubber Company.](#)
 9. [Pawling Corporation; Architectural Products Division.](#)
 10. [Tennessee Mat Company, Inc.](#)
 11. [Turtle Plastics.](#)
 12. <Insert manufacturer's name>.
 13. or approved equal.
- B. Rubber-Tire Tiles: Units of edge-grain-laminated and chenille-buffed, rubber-tire wall cuts; bonded to sheet rubber or other durable flexible backing sheet to form **3/8- to 7/16-inch-** (9.5- to 11-mm-) thick, square tile.
1. Colors, Textures, and Patterns: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors].**
 2. Tile Size: **[12 inches (300 mm)] [As indicated] <Insert size>.**
- C. **[Rubber] [or] [Vinyl] Tiles: [5/8-inch- (16-mm-)] [7/16-inch- (11-mm-)] thick, [solid] [open-grid] [rubber] [or] [vinyl] compound molded tiles with [concealed interlocking joint tabs] [1/4-inch- (6.4-mm-)] deep, serpentine-grooved top face and knob-base back face on solid tile].**
1. Colors, Textures, and Patterns: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors].**
 2. Tile Size: **[As indicated] <Insert size>.**
- D. Carpet-Type Tiles: **[Nylon] [Polypropylene] [Olefin] [Polyester] carpet bonded to 1/8- to 1/4-inch- (3.2- to 6.4-mm-) thick, flexible vinyl backing to form mats 3/8 or 7/16 inch (9.5 or 11 mm) thick with nonraveling edges.**
1. Colors, Textures, and Patterns: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors].**
 2. Tile Size: **[As indicated] <Insert size>.**

2.5 FRAMES

A. Surface-Mounted Frames:

1. Tapered Frames: Tapered [**flexible vinyl edge-**][**aluminum**] frame members, not less than [2 inches (50 mm)] [1-1/2 inches (38 mm)] wide[, **attached to mat at all four edges,**] with welded mitered corners.
 - a. Vinyl Color: [**As indicated by manufacturer's designations**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors**].
 - b. Aluminum Color: [**Mill finish**] [**Clear**] [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**].

B. Recessed Frames: Manufacturer's standard extrusion.

1. Extruded Aluminum: **ASTM B 221** (ASTM B 221M), Alloy 6061-T6 or Alloy 6063-T5, T6, or T52.
 - a. Color: [**Mill finish**] [**Clear**] [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from full range of industry colors and color densities**].
2. Architectural Bronze: ASTM B 455, Alloy UNS No. C38500.

2.6 CONCRETE FILL AND GROUT MATERIALS

- A. Provide concrete fill and grout equivalent in strength to cast-in-place concrete slabs for recessed mats and frames. Use aggregate no larger than one-third fill thickness.

2.7 FABRICATION

- A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.
- B. Surface-Mounted Frames: As indicated for permanent surface-mounted installation, complete with corner connectors, splice plates or connecting pins, and postinstalled expansion anchors.
- C. Recessed Frames: As indicated, for permanent recessed installation, complete with corner pins or reinforcement and anchorage devices.

1. Fabricate edge-frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.
- D. Coat concealed surfaces of aluminum frames that contact cementitious material with manufacturer's standard protective coating.

2.8 ALUMINUM FINISHES

- A. Mill finish.
- B. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
- C. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.

2.9 COPPER-ALLOY (BRONZE) FINISHES

- A. Finish designations prefixed by CDA comply with the system established by the Copper Development Association for designating copper-alloy finishes, as defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products."
 1. Remove tool and die marks and stretch lines, or blend into finish.
 2. Grind and polish surfaces to produce uniform, directionally textured, polished finish, free of cross scratches. Run grain of directional finishes with long dimension of each piece.
- B. CDA Mechanical Finish Designation: [**M11, specular, as fabricated**] [**M32, directionally textured, medium satin**].

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and floor conditions for compliance with requirements for location, sizes, [**minimum recess depth**,]and other conditions affecting installation of floor mats and frames.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install recessed mat frames to comply with manufacturer's written instructions. Set mat tops at height recommended by manufacturer for most effective cleaning action;

coordinate tops of mat surfaces with bottoms of doors that swing across mats to provide clearance between door and mat.

1. For installation in terrazzo flooring areas, provide allowance for grinding and polishing of terrazzo without grinding surface of recessed frames. Coordinate with other trades as required.
2. Install necessary shims, spacers, and anchorages for proper location, and secure attachment of frames.
3. Install grout and fill around frames and, if required to set mat tops at proper elevations, in recesses under mats. Finish grout and fill smooth and level.

B. Install surface-type units to comply with manufacturer's written instructions at locations indicated; coordinate with entrance locations and traffic patterns.

1. Anchor fixed surface-type frame members to floor with devices spaced as recommended by manufacturer.

3.3 PROTECTION

A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 124813

SECTION 124816 - ENTRANCE FLOOR GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes recessed floor grilles and frames.
- B. Related Requirements:
 - 1. Section 124813 "Entrance Floor Mats and Frames" for flexible floor mats and frames.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 COORDINATION

- A. Coordinate size and location of recesses in concrete to receive floor grilles and frames.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for entrance floor grilles and foot grilles.
 - 2. Include data substantiating that materials comply with requirements.
- B. Shop Drawings:
 - 1. Items penetrating floor grilles and frames, including door control devices.
 - 2. Divisions between grille sections.
 - 3. Perimeter floor moldings.
- C. Samples: For the following products, in manufacturer's standard sizes:
 - 1. Floor Grille: Assembled section of floor grille.
 - 2. Frame Members: Sample of each type and color.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For floor grilles and frames to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 FIELD CONDITIONS

- A. Field Measurements: Indicate measurements on Shop Drawings.

1.7 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. [Arden Architectural Specialties, Inc.](#)
 - 2. [Balco, Inc.](#)
 - 3. [Cactus Mat Mfg. Co.](#)
 - 4. [Crowder, K. N. Manufacturing, Inc.](#)
 - 5. [C/S Group.](#)
 - 6. [J. L. Industries, Inc.](#)
 - 7. [Kadee Industries, Inc.](#)
 - 8. [Mats Inc.](#)
 - 9. [Pawling Corporation; Architectural Products Division.](#)
 - 10. [Reese Enterprises, Inc.](#)
 - 11. **<Insert manufacturer's name>**.
 - 12. or approved equal.

2.2 ENTRANCE FLOOR GRILLES, GENERAL

- A. Structural Performance: Provide floor grilles and frames capable of withstanding the following loads and stresses:
 - 1. Uniform floor load of [300 lbf/sq. ft. (14.36 kN/sq. m)] **<Insert value>**.
 - 2. Wheel load of [350 lb (159 kg)] **<Insert value>** per wheel.

- B. Regulatory Requirements: Comply with applicable provisions in **[the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities]** **[and] [ICC A117.1] <Insert regulation>**.

2.3 FLOOR GRILLES

- A. General: Provide manufacturer's standard floor-grille assemblies consisting of treads of type and profile indicated, interlocked or joined together by cross members, and with support legs (if any) and other components needed to produce a complete installation.
- B. **[Aluminum] [Bronze]** Floor Grilles: Provide manufacturer's standard floor grilles with extruded members, top-surfaced tread rails, and as follows:
1. Tread Rails: Extruded-**[aluminum] [bronze]** tread rails.
 - a. Aluminum Color: **[Mill finish] [Clear] [Light bronze] [Medium bronze] [Dark bronze] [Black] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors and color densities]**.
 2. Tread Rail Spacing: **[1-1/2 inches (38 mm) o.c. with 1/8- to 3/16-inch- (3.2- to 4.8-mm-)] [2 inches (50 mm) o.c. with 1/4-inch- (6.4-mm-)] <Insert dimensions>** wide openings between treads.
 3. Top Surface: **[Serrated aluminum] [Serrated bronze] [Serrated vinyl cap with UV stabilizer and antifungal additive] [Textured-surface, resilient vinyl insert] [Aluminum-oxide or silicon-carbide grit in epoxy matrix] [Abrasive particles bonded to or imbedded in vinyl insert] [Fusion-bonded, level-cut-pile nylon carpet insert; 1/4 inch (6.4 mm) high, 28 oz./sq. yd. (950 g/sq. m)]**.
 - a. Top Surface Color: **[Match tread rail] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range of industry colors]**.
 4. Grille Size: **[As indicated] <Insert size>**.
- C. Stainless-Steel Floor Grille: Type 304.
1. Surface Treads: **[0.071-by-0.177-inch (1.8-by-4.49-mm) wire with 0.125-inch- (3.17-mm-)] [0.090-by-0.172-inch (2.2-by-4.37-mm) wire with 0.145-inch- (3.68-mm-)] [0.093-by-0.156-inch (2.36-by-3.96-mm) wire with 0.125-inch- (3.17-mm-)]** wide openings between wires.
 2. Support Rods: Spaced **1 inch (25.4 mm)** o.c., welded to each wire.
 3. Mat Grating: **5/8 inch (15.8 mm)** deep.
 4. Pit Grating: **1-1/8 inches (28.5 mm)** deep.
 5. Stainless-Steel Finish: **[Mill] [No. 4]**.
 6. Grille Size: **[As indicated] <Insert size>**.

- D. PVC Floor Grille: **1/8-by-1-1/2-by-1-inch** (3.2-by-38.1-by-25.4-mm) ribbed top, PVC tread bars joined with **3/8-inch** (9.5-mm) stainless-steel rods with **1-1/16-inch-** (27-mm-) long nylon spacers at **12 inches** (304 mm) o.c. Provide PVC frame with nylon anchors.
1. Colors: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors]**.
 2. Grille Size: **[As indicated] <Insert size>**.
- E. Lockdown: **[Manufacturer's standard] [Hidden] [In view]**.

2.4 FRAMES

- A. Provide manufacturer's standard frames of size and style for grille type, for permanent recessed installation in subfloor, complete with installation anchorages and accessories. Unless otherwise indicated, fabricate frame of same material and finish as grilles.

2.5 SUPPORT SYSTEM

- A. Level Bed Applications: Provide manufacturer's standard, vinyl cushion support system.
- B. Drainage Pit Applications: Provide manufacturer's special deep-pit frame and support extrusion system with intermediate support beams, sized and spaced as recommended by manufacturer for indicated spans and equipped with vinyl support cushions.

2.6 DRAIN PANS

- A. Provide manufacturer's standard[, **0.060-inch-** (1.52-mm-) **thick**], **[metallic-coated steel] [aluminum] [or] [stainless-steel]** sheet drain pan with **NPS 2** (DN 50) drain outlet for each floor-grille unit. Coat bottom of pan with protective coating recommended by manufacturer.

2.7 MATERIALS

- A. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with **A60** (ZF180) zinc-iron-alloy (galvannealed) coating or with **G60** (Z180) mill-phosphatized zinc coating; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified thickness according to ASTM A 924/A 924M.
- B. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.

- C. Aluminum Sheet: **ASTM B 209** (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of Alloy 5005-H15.
- D. Extruded Aluminum: **ASTM B 221** (ASTM B 221M), Alloy 6061-T6 or Alloy 6063-T5, T6, or T52 as standard with manufacturer. Coat surface of frame in contact with cementitious materials with manufacturer's standard protective coating.
- E. Extruded Architectural Bronze: ASTM B 455, Alloy No. C38500.
- F. Stainless-Steel Angles: ASTM A 276 or ASTM A 479/A 479M, corrosion resistant, Type 304.

2.8 FABRICATION

- A. Shop fabricate floor grilles to greatest extent possible in sizes as indicated. Unless otherwise indicated, provide each grille as a single unit; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in grilles are necessary, space symmetrically and away from normal traffic lanes.
- B. Fabricate frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.

2.9 ALUMINUM FINISHES

- A. Mill finish.
- B. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
- C. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.

2.10 STAINLESS-STEEL FINISHES

- A. Mill finish.
- B. Directional Satin Finish: No. 4.
 - 1. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.11 COPPER-ALLOY (BRONZE) FINISHES

- A. Finish designations for copper alloys comply with the system established for designating copper-alloy finish systems defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products."
 - 1. Remove tool and die marks and stretch lines, or blend into finish.
 - 2. Grind and polish surfaces to produce uniform, directionally textured, polished finish, free of cross scratches. Run grain of directional finishes with long dimension of each piece.
- B. Mechanical Finish Designation: [**M11, specular, as fabricated**] [**M32, directionally textured, medium satin**].

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and floor conditions for compliance with requirements for location, size, minimum recess depth, and other conditions affecting installation of floor grilles and frames.
- B. Examine roughing-in for drainage piping systems to verify actual locations of piping connections before floor grille and frame and drain pan installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install recessed floor grilles and frames[**and drain pans**] to comply with manufacturer's written instructions at locations indicated and with top of floor grilles and frames in relationship to one another and to adjoining finished flooring as recommended by manufacturer. Set floor-grille tops at height for most effective cleaning action.[**Coordinate top of floor-grille surfaces with doors that swing across grilles to provide clearance under door.**]

3.3 PROTECTION

- A. After completing frame installations, provide temporary filler of plywood or fiberboard in floor-grille recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 124816

SECTION 126100 - FIXED AUDIENCE SEATING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes fixed audience seating with the following:
 - 1. **[Standard] [Beam] [Pedestal]** mounting.
 - 2. **[Upholstered chairs] [Molded-plastic chairs] [Molded-plastic chairs with upholstered inserts] [Formed hardwood-veneer chairs]**.
 - 3. Lecture-hall tables.
 - 4. **[Power] [and] [data]** service to individual seat locations.
- B. Owner-Furnished Material: Upholstery fabric.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. Pan: An exposed, supporting seat bottom made of steel.
- B. Shell: An exposed, supporting seat bottom or back made of materials other than steel.
- C. Tablet Arm: A flat surface attached to a chair that has the primary function to support tasks such as writing and short-term reference-material handling.

1.4 ALLOWANCES

- A. Fixed audience seating is part of fixed audience seating allowance.
- B. Fabric for fixed audience seating is part of **<Insert allowance designation>** allowance.
- C. Installation of Owner-furnished upholstery fabric is part of fixed audience seating allowance.

1.5 COORDINATION

- A. Coordinate layout and installation of electrical wiring and devices with seating layout to ensure that floor junction boxes for electrical devices are accurately located to allow connection without exposed conduit.
- B. Coordinate layout and installation of diffuser pedestals with HVAC work and with properties of diffuser pedestals to ensure alignment, proper air diffusion, and correct seat locations.

1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager] <Insert location>**.

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of components, and finishes for fixed audience seating.
 - 2. Include electrical characteristics of electrical components, devices, and accessories.
 - 3. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.4: For composite wood products, documentation indicating that product contains no urea formaldehyde.
 - 2. Laboratory Test Reports for Credit IEQ 4.4: For composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Seating Layout: Show seating layout, aisle widths, aisle-end alignment or stepping, row-lettering and chair-numbering scheme, chair widths, and chair spacing in each row.
 - 2. Accessories: Show locations and features of accessories, including **[left- and right-hand tablet arms] [electrical devices] [bookracks] <Insert item>**, and accessibility provisions.
 - 3. Wiring Diagrams: For power, signal, and control wiring.
- D. Samples for Initial Selection: For each type of exposed color, finish, texture, and pattern indicated.

1. Include Samples of accessories involving color and finish selection.
- E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
1. Chair Unit: Full-size unit of each type[**and combination of finishes**].
 2. Molded Plastic: Manufacturer's standard-size unit, not less than **3 inches** (75 mm) square.
 3. Plastic Laminate: Manufacturer's standard-size unit, not less than **3 inches** (75 mm) square.
 4. Baked-on Coating Finishes: Manufacturer's standard-size unit, not less than **3 inches** (75 mm) square.
 5. Aluminum Finishes: Manufacturer's standard-size unit, not less than **3 inches** (75 mm) square.
 6. Wood and Plywood Materials and Finishes: Manufacturer's standard-size unit, not less than **3 inches** (75 mm) square.
 7. Upholstery Fabric: Full width by [**36-inch-** (914-mm-)] **<Insert dimension>** long section of fabric from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of fabric.
 8. Row-Letter and Chair-Number Plates: Full-size units with letters and numbers marked.
 9. Aisle Lighting: Full-size unit.
 10. Power[**and Data**] Service Devices: Full-size units.
 11. Bookracks: Full-size unit.
 12. Exposed Fasteners: Full-size units of each type.

1.8 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of fixed audience seating.
- B. Material Certificates: For each type of flame-retardant treatment of fabric.
- C. Field quality-control reports.
- D. Sample Warranty: For special warranty.

1.9 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fixed audience seating to include in operation and maintenance manuals.
 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Maintenance of self-rising seat mechanisms, folding armrests, and other operating components.
 - b. Adjustment of self-rising seat mechanisms to align seats.
 - c. Maintenance of electrical components, devices, and accessories.
 - d. Methods for maintaining upholstery fabric.

- e. Precautions for cleaning materials and methods that could be detrimental to seating finishes and performance.

- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.10 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials from the same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Chair Seats and Backs: [5] <Insert number> percent of quantity installed for each type and size of chair seat and back.
 2. Upholstered, Slip-on Cushions: [5] <Insert number> percent of quantity installed for each type and size of cushion.
 3. Tablet Arms: [5] <Insert number> percent of quantity installed for each type and size of tablet arm; left- and right-hand mounted.
 4. Armrests: [5] <Insert number> percent of quantity installed for each type of armrest.
 5. Power Receptacles: [5] <Insert number> percent of quantity installed.
 6. Data Ports: [5] <Insert number> percent of quantity installed.
 7. Chair Seat Hinges: [5] <Insert number> percent of quantity installed.
 8. Aisle-Lighting Fixture Bulbs: [5] <Insert number> percent of quantity installed.
 9. Donor Plates: [100] <Insert number>.
 10. Bookracks: [5] <Insert number> percent of quantity installed

1.11 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, demonstrate aesthetic effects, and set quality standards for fabrication and installation.
 1. Build mockups of [area of fixed audience seating indicated on Drawings] [two typical seats or a typical two-seat unit] [two typical seats in width and two typical rows deep with lecture-hall table between the rows] <Insert requirement>, including finishes and accessories:
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.12 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of fixed audience seating that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Structural failures including standards, beams, and pedestals.
 - b. Faulty operation of self-rising seat mechanism.
 - c. Faulty operation of electrical components.
 - d. Wear and deterioration of fabric and stitching beyond normal use.
 - e. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - f. **<Insert failure modes>**.
2. Warranty Periods: As follows, from date of Substantial Completion.
 - a. Structural: Minimum **[five (5) years] [ten (10 years)] [Lifetime]**.
 - b. Operating Mechanisms: Minimum **[three (3) years] [five (5) years] [Lifetime]**.
 - c. Electrical Components: Minimum **[three (3)] [five (5)]** years.
 - d. Plastic, Wood, and Paint Components: Minimum **[two (2)] [three (3)] [five (5)]** years.

1.13 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Source Limitations: Obtain each type of seating required, including accessories and mounting components, from single source from single manufacturer.
 1. Upholstery Fabric: Obtain fabric of a single dye lot for each color and pattern of fabric required.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics of Upholstered Chairs:
 1. Fabric: Class 1 according to DOC CS 191-1953 or 16 CFR 1610, tested according to California Technical Bulletin 117.
 2. Padding: Comply with California Technical Bulletin 117.
 3. Full-Scale Fire Test: Comply with California Technical Bulletin 133.

- B. Strength and Durability Performance: Chairs and components shall pass testing according to BIFMA X5.4.

2.3 FIXED AUDIENCE SEATING <Insert drawing designation>

- A. Fixed Audience Seating: Assembly-space seating in permanent arrangement <Insert description> as shown on Drawings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Seating Company.
- b. Clarin Seating.
- c. Ducharme Seating International Inc.
- d. GreyStone International, Inc.
- e. Hussey Seating Company.
- f. Interkal LLC.
- g. Irwin Seating Company.
- h. KI, Inc.
- i. Preferred Seating Co. Inc.
- j. Seating Concepts LLC.
- k. SERIES LLC.
- l. Sitmatic.
- m. Theatre Solutions, Inc.
- n. Track Seating; a division of Track Corporation.
- o. <Insert manufacturer's name>.
- p. or approved equal.

- B. Chair Mounting Standards: [Floor] [Riser] attached of the following material:

1. Steel: One-piece, heavy-tube or reinforced sheet with welded mounting plate and welded connections for seat pivots, backs, armrests, and end panels.
2. Cast [Iron] [Aluminum]: One-piece castings with integral mounting points and attachment anchoring points for seat pivots, backs, and armrests.
3. Molded Plastic: One-piece, solid injection-molded plastic with integral reinforcing ribs and attachment anchoring points for seat pivots, backs, and armrests.

- C. Chair Mounting Beam: Steel horizontal beam mounted on [floor] [riser]-attached steel support pedestals spaced at intervals of 2 to 2-1/2 chair widths. [Chair attachments equipped with 180-degree swivel capability, returning to forward position when unoccupied.]

- D. Chair Mounting Pedestal: Floor-attached pedestal, manufacturer's standard [base with 90-degree left and right rotation capability] [base with 360-degree swivel capability] [diffuser pedestal at location(s) indicated] <Insert description>.

- E. End Panels:

1. Material: **[Steel] [Cast iron with design] [Cast aluminum with design] [Plastic laminate] [Hardwood-veneer plywood] [Solid hardwood] [Fabric upholstered] [Molded plastic]**.
 - a. Cast-Metal Design: **[As indicated by manufacturer's designations] [As selected by DEN Project Manager from manufacturer's full range] <Insert design>**.
 2. Decorative Insert: **[Plastic laminate] [Hardwood-veneer plywood] [Solid hardwood] [Fabric upholstered] [Molded plastic] [Customized medallion]**.
 3. Style: **[Rectangular] [Oval] [Teardrop] [Tapered] [Panel to floor (pew)] <Insert requirement>** with **[square] [rounded]** corners.
- F. Fabric Upholstered Chairs:
1. Back:
 - a. Padding Thickness: **[1-1/4 inches (32 mm)] [2 inches (51 mm)] [3 inches (76 mm)] <Insert dimension>**.
 - b. Outer Back Surface: **[Steel] [Molded plastic] [Fabric upholstered with 1/4-inch (6-mm) padding] [Plastic laminate] [Hardwood-veneer plywood] <Insert requirement>**, with **[concealed] [exposed]** fasteners.
 - c. Top Corners: **[Square] [Rounded]**.
 - d. Upholstery Options: **[Tufting] [decorative stitching] [and] [welt cord trim] <Insert option>**.
 2. Seat: **[Two part, top and bottom construction] [One part, fully upholstered construction] [One part, fully upholstered construction with removable upholstery cover]** and as follows:
 - a. Top Padding Thickness: Minimum **[1-1/2 inches (38 mm)] [3 inches (76 mm)] [4 inches (102 mm)] <Insert dimension>** at front and rear edges.
 - b. Seat Bottom: **[Steel sheet seat pan] [Perforated steel sheet seat pan with acoustical insulation] [Hardwood-veneer-faced, formed plywood shell] [Molded-plastic shell] [Fabric upholstered] <Insert requirements>**.
- G. Plastic Chairs: **[Single] [Double]**-wall molded plastic and as follows:
1. Back: **[Smooth surface] [Textured surface] [Formed slats] [Smooth surface with upholstered inserts] [Textured surface with upholstered inserts]** with **[square] [rounded]** top corners **<Insert description>**.
 2. Seat: **[Smooth surface] [Textured surface] [With simulated slats] [Smooth surface with upholstered inserts] [Textured surface with upholstered inserts] <Insert description>**.
 3. Upholstered Inserts: Padding and fabric covering over **1/8-inch (3-mm)** plywood or medium-density fiberboard backing board, recessed **[3/16 inch (5 mm)] <Insert dimension>** into plastic surface, centered, and attached with hidden, vandal-resistant fasteners.

- H. Formed Hardwood-Veneer Chairs: Hardwood-veneer-faced, formed plywood backs and seats, with **[concealed] [exposed]** fasteners.
1. Back Top Corners: **[Square] [Rounded] <Insert requirement>**.
- I. Chair Width: **[Vary chair widths to optimize sightlines and row lengths] [Single-width chair in each row]**, with **[minimum]** chair width of **[18 inches (457 mm)] [19 inches (483 mm)] [20 inches (508 mm)] [21 inches (533 mm)] [22 inches (559 mm)] [23 inches (584 mm)] [24 inches (610 mm)] <Insert dimension>** from center to center of armrests.
- J. Back Height: **[Standard] [High] [Planetarium]-style backs**, **[31 inches (787 mm)] [32-1/2 inches (826 mm)] [35 inches (889 mm)] [38 inches (965 mm)] [40 inches (1016 mm)] [44 inches (1117 mm)] <Insert dimension>** high.
- K. Back Pitch: **[Fixed] [Variable at set angles (planetarium)] [Variable, hinged (rocker)]**.
1. Back Angle: **[Angle for optimum viewing comfort] [Different angles within manufacturer's available range, for optimum viewing comfort at each location] [16 degrees] [18 degrees] [20 degrees] [21 degrees] [24 degrees] <Insert requirement>**.
 2. Chair Back Hinges: Self-lubricating type with noiseless mechanism that raises back to vertical position when chair is unoccupied.
- L. Chair Seat Hinges: Self-lubricating, with noiseless **[self-rising seat mechanism passing ASTM F 851] [manual operation]**, positive internal stops cushioned with rubber or neoprene, and requiring no maintenance.
1. Self-Rising Seat Mechanism: **[Spring actuated, three-quarter fold] [Spring actuated, full fold] [Gravity actuated, full fold]**.
 2. Reclining Mechanism: Manufacturer's standard mechanism for reclining planetarium chairs.
- M. Armrests: **[Molded plastic] [Solid hardwood] [Upholstered] [Plastic laminate on medium-density fiberboard] [Integral scrolled cast iron]** with rounded edges[, **integral cup holder,**] and concealed mounting.
1. Folding Armrests: Equip seating with **[folding aisle armrests where indicated] [and] [folding center armrests]**.
- N. Aisle-Lighting Fixtures: Manufacturer's standard **[round] [rectangular-louvered] [concealed-in-armrest] <Insert description>** fixtures.
1. Bulb: **[LED] [or] [incandescent] <Insert bulb type>**.
 2. Power: **[12] [24] [or] [120] <Insert value> V**.
 3. For low-voltage lighting, provide manufacturer's voltage-reduction device housed in safety enclosure equipped with fuses, terminal blocks, and safety disconnect.

- O. Power and Data Service Package: **[Manufacturer's standard service]** **[Service]** to each seat position **[indicated]**, including terminal devices and wiring with **18 inches** (457 mm) of extra length and as follows:
1. Power Receptacles: 120 V with wiring and **[duplex]** receptacle.
 2. Data Ports: Data-port terminal with wiring and receptacle jack **[of type indicated]** **<Insert type>**.
 3. Location: **[Manufacturer's standard location]** **[On raceway beneath the seating]** **[In the armrest]** **[Beneath the armrest on front or side of the standard]** **[In back panel of seat in front]** **<Insert requirement>**.
- P. Tablet Arms: **[Manufacturer's standard-size]** **[Manufacturer's oversize]** **<Insert size in minimum sq. in. (sq. mm) of surface area>**, **[fixed]** **[foldaway]** tablet arm with plastic-laminate writing surface over medium-density fiberboard or plywood core and with rounded, matching PVC edges.
1. Mounting: **[Right-hand mounted unless otherwise indicated]** **<Insert mounting>**.
 2. Fold-Away Mechanism: Cast-iron or steel hinge and swivel mechanism that give positive support in open position and semiautomatic return to stored position below arm block and parallel to chair.
- Q. Accessible Seating:
1. Provide **[removable]** **[rollaway]** **[swing-away]** chair for each wheelchair space unless otherwise indicated.
 2. Provide chairs with folding armrest on aisle side in locations indicated, but not less than five percent of aisle seats, dispersed through the audience seating area. Identify these seats with a sign or marker.
- R. Row-Letter and Chair-Number Plates: **[Manufacturer's standard]** **<Insert description>**.
1. Material: **[Aluminum]** **[Bronze]** **[Stainless steel]** **<Insert material>** with black embossed characters.
 2. Location: **[As indicated on Drawings]** **[row letter on top of aisle armrest]** **[chair number on front edge of seat]** **[and]** **[chair number on top edge of back]** **<Insert requirement>**.
 3. Attachment: **[Manufacturer's standard method]** **[Adhesive]** **[Minimum of two mechanical fasteners]** **<Insert attachment>**.
- S. **[Accessibility-Logo]** **[and]** **[Donor]** Plates: **[Manufacturer's standard]** **<Insert description>**.
1. Material: **[Aluminum]** **[Bronze]** **[Stainless steel]** **<Insert material>** with black embossed characters.
 2. Location: **[As indicated on Drawings]** **[Top of armrest]** **[Front of chair back]** **<Insert requirement>**.
 3. Attachment: **[Manufacturer's standard method]** **[Adhesive]** **[Minimum of two mechanical fasteners]** **<Insert attachment>**.

- T. Bookracks: Manufacturer's standard [**under-chair**] [**or**] [**back-of-chair**] boxes, matching material and finish of mounting surface.

1. Size: Minimum **<Insert dimensions>**.

2.4 LECTURE-HALL TABLES **<Insert drawing designation>**

- A. Lecture-Hall Tables: Continuous tables in permanent arrangement **<Insert description>** as indicated on Drawings.

1. Manufacturer: Subject to compliance with requirements, provide products by the same manufacturer as for fixed audience seating.

- B. Supports: Attached to [**floor**] [**fixed audience seating**] and matching construction and finish structure for fixed audience seating.

- C. Table Top: Manufacturer's standard construction, [**plastic laminate on medium-density fiberboard**] [**hardwood-veneer plywood**] **<Insert requirement>** with rounded edges[, **integral pencil groove**,] and concealed mounting.

1. Depth: [**Manufacturer's standard**] **<Insert dimension>**.

- D. Modesty Panels: Manufacturer's standard construction, [**matching Tabletop**] [**plastic laminate on medium-density fiberboard**] [**hardwood-veneer plywood**] [**perforated steel**] [**fabric upholstered**] **<Insert requirement>**.

1. Height: [**Full height to 1 inch (25 mm) above floor**] [**24 inches (610 mm)**] [**14 inches (356 mm)**] **<Insert dimension>**.

- E. Power and Data Service Package: [**Manufacturer's standard service**] [**Service**] to each seat position[**indicated**], including terminal devices and wiring with **18 inches (457 mm)** of extra length and as follows:

1. Power Receptacles: 120 V with wiring and[**duplex**] receptacle.
2. Data Ports: Data-port terminal with wiring and receptacle jack [**of type indicated**] **<Insert type>**.
3. Location: [**Manufacturer's standard location**] [**On raceway beneath the tabletop**] **<Insert requirement>**.

2.5 MATERIALS AND FINISHES

- A. Composite Wood Products: [**Made with binder containing no urea formaldehyde.**] [**Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."**]

1. Medium-Density Fiberboard: ANSI A208.2, Grade MD.

2. Concealed Plywood: HPVA HP-1 hardwood plywood or DOC PS 1 softwood plywood as standard with manufacturer.
 3. Exposed Plywood: HPVA HP-1, Face Grade A, hardwood-veneer core with color-matched hardwood-veneer faces.
- B. Hardwood Lumber and Veneer Faces: **[American black walnut] [Red oak] [Teak] [Birch] [Cherry] [Maple] <Insert wood species>** selected to be free of visible defects.
1. Stain and Finish: **[Manufacturer's standard, transparent, ultraviolet (UV)-resistant, protective finish] [As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert stain and finish>**.
- C. Plastic Laminate: NEMA LD 3, Grade VGS for vertical surfaces and Grade HGS for horizontal surfaces.
1. Color and Pattern: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and pattern>**.
- D. Molded Plastic: High-density polyethylene or polypropylene, blow or injection molded, with surface that is mar and dent resistant.
1. Provide with UV inhibitors to retard fading.
 2. Color and Texture: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and texture>**.
- E. Fabric: Manufacturer's standard **[100 percent nylon] [100 percent polyolefin] <Insert fiber>** with flame-retardant treatment.
1. Weight: **[12 oz./linear yd. (0.37 kg/linear m)] [16 oz./linear yd. (0.50 kg/linear m)] [18 oz./linear yd. (0.56 kg/linear m)] [20 oz./linear yd. (0.62 kg/linear m)] <Insert weight>**.
 2. Color and Pattern: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and pattern>**.
- F. Upholstery Padding: Flexible, cellular, molded or slab polyurethane foam.
- G. Metal Finish: Finish exposed metal parts with manufacturer's standard **[polyurethane] [baked-on] [minimum 1.5-mil- (0.04-mm-) thick, polyester baked-on powder] [minimum 1.5-mil- (0.04-mm-) thick, epoxy baked-on powder] [minimum 70 percent by weight, PVDF fluoropolymer resin baked-on powder]** coating.
1. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.

2.6 FABRICATION

- A. Floor Attachments: Fabricate to conform to floor slope so that standards and pedestals are plumb and chairs are maintained at same angular relationship to vertical throughout Project.
- B. For beam-mounted chairs[**and tables**] in curved patterns, curve the beam uniformly to the various radii required for the rows.
- C. Upholstery: Fabricate fabric-covered cushions with molded padding beneath fabric and with fabric covering free of welts, creases, stretch lines, and wrinkles. For each upholstered component, install pile and pattern run in a consistent direction.
- D. Upholstered Chairs: Fabricate as follows:
 - 1. Two-Part Upholstered Back: Padded cushion glued to a curved steel, plywood, or molded-plastic inner panel and covered with easily replaceable fabric; with curved outer back shell that fully encloses upholstery edges.
 - 2. Two-Part, Steel-Pan Seats: Upper part, an upholstered cushion with molded padding over no fewer than **[five]** **<Insert number>** serpentine springs attached to reinforced steel frame, with weight-distributing and abrasion-resistant sheeting separating padding from springs, and removable for reupholstering without removing steel pan from chair. Lower part, a steel pan, reinforced at stress points and completely enclosing hinges and self-rising mechanism.
 - 3. Two-Part, Molded-Plastic Seats: Upper part, an upholstered cushion with formed padding over a five-ply plywood panel[**with fabric cover conforming to shape of cushion to conceal inner seat structure and hinge mechanism**]. Lower part, a molded-plastic shell.
 - 4. One-Part Seats: Double-wall plastic shells **[fitted with a padded upholstered cushion and covered with easily replaceable fabric]** **[padded and fully upholstered]**.
- E. Double-Wall, Molded-Plastic Chairs: Contoured seat and back fabricated of double-wall, blow-molded plastic; both sides of seat and back components are finished surfaces. Reinforce plastic with interior steel plates at attachment points.
- F. Single-Wall, Molded-Plastic Chairs: Contoured plastic shell with smoothly rolled edges and reinforcing ribs on underside of shell. Fabricate for attachment of chair to support with self-threading, corrosion-resistant screws.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine floors, risers, and other adjacent work and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Verify that electrical connections are properly located.

- C. Verify that HVAC air-distribution locations are correct.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install seating[**and tables**] in locations indicated and fasten securely to substrates according to manufacturer's written installation instructions.
 - 1. Install fixed audience seating with each chair capable of complying with performance requirements without failure or other conditions that might impair the chair's usefulness.
 - 2. Install standards and pedestals plumb.
 - 3. Install seating so moving components operate smoothly and quietly.
- B. Install seating[**and tables**] with end standards aligned or stepped as indicated from first to last row and with backs and seats varied in [**width**] [**and**] [**spacing**] to optimize sightlines.
- C. Install riser-mounted standards and attachments to maintain uniform chair heights above floor.
- D. Install chairs[**and tables**] in curved rows at a constant radius.
- E. Install wiring conductors and cables concealed in components of seating[**and tables**] and accessible for servicing.
 - 1. Connect electrical service at junction-box locations according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
 - 2. Connect voice and data communication service at junction-box locations according to Section 271500 "Communications Horizontal Cabling."

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections[**with the assistance of a factory-authorized service representative**]:
 - 1. Inspect components, assemblies, and equipment, including connections, to verify proper, complete, and sturdy installation according to manufacturer's written instructions and product specifications.
 - 2. Verify that seats return to correct and uniform at-rest position.
 - 3. Test power receptacles as specified in Section 262726 "Wiring Devices" when power is activated.
 - 4. Test data ports when data connection is activated.
- B. Fixed audience seating will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust chair backs so that they are at proper angles and aligned with each other in uniform rows.
- B. Adjust hardware and moving parts to function smoothly so they operate easily. Lubricate bearings and sliding parts as recommended in writing by manufacturer.
- C. Adjust self-rising seat mechanisms so seats in each row are aligned when in upright position.
- D. Repair minor abrasions and imperfections in finishes with coating that matches factory-applied finish.
- E. Replace damaged and malfunctioning components that cannot be acceptably repaired.
- F. Replace upholstery fabric damaged during installation or work of other trades.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 126100

SECTION 129200 - INTERIOR PLANTERS AND ARTIFICIAL PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Freestanding interior planters.
2. Freestanding planters with built-in subirrigation.
3. Site-installed, self-contained subirrigation units.
4. Planter liners.
5. Manufactured interior plants.

B. Owner-Furnished, Contractor-Installed Material: **<Insert product>**.

C. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for site-built, cast-in-place concrete planters.
2. Section 033300 "Architectural Concrete" for site-built, cast-in-place architectural concrete planters.
3. Section 034500 "Precast Architectural Concrete" for plant-cast architectural planters.
4. Section 042000 "Unit Masonry" for site-built masonry planters.
5. Section 044313.13 "Anchored Stone Masonry Veneer" for site-built natural stone planters.
6. Section 044313.16 "Adhered Stone Masonry Veneer" for site-built natural stone planters.
7. Section 047200 "Cast Stone Masonry" for plant-manufactured cast stone planters.
8. Section 328400 "Planting Irrigation" for interior above-grade or suspended irrigation systems.
9. Section 329300 "Plants" for interior live plants, planting mediums, and planting accessories.
10. Section 334713 "Pond and Reservoir Liners" for interior ponds.

D. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ALLOWANCES

- A. Work of this Section is part of **[Interior Planter and Artificial Plant Allowance]** **<Insert allowance>**.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site]** **[location and time as determined by DEN Project Manager]** **<Insert location>**.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings:
1. Metal Plant Liners: Show layouts, profiles, shapes, seams, and dimensions.
 2. Self-Contained Subirrigation Units: Show fabrication and installation details of units and accessories.
- C. Samples: For each freestanding planter finish, color, and texture specified, not less than **3 by 3 inches** (76 by 76 mm) in size.
- D. Product Schedule:
1. For freestanding interior planters, include the following:
 - a. Finish, color, and texture.
 - b. Dimensions.
 - c. Manufacturer's name.
 - d. Manufacturer's product designation.
 2. For manufactured interior plants, include the following:
 - a. Plant height.
 - b. Plant width.
 - c. 35-mm color print or digital photographic record.
 - d. Manufacturer's name.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For interior **[planters]** **[and]** **[manufactured interior plants]** to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300

"Submittal Procedures".

1.7 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 FREESTANDING INTERIOR PLANTERS <Insert drawing designation>

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. <Insert manufacturer's name>.
 2. or approved equal.
- B. Type: [**Hanging**] [**Tabletop**] [**Panel/Wall mounted**] [**Floor mounted**].
- C. Material: [**Ceramic**] [**Fiberglass**] [**Metal**] [**Plastic**] [**Cast stone**] [**Terra cotta**] [**Wood**] <Insert material>.
- D. Inside Width: <Insert inches (mm)>.
- E. Outside Width: <Insert inches (mm)>.
- F. Inside Length: <Insert inches (mm)>.
- G. Outside Length: <Insert inches (mm)>.
- H. Inside Diameter: <Insert inches (mm)>.
- I. Outside Diameter: <Insert inches (mm)>.
- J. Height: <Insert inches (mm)>.
- K. Pattern: <Insert manufacturer's designation>.
- L. Color: <Insert manufacturer's designation>.
- M. Finish: <Insert manufacturer's designation>.
- N. Accessories: [**Planter pad**] [**Matching saucer**] [**Carpet protector disc**] [**Casters**] <Insert accessory>.

2.2 FREESTANDING PLANTERS WITH BUILT-IN SUBIRRIGATION <Insert drawing designation>

- A. General Planter Requirements: Freestanding, self-contained, seamless, one-piece units; low-density polyethylene with subirrigation unit, exterior drainage adapter, integral air and watertight reservoir, vacuum sensor system, and tamper-resistant stopper.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Jardinier Planter Systems, Inc.](#)
 - b. [PLAYMOBIL USA, Inc., Lechuza Division.](#)
 - c. [TourneSol Siteworks, Inc.](#)
 - d. <Insert manufacturer's name>.
 - e. or approved equal.
 2. Color: <Insert color>.
 3. Accessories: [Tree tie downs, three per container] [Security tie downs] [Root-control fabric] <Insert accessory>.

2.3 SITE-INSTALLED, SELF-CONTAINED SUBIRRIGATION UNITS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. [Jardinier Planter Systems, Inc.](#)
 2. [TourneSol Siteworks, Inc.](#)
 3. <Insert manufacturer's name>.
 4. or approved equal.
- B. Provide fittings and accessories necessary for proper functioning of unit as recommended by manufacturer and as follows:
1. <Insert required fittings and accessories, in separate subparagraphs, to suit Project>.

2.4 PLASTIC PLANTER LINERS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. [PLAYMOBIL USA, Inc., Lechuza Division.](#)
 2. [TourneSol Siteworks, Inc.](#)
 3. <Insert manufacturer's name>.
 4. or approved equal.

- B. Seamless Modular Planter Liners: Thermoplastic, **[high-impact polystyrene] [linear low-density polyethylene]** plastic unibody construction with no seams or welded joints.
1. Color: **[Black] <Insert color>**.
- C. Welded Modular Planter Liners: Stress-relieved polypropylene plastic with welded rigid wall sections.
1. Color: **[Black] <Insert color>**.

2.5 METAL PLANT LINERS

- A. Materials:
1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, **G90 (Z275)** coating designation; structural quality, mill phosphatized for field painting, **[0.0276 inch (0.7 mm)] [0.0336 inch (0.85 mm)] <Insert thickness>** thick.
 2. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, No. 2D finish, **[0.040 inch (1.0 mm)] [0.050 inch (1.2 mm)] <Insert thickness>** thick.
 3. Copper Sheet: ASTM B 370, Temper H00 or H01, cold-rolled copper sheet, **[16 oz./sq. ft. (0.55 mm thick)] [20 oz./sq. ft. (0.7 mm thick)] <Insert weight (thickness)>**.
 4. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal and remain watertight.
 5. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
 6. Solder for Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.
- B. Fabrication:
1. Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of planter liner indicated.
 2. Shop fabricate where practical. Obtain field measurements for accurate fit before shop fabrication.
 3. Fabricate sheet metal without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 4. Fabricate sheet metal joints with soldered, flat-lock seams. Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of **1-1/2 inches (38 mm)**.
 - a. Stainless-Steel Soldering: Pretin edges of uncoated sheets to be soldered using phosphoric acid flux and solder for stainless steel. Promptly wash off acid flux residue from metal after soldering.
 - b. Copper Soldering: Tin uncoated copper surfaces at edges of sheets using solder for copper.

5. Fabricate joints in sheet metal to accommodate elastomeric sealant.
 - a. Seal joints with elastomeric sealant as required for watertight construction. Embed hooked flanges of joint members not less than **1 inch (25 mm)** into sealant. Form joints to completely conceal sealant. Prepare joints and apply sealants according to manufacturer's written instructions.

2.6 MANUFACTURED INTERIOR PLANTS <Insert drawing designation>

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. **<Insert manufacturer's name>**.
 2. or approved equal.
- B. Plant Type: **<Insert description>**.
- C. Treat trunk, branch, and foliage surfaces with flame retardant to comply with NFPA 701.

2.7 MINERAL MULCH

- A. Mineral Mulch: Hard, durable stone, washed free of loam, sand, clay, and other foreign substances, of the following type, size range, and color:
 1. Type: **[Rounded riverbed gravel or smooth-faced stone] [Crushed stone or gravel] [Marble chips] [Granite chips] <Insert material>**.
 2. Size Range: **[1-1/2 inches (38 mm) maximum, 3/4 inch (19 mm) minimum] [3/4 inch (19 mm) maximum, 1/4 inch (6 mm) minimum]**.
 3. Color: **[Uniform tan-beige color range acceptable to DEN Project Manager] [Readily available natural gravel color range] <Insert color>**.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine installation areas, with Installer present, for compliance with environmental requirements and other conditions affecting installation and performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before installation, lay out interior planters in locations indicated. Adjust locations when requested by DEN Project Manager and obtain DEN Project Manager's acceptance of layout before installation.

3.3 FREESTANDING PLANTER PLACEMENT

- A. Install freestanding planters level and plumb. Use concealed shims where required for alignment.
- B. Remove stickers and other temporary labels from interior planters.

3.4 INSTALLATION OF SELF-CONTAINED SUBIRRIGATION UNITS

- A. Install self-contained subirrigation units into planters according to manufacturer's written instructions, level and plumb.
- B. Install drainage overflow adapters prior to installing self-contained subirrigation units.
- C. Trim fill tubes to no less than **1 inch (25 mm)** higher than level of planting medium.

3.5 INSTALLATION OF PLANTER LINERS

- A. Set liners in planters [**according to freestanding planter manufacturer's written instructions**] [**as indicated on Drawings**].
- B. Install liners to allow for liner removal.

3.6 MANUFACTURED PLANT PLACEMENT

- A. Set manufactured plants at locations indicated on Drawings according to manufacturer's written instructions.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 129200

SECTION 129300 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Seating.
2. Tables.
3. Bicycle racks.
4. Bicycle lockers.
5. Trash receptacles.
6. Ash receptacles.
7. Planters.
8. Bollards.

- B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for **[installing pipe sleeves cast]** **[installing anchor bolts cast]** **[formed voids]** in concrete footings.
2. Section 312000 "Earth Moving" for excavation for installing concrete footings.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include data substantiating that materials comply with requirements.

- B. LEED Submittals:

1. Product Data for Credit MR 4.1[**and Credit MR 4.2**]: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Certificates for **[Credit MR 6]** **[Credit MR 7]**: Chain-of-custody certificates indicating that wood components of site furnishings comply with forest

certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.

- C. Samples: For each exposed product and for each color and texture specified.
- D. Samples for Initial Selection: For units with factory-applied finishes.
- E. Samples for Verification: For each type of exposed finish, not less than **6-inch-** (152-mm-) long linear components and **4-inch-** (102-mm-) square sheet components.
 - 1. Include full-size Samples of **[bench] [table] [bicycle rack] [trash receptacle] [ash receptacle] <Insert product>**.
- F. Product Schedule: For site furnishings. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For site furnishings.
 - 1. Wood Preservative Treatment: Include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For site furnishings to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Bench Replacement **[Slats] [Planks]**: No fewer than **[two] <Insert number>** full-size units for each size indicated.
 - 2. Trash Receptacle Inner Containers: **[Five] <Insert number>** full-size units for each size indicated, but no fewer than **[two] <Insert number>** units.
 - 3. Anchors: **<Insert type and number>**.

1.7 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to

satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 [SEATING] [AND] [TABLES] <Insert drawing designation>

A. Products: Subject to compliance with requirements, provide one of the following:

1. <Insert manufacturer's name; product name or designation>.
2. A & T Iron Works, Inc.
3. BCI Burke Company, LLC.
4. BRP Enterprises, Inc.
5. Canterbury International.
6. Columbia Cascade Company.
7. Country Casual.
8. Creative Pipe, Inc.
9. DuMor Inc.
10. FairWeather Site Furnishings; Division of Leader Manufacturing, Inc.
11. Fibrex Group Inc. (The).
12. Forms+Surfaces.
13. GameTime; a PlayCore, Inc. company.
14. Gardenside, Ltd.
15. Henderson Recreation Equipment Ltd.
16. Huntco Supply, LLC.
17. Kay Park Recreation.
18. Keystone Ridge Designs, Inc.
19. Kingsley~Bate, Ltd.
20. Landscape Forms.
21. Landscape Structures Inc.
22. L. A. Steelcraft.
23. Madrax; Division of Trilary, Inc.
24. Maglin Site Furniture Inc.
25. Miracle Recreation Equipment Co.; a division of PlayPower, Inc.
26. Playworld Systems, Inc.
27. Recreation Creations, Inc.
28. RPI.
29. Sitecraft.
30. Smith & Hawken, Ltd.
31. SportsPlay Equipment, Inc.
32. Thomas Steele; Division of Trilary, Inc.
33. Urban Accessories, Inc.
34. Victor Stanley, Inc.
35. Wausau Tile, Inc.
36. Weatherend Estate Furniture.
37. <Insert manufacturer's name>.
38. or approved equal.

B. Frame: **[Cast aluminum] [Cast iron] [Steel] [Stainless steel] [Wrought iron] [Cedar] [Teak] <Insert material>**.

C. Seat**[and Back]**:

1. Material:

- a. Aluminum Sheet: **[Perforated] [Expanded] metal**.
- b. **[Painted] Steel: [Perforated metal] [Expanded metal] [Evenly spaced, parallel flat straps or bars] [Evenly woven, flat straps or bars] [Edge framed, evenly spaced, parallel rods or rolled bars] <Insert description>**.
- c. Stainless Steel: **[Perforated metal] [Expanded metal] [Evenly spaced, parallel flat straps or bars] [Evenly woven, flat straps or bars] [Edge framed, evenly spaced, parallel rods or rolled bars] <Insert description>**.
- d. Wood: **[Douglas fir] [Pine] [Cedar] [Redwood] [Teak] <Insert species>; formed into [evenly spaced parallel slats] [planks] <Insert description>**.
- e. **[Recycled] [Plastic] [Fiberglass] Planks: [Evenly spaced, parallel] <Insert description>**.
- f. **[Recycled] [Plastic] [Fiberglass] Sheet: [Solid] [Perforated]**.

2. Seat Height: **[As indicated] <Insert dimension>**.

3. Seat Surface Shape: **[Flat] [Contoured or dished]**.

4. Overall Height: **[As indicated] <Insert dimension>**.

5. Overall Width: **[As indicated] <Insert dimension>**.

6. Overall Depth: **[As indicated] <Insert dimension>**.

7. Arms: **[None] [One, as indicated] [Two, one at each end] [Three, one at each end and in center] <Insert requirements>**.

a. Arm Material: Match **[frame] [seat] <Insert component>**.

8. Weight: **<Insert weight>**.

9. Seating Configuration: Multiple units**[as indicated]**.

a. **[Straight] [Angled] [Curved] shape**.

b. Closed **[hexagon] [circle] [shape indicated] around a [tree trunk] [planter] [light post] <Insert central element>**.

D. Table Top:

1. Material:

a. Aluminum Sheet: **[Perforated] [Expanded] metal**.

b. **[Painted] Steel: [Perforated metal] [Expanded metal] [Evenly spaced, parallel flat straps or bars] [Evenly woven, flat straps or bars] [Edge framed, evenly spaced, parallel rods or rolled bars] <Insert description>**.

c. Stainless Steel: **[Perforated metal] [Expanded metal] [Evenly spaced, parallel flat straps or bars] [Evenly woven, flat straps or bars] [Edge**

- framed, evenly spaced, parallel rods or rolled bars] <Insert description>.**
- d. Wood: **[Douglas fir] [Pine] [Cedar] [Redwood] [Teak] <Insert species>;** formed into **[evenly spaced parallel slats] [planks] <Insert description>.**
 - e. **[Recycled] [Plastic] [Fiberglass] Planks: [Evenly spaced, parallel] <Insert description>.**
 - f. **[Recycled] [Plastic] [Fiberglass] Sheet: [Solid] [Perforated].**
- 2. Surface Shape: **[Round] [Hexagon] [Shape indicated] <Insert shape>.**
 - 3. Feature: **[Center umbrella hole] <Insert feature>.**
- E. Aluminum Finish: **[Mill finish] [Color coated].**
- 1. Color: **[As indicated by manufacturer's designation] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert color>.**
- F. Steel Finish: **[Galvanized and] [color] [PVC-color] coated.**
- 1. Color: **[As indicated by manufacturer's designation] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert color>.**
- G. Stainless-Steel Finish: **[No. 6] <Insert description>.**
- H. Wood Finish: **[Unfinished] [Factory-applied transparent finish] [Factory-applied stain and transparent finish] [Factory-applied opaque finish] [Manufacturer's standard finish].**
- 1. Stain: **[Manufacturer's standard] <Insert stain type and color>.**
- I. **[Fiberglass] [HDPE] Color: [As indicated by manufacturer's designation] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>.**
- J. Graphics: **[Surface-applied] [Engraved] [Attached brass plaque with engraved] copy, content, and style [per manufacturer's standard] [as indicated on Drawings].**
- 2.2 BICYCLE RACKS **<Insert drawing designation>**
- A. Products: Subject to compliance with requirements, provide one of the following:
- 1. **<Insert manufacturer's name; product name or designation>.**
 - 2. A A A Ribbon Rack Co., Inc.; Division of Brandir International, Inc.
 - 3. American Bicycle Security Company.
 - 4. BCI Burke Company, LLC.
 - 5. BRP Enterprises, Inc.

6. Canterbury International.
7. Columbia Cascade Company.
8. Cora Bike Rack.
9. Creative Pipe, Inc.
10. CycleSafe.
11. Dero Bike Rack Co.
12. DuMor Inc.
13. FairWeather Site Furnishings; Division of Leader Manufacturing, Inc.
14. GameTime; a PlayCore, Inc. company.
15. Henderson Recreation Equipment Ltd.
16. Huntco Supply, LLC.
17. Kay Park Recreation.
18. Keystone Ridge Designs, Inc.
19. Landscape Forms.
20. Landscape Structures Inc.
21. L. A. Steelcraft.
22. Madrax; Division of Trilary, Inc.
23. Maglin Site Furniture Inc.
24. Miracle Recreation Equipment Co.; a division of PlayPower, Inc.
25. Playworld Systems, Inc.
26. Recreation Creations, Inc.
27. RPI.
28. SportsPlay Equipment, Inc.
29. Urban Accessories, Inc.
30. Victor Stanley, Inc.
31. Wausau Tile, Inc.
32. <Insert manufacturer's name>.
33. or approved equal.

B. Bicycle Rack Construction:

1. Frame: [Aluminum] [Steel] [Galvanized steel] [Stainless steel] [Steel and redwood] [Steel and pine] <Insert description>.
 - a. [Pipe] [Tubing] OD: Not less than [1-5/8 inches (41 mm)] [2-3/8 inches (60 mm)] [2-7/8 inches (73 mm)] [4-1/2 inches (115 mm)] <Insert dimension>.
 - b. Locking Bars: Solid round bar, not less than [3/4 inch (19 mm)] [1 inch (25 mm)] in diameter.
2. Style: [Single-side parking] [Double-side parking] [Bollard] [As indicated] <Insert description>.
 - a. Overall Height: [As indicated] <Insert dimension>.
 - b. Overall Width: [As indicated] <Insert dimension>.
 - c. Overall Depth: [As indicated] <Insert dimension>.
 - d. Capacity: Designed to accommodate no fewer than [two] [three] [four] <Insert number> bicycles.
3. Security: Designed to lock [wheel] [and] [frame].

4. Accessories: **[Base covers for each pipe and tubing anchored end] [Wheel stops] <Insert accessory>**.
 5. Installation Method: **[Freestanding] [Surface flange anchored at finished grade to substrate indicated] [Surface flange anchored below finished grade to substrate indicated] [Cast in concrete] [Bolted to cast-in anchor bolts] [Wall mounted] [As indicated]**.
- C. Aluminum Finish: **[Mill finish] [Color coated]**.
1. Color: **[As indicated by manufacturer's designation] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>**.
- D. Steel Finish: **[Galvanized] [Color coated]**.
1. Color: **[As indicated by manufacturer's designation] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert color>**.
- E. Stainless-Steel Finish: **[No. 4] <Insert description>**.
- F. Wood Finish: **[Unfinished] [Manufacturer's standard finish]**.
- 2.3 BICYCLE LOCKERS **<Insert drawing designation>**
- A. Products: Subject to compliance with requirements, provide one of the following:
1. **<Insert manufacturer's name; product name or designation>**.
 2. American Bicycle Security Company.
 3. Columbia Cascade Company.
 4. Cora Bike Rack.
 5. Creative Pipe, Inc.
 6. CycleSafe.
 7. Dero Bike Rack Co.
 8. Huntco Supply, LLC.
 9. Madrax; Division of Trilary, Inc.
 10. **<Insert manufacturer's name>**.
 11. or approved equal.
- B. Bicycle Locker Construction:
1. Locker: **[Molded one-piece fiberglass] [Steel sheet, 0.053 inch (1.4 mm) thick] [Steel sheet, 0.053 inch (1.4 mm) thick, with perforated metal sides] [with welded tubular steel frame] <Insert material>**.
 2. Door: **[Molded one-piece fiberglass] [Steel sheet, 0.053 inch (1.4 mm) thick] [with tubular steel frame] [Match locker] <Insert material>**.
 3. View **[Window] [Grille]: [Lexan, 12 inches (305 mm) square] [Perforated metal]**.

4. Lock: **[Manufacturer's standard] [Key lock with internal locking bar] [Coin/token lock] <Insert description>**.
 - a. Provide **[four] <Insert number>** keys.
 5. Overall Height: **[As indicated] <Insert dimension>**.
 6. Overall Width: **[As indicated] <Insert dimension>**.
 7. Overall Depth: **[As indicated] <Insert dimension>**.
 8. Capacity: Designed to accommodate **[one] [two]** bicycle(s).
 9. Installation Method: **[Locker anchored at finished grade to substrate indicated] [Locker anchored below finished grade to substrate indicated] [As indicated]**.
 10. Locker Configuration: **[Multiple] [Four] <Insert number> units[as indicated], in [straight row] [curved shape] [shape indicated] <Insert description>**.
- C. Steel Finish: Color coated.
1. Color: **[As indicated by manufacturer's designation] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>**.
- D. Fiberglass Color: **[As indicated by manufacturer's designation] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>**.
- 2.4 **[TRASH] [AND] [ASH] RECEPTACLES <Insert drawing designation>**
- A. Products: Subject to compliance with requirements, provide one of the following:
1. **<Insert manufacturer's name; product name or designation>**.
 2. BCI Burke Company, LLC.
 3. BRP Enterprises, Inc.
 4. Canterbury International.
 5. Columbia Cascade Company.
 6. Country Casual.
 7. Creative Pipe, Inc.
 8. DuMor Inc.
 9. FairWeather Site Furnishings; Division of Leader Manufacturing, Inc.
 10. Fiberglass Engineering Company.
 11. Fibrex Group Inc. (The).
 12. Forms+Surfaces.
 13. GameTime; a PlayCore, Inc. company.
 14. Gardenside, Ltd.
 15. Henderson Recreation Equipment Ltd.
 16. Huntco Supply, LLC.
 17. Kay Park Recreation.
 18. Keystone Ridge Designs, Inc.

19. Landscape Forms.
 20. Landscape Structures Inc.
 21. L. A. Steelcraft.
 22. Maglin Site Furniture Inc.
 23. Miracle Recreation Equipment Co.; a division of PlayPower, Inc.
 24. Playworld Systems, Inc.
 25. Recreation Creations, Inc.
 26. RPI.
 27. Sitecraft.
 28. Smith & Hawken, Ltd.
 29. Thomas Steele; Division of Trilary, Inc.
 30. Urban Accessories, Inc.
 31. Victor Stanley, Inc.
 32. Wausau Tile, Inc.
 33. Weatherend Estate Furniture.
 34. **<Insert manufacturer's name>**.
 35. or approved equal.
- B. Aluminum Facing Surrounds: **[Aluminum sheet] [Perforated aluminum sheet] [Grid in tubular frame] [Evenly patterned, parallel flat aluminum straps, bars, or tubular shapes] [Match benches] <Insert material and description>**.
- C. Steel Facing Surrounds: **[Steel sheet] [Perforated-steel sheet] [Evenly patterned, parallel flat steel straps, bars, or tubular shapes] [Evenly patterned, parallel round steel rods, bars, or tubular shapes] [Grid in tubular frame] [Match benches] <Insert material and description>**.
- D. Stainless-Steel Facing Surrounds: **[Steel sheet] [Perforated-steel sheet] [Evenly patterned, parallel flat steel straps, bars, or tubular shapes] [Evenly patterned, parallel round steel rods, bars, or tubular shapes] [Grid in tubular frame] [Match benches] <Insert material and description>**.
- E. Wood Facing Surrounds: **[Evenly spaced, Douglas fir slats] [Evenly spaced pine slats] [Evenly spaced cedar slats] [Redwood panels] [Evenly spaced redwood slats] [Teak panels] [Evenly spaced teak slats] [Match benches] <Insert wood type and description>**.
- F. Fiberglass Facing Surrounds: Molded fiberglass shape.
- G. Plastic Facing Surrounds: **[Molded HDPE shape] [Evenly spaced HDPE slats] [Evenly spaced, recycled HDPE slats] [Match benches] <Insert plastic type and description>**.
- H. Support Frames: **[Steel] [Galvanized steel]**; welded.
- I. **[Trash] [and] [Ash] Receptacles:**
1. Receptacle Shape and Form: **[Round cylinder] [Round cylinder with tapered funnel top] [Round, tapered column] [Square column] [Rectangular column]**

- [As indicated] <Insert shape and form>; with opening for depositing trash in [lid or top] [side of lid or top] [receptacle side].
2. Ash Receptacle Function: [Uncovered receptacle with sand pan] [Uncovered receptacle with bowl and funnel] [Covered receptacle with sand pan] [Covered receptacle with bowl and screen] [Covered receptacle with slots] [Uncovered receptacle with sand pan attaching to side of trash receptacle] <Insert description and accessories> for depositing cigarette butts; fire-proof design; bowl and pan removable for cleaning.
 3. Lids and Tops: [Matching facing panels] [Aluminum] [Steel] [HDPE] [Recycled HDPE] <Insert material and description> secured by cable or chain, hinged, swiveled, or permanently secured.
 - a. Description: [Flat rim ring lid with center opening] [Dome top] [Arched top] [Elevated flat or shallow dome rain-cap lid] [Combination ash sand pan and rim lid] [Combination ash sand pan and dome top] [Combination ash sand pan and elevated flat or shallow dome rain-cap lid] <Insert description>.
 - b. Opening for depositing trash covered by [self-closing, spring-loaded-hinged, push-in] [rotating] weather flap.
 4. Receptacle Height: [As indicated] <Insert dimension>.
 5. Overall Width: [As indicated] <Insert dimension>.
 6. Weight: <Insert weight>.
 7. Inner Container: [Aluminum] [Galvanized-steel sheet] [Perforated-metal] [Fiberglass] [Rigid plastic] container with [drain holes] [lift-out handles]; designed to be removable and reusable.
 8. Disposable Liners: Provide receptacle designed to accommodate disposable liners.
 9. Capacity: Not less than [22 gal. (83 L)] [28 gal. (106 L)] [30 gal. (114 L)] [32 gal. (121 L)] [40 gal. (151 L)] [55 gal. (208 L)] <Insert value>.
 10. Service Access: [Removable lid or top] [Fixed lid or top, side access]; inner container and disposable liner lift or slide out for emptying[; lockable with padlock hasps] [; keyed lock with two keys per receptacle] [; self-latching hinge].
 11. Post Mount: [Color-coated steel pipe; color to match receptacle] [Galvanized-steel pipe] [Wood]; for mounting [one] [two] [three] receptacle(s).
 12. Ash Receptacle Accessories: [Sand sifter] [Butt stub-out] <Insert accessory>.
- J. Aluminum Finish: [Mill finish] [Color coated].
1. Color: [As indicated by manufacturer's designation] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>.
- K. Steel Finish: [Galvanized and] [color] [PVC-color] coated.
1. Color: [As indicated by manufacturer's designation] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from

**manufacturer's full range] [As indicated in a site furnishing schedule]
<Insert description>.**

- L. Stainless-Steel Finish: **[No. 6] <Insert description>.**
- M. Wood Finish: **[Unfinished] [Factory-applied transparent finish] [Factory-applied stain and transparent finish] [Factory-applied opaque finish] [Manufacturer's standard finish].**
 - 1. Stain: **[Manufacturer's standard] <Insert stain type and color>.**
- N. **[Fiberglass] [HDPE] Color: [As indicated by manufacturer's designation] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>.**
- O. Graphics: **[Surface-applied] [Engraved] [Attached brass plaque with engraved] copy, content, and style [per manufacturer's standard] [as indicated on Drawings].**
 - 1. Copy: **[Litter] [Trash] [Waste] [Recycle] <Insert term>.**

2.5 PLANTERS <Insert drawing designation>

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. **<Insert manufacturer's name; product name or designation>.**
 - 2. Country Casual.
 - 3. DuMor Inc.
 - 4. FairWeather Site Furnishings; Division of Leader Manufacturing, Inc.
 - 5. Fiberglass Engineering Company.
 - 6. Fibrex Group Inc. (The).
 - 7. Gardenside, Ltd.
 - 8. Kay Park Recreation.
 - 9. Keystone Ridge Designs, Inc.
 - 10. Kingsley~Bate, Ltd.
 - 11. Maglin Site Furniture Inc.
 - 12. RPI.
 - 13. Sitecraft.
 - 14. Thomas Steele; Division of Trilary, Inc.
 - 15. Victor Stanley, Inc.
 - 16. Wausau Tile, Inc.
 - 17. Weatherend Estate Furniture.
 - 18. **<Insert manufacturer's name>.**
 - 19. or approved equal.
- B. Aluminum Facing Surrounds: **[Aluminum sheet] [Perforated aluminum sheet] [Grid in tubular frame] [Evenly patterned, parallel flat aluminum straps, bars, or tubular shapes] [Match benches] <Insert material and description>.**

- C. Steel Facing Surrounds: [**Steel sheet**] [**Perforated-steel sheet**] [**Evenly patterned, parallel flat steel straps, bars, or tubular shapes**] [**Evenly patterned, parallel round steel rods, bars, or tubular shapes**] [**Grid in tubular frame**] [**Match benches**] <Insert material and description>.
- D. Stainless-Steel Facing Surrounds: [**Steel sheet**] [**Perforated-steel sheet**] [**Evenly patterned, parallel flat steel straps, bars, or tubular shapes**] [**Evenly patterned, parallel round steel rods, bars, or tubular shapes**] [**Grid in tubular frame**] [**Match benches**] <Insert material and description>.
- E. Wood Facing Surrounds: [**Evenly spaced, Douglas fir slats**] [**Evenly spaced pine slats**] [**Evenly spaced cedar slats**] [**Redwood panels**] [**Evenly spaced redwood slats**] [**Teak panels**] [**Evenly spaced teak slats**] [**Match benches**] <Insert wood type and description>.
- F. Fiberglass Facing Surrounds: Molded fiberglass shape.
- G. Plastic Facing Surrounds: [**Molded HDPE shape**] [**Evenly spaced HDPE slats**] [**Evenly spaced, recycled HDPE slats**] [**Match benches**] <Insert plastic type and description>.
- H. Support Frames: [**Steel**] [**Galvanized steel**]; welded.
- I. Planter Shape and Form: [**Round cylinder**] [**Round cylinder with tapered funnel top**] [**Round, tapered column**] [**Square column**] [**Rectangular column**] [**As indicated**] <Insert shape and form>.
- J. Style: [**To match benches**] [**As indicated by manufacturer's designation**].
- K. Overall Height: [**As indicated**] <Insert dimension>.
- L. Overall [**Diameter**] [**Width**]: [**As indicated**] <Insert dimension>.
- M. Overall Depth: [**As indicated**] <Insert dimension>.
- N. Weight: <Insert weight>.
- O. Inner Container: [**Aluminum**] [**Galvanized-steel sheet**] [**Fiberglass**] [**Rigid plastic**] container[**with drain holes**].
- P. Capacity: Not less than [**22 gal. (83 L)**] [**28 gal. (106 L)**] [**30 gal. (114 L)**] [**32 gal. (121 L)**] [**40 gal. (151 L)**] [**55 gal. (208 L)**] <Insert value>.
- Q. Installation Method: [**Freestanding**] [**Freestanding with weighted base**] [**Anchored to substrate indicated on Drawings**] [**Wall mounted**] [**Post mounted**] [**Mounted on elevated leg angles anchored at finished grade to substrate indicated on Drawings**] [**Mounted on elevated leg angles anchored below finished grade to substrate indicated on Drawings**] [**As indicated on Drawings**].
1. Post Mount: [**Color-coated steel pipe; color to match receptacle**] [**Galvanized-steel pipe**] [**Wood**]; for mounting [**one**] [**two**] [**three**] planter(s).

- R. Aluminum Finish: Color coated.
1. Color: **[As indicated by manufacturer's designation] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>.**
- S. Steel Finish: **[Galvanized and] [color] [PVC-color]** coated.
1. Color: **[As indicated by manufacturer's designation] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>.**
- T. Stainless-Steel Finish: **[No. 6] <Insert description>.**
- U. Wood Finish: **[Unfinished] [Factory-applied transparent finish] [Factory-applied stained and transparent finish].**
1. Stain: **<Insert stain type and color>.**
- V. **[Fiberglass] [HDPE]** Color: **[As indicated by manufacturer's designation] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>.**
1. Finish: **[Smooth] [Textured].**

2.6 BOLLARDS **<Insert drawing designation>**

- A. Products: Subject to compliance with requirements, provide one of the following:
1. **<Insert manufacturer's name; product name or designation>.**
 2. BRP Enterprises, Inc.
 3. Canterbury International.
 4. Columbia Cascade Company.
 5. Creative Pipe, Inc.
 6. Dero Bike Rack Co.
 7. DuMor Inc.
 8. FairWeather Site Furnishings; Division of Leader Manufacturing, Inc.
 9. Huntco Supply, LLC.
 10. Keystone Ridge Designs, Inc.
 11. L. A. Steelcraft.
 12. Maglin Site Furniture Inc.
 13. Thomas Steele; Division of Trilary, Inc.
 14. Urban Accessories, Inc.
 15. Victor Stanley, Inc.
 16. **<Insert manufacturer's name>.**
 17. or approved equal.

B. Bollard Construction:

1. **[Pipe] [Tubing] [Cast Iron]** OD: Not less than **[4-1/2 inches (115 mm)] <Insert dimension>**, **[fluted]**.
 - a. Steel: **[Schedule 40] [Schedule 80]** pipe.
 - b. Aluminum: **[Extruded pipe and tubes] [Castings]**.
 - c. Stainless Steel: **[Tubes] [Pipe]**.
 - d. Cast Iron: **[Tapered] [As indicated]**.
2. **[Round] [Square]** Wood: **[Cedar] <Insert material>**, **[8 inches (203 mm) square] [10 inches (254 mm) in diameter]**.
3. Style: **[Manufacturer's standard] [Chamfered top] [Dome top] [Ornamental cap] [As indicated] <Insert description>**.
4. Overall Height: **[As indicated] <Insert dimension>**.
5. Overall Width: **[As indicated] <Insert dimension>**.
6. Overall Depth: **[As indicated] <Insert dimension>**.
7. Accessories: **[Eye bolts] <Insert accessory>**.
8. Installation Method: **[Surface flange anchored at finished grade to substrate indicated] [Surface flange anchored below finished grade to substrate indicated] [Cast in concrete] [Bolted to cast-in anchor bolts] [As indicated]**.

C. Aluminum Finish: **[Mill finish] [Color coated]**.

1. Color: **[As indicated by manufacturer's designation] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>**.

D. Steel Finish: **[Galvanized] [Color coated]**.

1. Color: **[As indicated by manufacturer's designation] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>**.

E. Cast-Iron Finish: **[Manufacturer's standard] [Galvanized] [Color coated]**.

1. Color: **[As indicated by manufacturer's designation] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>**.

F. Stainless-Steel Finish: **[No. 4] <Insert description>**.

G. Wood Finish: **[Unfinished] [Manufacturer's standard finish]**.

2.7 MATERIALS

- A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated; free of surface blemishes and complying with the following:
1. Rolled or Cold-Finished Bars, Rods, and Wire: [ASTM B 211](#) (ASTM B 211M).
 2. Extruded Bars, Rods, Wire, Profiles, and Tubes: [ASTM B 221](#) (ASTM B 221M).
 3. Structural Pipe and Tube: ASTM B 429/B 429M.
 4. Sheet and Plate: [ASTM B 209](#) (ASTM B 209M).
 5. Castings: ASTM B 26/B 26M.
- B. Steel and Iron: Free of surface blemishes and complying with the following:
1. Plates, Shapes, and Bars: ASTM A 36/A 36M.
 2. Steel Pipe: Standard-weight steel pipe complying with ASTM A 53/A 53M, or electric-resistance-welded pipe complying with ASTM A 135/A 135M.
 3. Tubing: Cold-formed steel tubing complying with ASTM A 500/A 500M.
 4. Mechanical Tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A 513, or steel tubing fabricated from steel complying with ASTM A 1011/A 1011M and complying with dimensional tolerances in ASTM A 500/A 500M; zinc coated internally and externally.
 5. Sheet: Commercial steel sheet complying with ASTM A 1011/A 1011M.
 6. Perforated Metal: From steel sheet not less than [[0.075-inch](#) (1.9-mm)] [[0.090-inch](#) (2.3-mm)] [[0.120-inch](#) (3.0-mm)] **<Insert dimension>** nominal thickness; manufacturer's standard perforation pattern.
 7. Expanded Metal: Carbon-steel sheets, deburred after expansion, and complying with ASTM F 1267.
 8. Malleable-Iron Castings: ASTM A 47/A 47M, grade as recommended by fabricator for type of use intended.
 9. Gray-Iron Castings: ASTM A 48/A 48M, Class 200.
- C. Stainless Steel: Free of surface blemishes and complying with the following:
1. Sheet, Strip, Plate, and Flat Bars: ASTM A 666.
 2. Pipe: Schedule 40 steel pipe complying with ASTM A 312/A 312M.
 3. Tubing: ASTM A 554.
- D. Wood: Surfaced smooth on four sides with eased edges; kiln dried, free of knots, solid stock of species indicated.
1. Wood Species:[**Manufacturer's standard.**]
 - a. Douglas Fir: Clear Grade, vertical grain.
 - b. Pine: Southern pine; No. 2 or better[; **preservative treated, kiln dried after treatment**].
 - c. [**Eastern White**] [**Red**] [**Yellow**] Cedar: Select Grade or better.
 - d. Redwood: [**Clear all heart**] [**Construction heart or better**], free-of-heart center.
 - e. Teak (Tectona Grandis): Clear Grade.

- f. **<Insert wood species>: <Insert grade, if applicable, and other requirements>.**
2. Certified Wood: Fabricate site furnishings with components produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
 3. Finish: Manufacturer's standard **[stain] [and] [transparent sealer] [transparent wood preservative treatment and sealer] <Insert treatment or finish>.**
- E. Fiberglass: Multiple laminations of glass-fiber-reinforced polyester resin with UV-light stable, colorfast, nonfading, weather- and stain-resistant, colored polyester gel coat, and with manufacturer's standard finish.
- F. Plastic: Color impregnated, color and UV-light stabilized, and mold resistant.
1. Polyethylene: Fabricated from virgin plastic HDPE resin.
 2. Recycled Content of Polyethylene: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert number>** percent.
- G. Anchors, Fasteners, Fittings, and Hardware: **[Stainless steel] [Brass] [Galvanized steel] [Zinc-plated steel] [Manufacturer's standard, corrosion-resistant-coated or noncorrodible materials]**; commercial quality[, **tamperproof, vandal and theft resistant**] [, **concealed, recessed, and capped or plugged**].
1. Angle Anchors: For inconspicuously bolting legs of site furnishings to **[on] [below]**-grade substrate; **[one per leg] [extent as indicated] <Insert extent>.**
 2. Antitheft Hold-Down Brackets: For securing site furnishings to substrate; **[two per unit] [extent as indicated on Drawings] <Insert extent>.**
- H. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M; recommended in writing by manufacturer, for exterior applications.
- I. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound; resistant to erosion from water exposure without needing protection by a sealer or waterproof coating; recommended in writing by manufacturer, for exterior applications.
- J. Galvanizing: Where indicated for steel and iron components, provide the following protective zinc coating applied to components after fabrication:
1. Hot-Dip Galvanizing: According to ASTM A 123/A 123M, ASTM A 153/A 153M, or ASTM A 924/A 924M.
- 2.8 WOOD-PRESERVATIVE-TREATED MATERIALS
- A. Preservative Treatment: Pressure-treat wood according to AWPA U1 and the following:

1. Use preservative chemicals acceptable to authorities having jurisdiction and containing no arsenic or chromium. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
2. Kiln-dry lumber and plywood after treatment to a maximum moisture content, respectively, of 19 and 15 percent. Do not use materials that are warped or do not comply with requirements for untreated materials.

2.9 FABRICATION

- A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.
- B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.
- C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.
- D. Preservative-Treated Wood Components: Complete fabrication of treated items before treatment if possible. If cut after treatment, apply field treatment complying with AWPA M4 to cut surfaces.
- E. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.
- F. Factory Assembly: Assemble components in the factory to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.10 GENERAL FINISH REQUIREMENTS

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.11 ALUMINUM FINISHES

- A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.12 STEEL AND GALVANIZED-STEEL FINISHES

- A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.
- B. PVC Finish: Manufacturer's standard, UV-light stabilized, mold-resistant, slip-resistant, matte-textured, dipped or sprayed-on, PVC-plastisol finish, with flame retardant added; complying with coating manufacturer's written instructions for pretreatment, application, and minimum dry film thickness.

2.13 IRON FINISHES

- A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.14 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run directional finishes with long dimension of each piece.
 - 2. Directional Satin Finish: No 4.
 - 3. Dull Satin Finish: No. 6.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

- B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.
- C. Install site furnishings level, plumb, true, and **[securely anchored] [positioned]** at locations indicated on Drawings.
- D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.
- E. Posts Set into Voids in Concrete: Form or core-drill holes for installing posts in concrete to depth recommended in writing by manufacturer of site furnishings and **3/4 inch (19 mm)** larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with **[nonshrink, nonmetallic grout] [or] [anchoring cement]**, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.
- F. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with **[nonshrink, nonmetallic grout] [or] [anchoring cement]**, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 129300

SECTION 133419 - METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Structural-steel framing.
2. Metal roof panels.
3. Metal wall panels.
4. Foam-insulation-core metal wall panels.
5. Translucent panels.
6. Metal soffit panels.
7. Thermal insulation.
8. Doors and frames.
9. Windows.
10. Accessories.

- B. Related Sections:

1. Section 083323 "Overhead Coiling Doors."
2. Section 083613 "Sectional Doors."

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in referenced standards.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of metal building system component. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

1. Structural-steel-framing system.
2. Metal roof panels.
3. Metal wall panels.
4. Metal liner panels.
5. Translucent panels.
6. Insulation and vapor retarder facings.
7. Flashing and trim.
8. Doors.
9. Windows.
10. Accessories.
11. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Product Test Reports for Credit SS 7.2: For roof panels, documentation indicating that panels comply with Solar Reflectance Index requirement.
2. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

C. Shop Drawings: For the following metal building system components. Include plans, elevations, sections, details, and attachments to other work.

1. Anchor-Bolt Plans: Submit anchor-bolt plans and templates before foundation work begins. Include location, diameter, and projection of anchor bolts required to attach metal building to foundation. Indicate column reactions at each location.
2. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
 - a. Show provisions for attaching **[roof curbs] [service walkways] [platforms] [and] [pipe racks]**.
3. Metal **[Roof] [and] [Wall]** Panel Layout Drawings: Show layouts of metal panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
 - a. Show roof-mounted items including roof hatches, equipment supports, pipe supports and penetrations, lighting fixtures, and items mounted on roof curbs.
 - b. Show wall-mounted items including doors, windows, louvers, and lighting fixtures.
 - c. Show translucent panels.
4. Accessory Drawings: Include details of the following items, at a scale of not less than **[1-1/2 inches per 12 inches (1:8)] <Insert scale>**:

- a. Flashing and trim.
 - b. Gutters.
 - c. Downspouts.
 - d. Roof ventilators.
 - e. Louvers.
 - f. Service walkways.
- D. Samples for Initial Selection: For units with factory-applied color finish.
- E. Samples for Verification: For each type of exposed finish required, prepared on Samples of sizes indicated below:
1. Metal Panels: Nominal **12 inches** (300 mm) long by actual panel width. Include fasteners, closures, and other exposed panel accessories.
 2. Translucent Panels: Nominal **12 inches** (300 mm) long by actual panel width.
 3. Flashing and Trim: Nominal **12 inches** (300 mm) long. Include fasteners and other exposed accessories.
 4. Vapor-Retarder Facings: Nominal **6-inch-** (150-mm-) square Samples.
 5. Windows: Full-size, nominal **12-inch-** (300-mm-) long frame Samples showing typical profile.
 6. Accessories: Nominal **12-inch-** (300-mm-) long Samples for each type of accessory.
- F. Door Schedule: For doors and frames. Use same designations indicated on Drawings. Include details of reinforcement.
1. Door Hardware Schedule: Include details of fabrication and assembly of door hardware. Organize schedule into door hardware sets indicating complete designations of every item required for each door or opening.
 2. Keying Schedule: Detail Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.
- G. Delegated-Design Submittal: For metal building systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For qualified **[erector] [manufacturer] [professional engineer] [land surveyor] [testing agency]**.
- B. Welding certificates.
- C. Metal Building System Certificates: For each type of metal building system, from manufacturer.
1. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
 - a. Name and location of Project.

- b. Order number.
 - c. Name of manufacturer.
 - d. Name of Contractor.
 - e. Building dimensions including width, length, height, and roof slope.
 - f. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
 - g. Governing building code and year of edition.
 - h. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
 - i. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
 - j. Building-Use Category: Indicate category of building use and its effect on load importance factors.
 - k. AISC Certification for Category MB: Include statement that metal building system and components were designed and produced in an AISC-Certified Facility by an AISC-Certified Manufacturer.
- D. Erector Certificates: For each product, from manufacturer.
- E. Manufacturer Certificates: For each product, from manufacturer.
- F. Material Test Reports: For each of the following products:
- 1. Structural steel including chemical and physical properties.
 - 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 - 4. Shop primers.
 - 5. Nonshrink grout.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for insulation and vapor-retarder facings. Include reports for thermal resistance, fire-test-response characteristics, water-vapor transmission, and water absorption.
- H. Source quality-control reports.
- I. Field quality-control reports.
- J. Surveys: Show final elevations and locations of major members. Indicate discrepancies between actual installation and the Contract Documents. Have surveyor who performed surveys certify their accuracy.
- K. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panel finishes[**and door hardware**] to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer[**and member of MBMA**].
 - 1. AISC Certification for Category MB: An AISC-Certified Manufacturer that designs and produces metal building systems and components in an AISC-Certified Facility.
 - 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Land Surveyor Qualifications: A professional land surveyor who practices in jurisdiction where Project is located and who is experienced in providing surveying services of the kind indicated.
- C. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.
- D. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- E. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.
- F. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."
- G. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings," for design requirements and allowable stresses.
- H. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.
- I. Fire-Resistance Ratings: Where indicated, provide metal panel assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
 2. Combustion Characteristics: ASTM E 136.
- J. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
- K. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockup of typical wall area as shown on Drawings.
 2. Build mockups for typical wall metal panel including accessories.
 - a. Size: **[48 inches (1200 mm) long by 48 inches (1200 mm)] <Insert dimensions>**.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
- L. Preinstallation Conference: Conduct conference at **[Project site] [location and time as determined by DEN Project Manager]<Insert location>**.
1. Review methods and procedures related to metal building systems including, but not limited to, the following:
 - a. Condition of foundations and other preparatory work performed by other trades.
 - b. Structural load limitations.
 - c. Construction schedule. Verify availability of materials and erector's personnel, equipment, and facilities needed to make progress and avoid delays.
 - d. Required tests, inspections, and certifications.
 - e. Unfavorable weather and forecasted weather conditions.
 2. Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:
 - a. Compliance with requirements for purlin and rafter conditions, including flatness and attachment to structural members.
 - b. Structural limitations of purlins and rafters during and after roofing.
 - c. Flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.

- d. Temporary protection requirements for metal roof panel assembly during and after installation.
 - e. Roof observation and repair after metal roof panel installation.
3. Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:
- a. Compliance with requirements for support conditions, including alignment between and attachment to structural members.
 - b. Structural limitations of girts and columns during and after wall panel installation.
 - c. Flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
 - d. Temporary protection requirements for metal wall panel assembly during and after installation.
 - e. Wall observation and repair after metal wall panel installation.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Protect foam-plastic insulation as follows:
 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 2. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.
 3. Complete installation and concealment of foam-plastic materials as rapidly as possible in each area of construction.

1.9 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements:

1. Established Dimensions for Foundations: Comply with established dimensions on approved anchor-bolt plans, establishing foundation dimensions, and proceeding with fabricating structural framing without field measurements. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.
2. Established Dimensions for Metal Panels: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal panels without field measurements, or allow for field trimming metal panels. Coordinate construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.10 COORDINATION

- A. Coordinate sizes and locations of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate installation of **[roof curbs] [equipment supports] [and] [roof penetrations]**, which are specified in Section 077200 "Roof Accessories."
- C. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

- A. Special Warranty on Metal Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: Minimum **[20] [10] <Insert number>** years from date of Substantial Completion.
- B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.
 1. Warranty Period: Minimum **[20] <Insert number>** years from date of Substantial Completion.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. [A&S Building Systems, Inc.](#); Division of NCI Building Systems, L.P.
2. [Alliance Steel, Inc.](#)
3. [American Buildings Company; Division of Magnatrax Corp.](#)
4. [American Steel Building Co., Inc.](#)
5. [BC Steel Buildings, Inc.](#)
6. [Behlen Mfg. Co.](#)
7. [Bigbee Steel Buildings, Inc.](#)
8. [Butler Manufacturing Company; a BlueScope Steel company.](#)
9. [CBC Steel Buildings; Division of Magnatrax Corp.](#)
10. [Ceco Building Systems; Division of NCI Building Systems, L.P.](#)
11. [Chief Buildings; Division of Chief Industries, Inc.](#)
12. [Elite Structures, Inc.](#)
13. [Garco Building Systems; Division of NCI Building Systems, L.P.](#)
14. [Gulf States Manufacturers, Inc.; Division of Magnatrax Corp.](#)
15. [Inland Buildings; Subsidiary of Behlen Mfg. Co.](#)
16. [Kirby Building Systems; Division of Magnatrax Corp.](#)
17. [Mesco Building Solutions; Division of NCI Building Systems, L.P.](#)
18. [Metallic Building Company; Division of NCI Building Systems, L.P.](#)
19. [Metco Metal Supply.](#)
20. [Mid-West Steel Building Company; Division of NCI Building Systems, L.P.](#)
21. [Nucor Building Systems.](#)
22. [Oakland Metal Buildings, Inc.](#)
23. [Olympia Steel Building Systems.](#)
24. [Package Industries, Inc.](#)
25. [Pinnacle Structures, Inc.](#)
26. [Robertson Building Systems; an NCI company.](#)
27. [Ruffin Building Systems, Inc.](#)
28. [Schulte Building Systems, LLP.](#)
29. [Spirco Manufacturing.](#)
30. [Star Building Systems; an NCI company.](#)
31. [Tyler Building Systems, L.P.](#)
32. [USA, Inc.](#)
33. [VP Buildings; a United Dominion company.](#)
34. [Vulcan Steel Structures, Inc.](#)
35. [Whirlwind Building Systems.](#)

36. <Insert manufacturer's name>.
37. or approved equal.

2.2 METAL BUILDING SYSTEMS

- A. Description: Provide a complete, integrated set of [**metal building system manufacturer's standard**] mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.
1. Provide metal building system of size and with bay spacings, roof slopes, and spans indicated.
- B. Primary-Frame Type:
1. Rigid Clear Span: Solid-member, structural-framing system without interior columns.
 2. Rigid Modular: Solid-member, structural-framing system with interior columns.
 3. Truss-Frame Clear Span: Truss-member, structural-framing system without interior columns.
 4. Truss-Frame Modular: Truss-member, structural-framing system with interior columns.
 5. Lean to: Solid- or truss-member, structural-framing system without interior columns, designed to be partially supported by another structure.
- C. End-Wall Framing: Manufacturer's standard, for buildings not required to be expandable, consisting of [**primary frame, capable of supporting one-half of a bay design load, and end-wall columns**] [**load-bearing end-wall and corner columns and rafters**].
- D. End-Wall Framing: Engineer end walls to be expandable. Provide primary frame, capable of supporting full-bay design loads, and end-wall columns.
- E. Secondary-Frame Type: Manufacturer's standard purlins and joists and [**flush-framed**] [**partially inset-framed**] [**exterior-framed (bypass)**] girts.
- F. Eave Height: [16 feet (4.9 m)] [20 feet (6.1 m)] [24 feet (7.3 m)] [28 feet (8.5 m)] [**Manufacturer's standard height, as indicated by nominal height on Drawings**] <Insert dimension>.
- G. Bay Spacing: [20 feet (6.1 m)] [25 feet (7.6 m)] [30 feet (9.1 m)] [**As determined by manufacturer**] <Insert dimension>.
- H. Roof Slope: [1/4 inch per 12 inches (1:48)] [1/2 inch per 12 inches (1:24)] [1 inch per 12 inches (1:12)] [4 inches per 12 inches (1:3)] [**Manufacturer's standard for frame type required**] <Insert slope>.
- I. Roof System: Manufacturer's standard [**vertical-rib, standing-seam**] [**trapezoidal-rib, standing-seam**] [**lap-seam**] metal roof panels [**with field-installed insulation**].

- J. Exterior Wall System: Manufacturer's standard [**tapered-rib, exposed-fastener**] [**reverse-rib, exposed-fastener**] [**concealed-fastener**] metal wall panels[**with field-installed insulation**].
- K. Exterior Wall System: Manufacturer's standard foam-insulation-core metal wall panels.

2.3 METAL BUILDING SYSTEM PERFORMANCE

- A. Delegated Design: Design metal building system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."
 - 1. Design Loads: As indicated on Drawings.
 - 2. Design Loads: As required by [**MBMA's "Metal Building Systems Manual."**] [**ASCE/SEI 7.**] <Insert applicable code requirement.>
 - 3. Deflection Limits: Design metal building system assemblies to withstand design loads with deflections no greater than the following:
 - a. Purlins and Rafters: Vertical deflection of [**1/180**] [**1/240**] <Insert limit> of the span.
 - b. Girts: Horizontal deflection of [**1/180**] [**1/240**] <Insert limit> of the span.
 - c. Metal Roof Panels: Vertical deflection of [**1/180**] [**1/240**] <Insert limit> of the span.
 - d. Metal Wall Panels: Horizontal deflection of [**1/180**] [**1/240**] <Insert limit> of the span.
 - e. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
 - 4. Drift Limits: Engineer building structure to withstand design loads with drift limits no greater than the following:
 - a. Lateral Drift: Maximum of [**1/200**] [**1/400**] <Insert limit> of the building height.
 - 5. Metal panel assemblies shall withstand the effects of gravity loads and loads and stresses within limits and under conditions indicated according to ASTM E 1592.
- C. Seismic Performance: Metal building systems shall withstand the effects of earthquake motions determined according to [**ASCE/SEI 7**] <Insert requirement>.
- D. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculations on

surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): [120 deg F (67 deg C), **ambient**; 180 deg F (100 deg C)] **<Insert temperature range>**, material surfaces.
- E. Air Infiltration for Metal Roof Panels: Air leakage through assembly of not more than [0.06 cfm/sq. ft. (0.3 L/s per sq. m)] **<Insert value>** of roof area when tested according to ASTM E 1680 at negative test-pressure difference of [1.57 lbf/sq. ft. (75 Pa)] **<Insert value>**.
- F. Air Infiltration for Metal Wall Panels: Air leakage through assembly of not more than [0.06 cfm/sq. ft. (0.3 L/s per sq. m)] **<Insert value>** of wall area when tested according to ASTM E 283 at static-air-pressure difference of [1.57 lbf/sq. ft. (75 Pa)] **<Insert value>**.
- G. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E 1646 at test-pressure difference of [2.86 lbf/sq. ft. (137 Pa)] **<Insert value>**.
- H. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E 331 at a wind-load design pressure of not less than [2.86 lbf/sq. ft. (137 Pa)] **<Insert value>**.
- I. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for [Class 30] [Class 60] [Class 90].
- J. Thermal Performance: Provide insulated metal panel assemblies with the following maximum U-factors and minimum R-values for opaque elements when tested according to ASTM C 1363 or ASTM C 518:
1. Metal Roof Panel Assemblies:
 - a. U-Factor: **<Insert value>**.
 - b. R-Value: **<Insert value>**.
 2. Metal Wall Panel Assemblies:
 - a. U-Factor: **<Insert value>**.
 - b. R-Value: **<Insert value>**.
- K. Solar Reflectance Index: Not less than [78] [29] when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.
- L. Energy Performance: Provide roof panels that are listed on the DOE's ENERGY STAR Roof Products Qualified Product List for [low] [steep]-slope roof products.
- M. Energy Performance: Provide roof panels with initial solar reflectance not less than [0.70] **<Insert value>** and emissivity not less than [0.75] **<Insert value>** when tested according to CRRC.

2.4 STRUCTURAL-STEEL FRAMING

- A. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafter, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.
1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
 - a. Slight variations in span and spacing may be acceptable if necessary to comply with manufacturer's standard, as approved by DEN Project Manager.
 2. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
 3. Rigid Modular Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide interior columns fabricated from round steel pipes or tubes, or shop-welded, built-up steel plates.
 4. Truss-Frame, Clear-Span Frames: Rafter frames fabricated from joist girders, and I-shaped column sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.
 5. Truss-Frame Modular Frames: Rafter frames fabricated from joist girders, and I-shaped column sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide interior columns fabricated from round steel pipes or tubes, or shop-welded, built-up steel plates.
 6. Long-Bay Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide interior columns fabricated from round steel pipes or tubes, or shop-welded, built-up steel plates.
 7. Frame Configuration: [**Single gable**] [**One-directional sloped**] [**Lean to, with high side connected to and supported by another structure**] [**Multiple gable**] [**Load-bearing-wall type**] [**Multistory**].
 8. Exterior Column Type: [**Uniform depth**] [**Tapered**].
 9. Rafter Type: [**Uniform depth**] [**Tapered**].
- B. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:
1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet.
 2. End-Wall Rafters: C-shaped, cold-formed, structural-steel sheet; or I-shaped sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.
- C. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate

framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:

1. Purlins: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum **2-1/2-inch- (64-mm-)** wide flanges.
 - a. Depth: **[As indicated] [As needed to comply with system performance requirements] <Insert dimension>**.
 2. Purlins: Steel joists of depths indicated.
 3. Girts: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees from flange, with minimum **2-1/2-inch- (64-mm-)** wide flanges.
 - a. Depth: **[As indicated] [As required to comply with system performance requirements] <Insert dimension>**.
 4. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.
 5. Flange Bracing: Minimum **2-by-2-by-1/8-inch (51-by-51-by-3-mm)** structural-steel angles or **1-inch (25-mm)** diameter, cold-formed structural tubing to stiffen primary-frame flanges.
 6. Sag Bracing: Minimum **1-by-1-by-1/8-inch (25-by-25-by-3-mm)** structural-steel angles.
 7. Base or Sill Angles: Minimum **3-by-2-inch (76-by-51-mm)** zinc-coated (galvanized) steel sheet.
 8. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
 9. Secondary End-Wall Framing: Manufacturer's standard sections fabricated from **[zinc-coated (galvanized) steel sheet] [structural-steel sheet]**.
 10. Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings and head, jamb, and sill of other openings.
 11. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
- D. Canopy Framing: Manufacturer's standard structural-framing system, designed to withstand required loads; fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide frames with attachment plates and splice members, factory drilled for field-bolted assembly.
1. Type: **[Straight-beam, eave type] [Purlin-extension type] [Tapered-beam, below-eave type] [As indicated]**.
- E. Bracing: Provide adjustable wind bracing as follows:

1. Rods: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 (345); or ASTM A 529/A 529M, Grade 50 (345); minimum 1/2-inch- (13-mm-) diameter steel; threaded full length or threaded a minimum of 6 inches (152 mm) at each end.
 2. Cable: ASTM A 475, 1/4-inch- (6-mm-) diameter, extra-high-strength grade, Class B, zinc-coated, seven-strand steel; with threaded end anchors.
 3. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
 4. Rigid Portal Frames: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
 5. Fixed-Base Columns: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
 6. Diaphragm Action of Metal Panels: Design metal building to resist wind forces through diaphragm action of metal panels.
 7. Bracing: Provide wind bracing using any method specified above, at manufacturer's option.
- F. Bolts: Provide plain-finish bolts for structural-framing components that are primed or finish painted. Provide **[zinc-plated]** [or] **[hot-dip galvanized]** bolts for structural-framing components that are galvanized.
- G. Materials:
1. W-Shapes: ASTM A 992/A 992M; ASTM A 572/A 572M, Grade 50 or 55 (345 or 380); or ASTM A 529/A 529M, Grade 50 or 55 (345 or 380).
 2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55 (345 or 380); or ASTM A 529/A 529M, Grade 50 or 55 (345 or 380).
 3. Plate and Bar: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55 (345 or 380); or ASTM A 529/A 529M, Grade 50 or 55 (345 or 380).
 4. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
 5. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B or C, structural tubing.
 6. Structural-Steel Sheet: Hot-rolled, ASTM A 1011/A 1011M, Structural Steel (SS), Grades 30 through 55 (205 through 380), or High-Strength Low-Alloy Steel (HSLAS), Grades 45 through 70 (310 through 480); or cold-rolled, ASTM A 1008/A 1008M, Structural Steel (SS), Grades 25 through 80 (170 through 550), or High-Strength Low-Alloy Steel (HSLAS), Grades 45 through 70 (310 through 480).
 7. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80 (230 through 550,) or High-Strength Low-Alloy Steel (HSLAS), Grades 50 through 80 (340 through 550); with G60 (Z180) coating designation; mill phosphatized.
 8. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80 (230 through 550,) or High-Strength

- Low-Alloy Steel (HSLAS), Grades 50 through 80 (340 through 550); with G90 (Z275) coating designation.
- b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Structural Steel (SS), Grade 50 or 80 (340 or 550); with Class AZ50 (AZM150) coating.
9. Joist Girders: Manufactured according to "Standard Specifications for Joist Girders," in SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders"; with steel-angle, top- and bottom-chord members, and end- and top-chord arrangements as indicated and required for primary framing.
10. Steel Joists: Manufactured according to "Standard Specifications for Open Web Steel Joists, K-Series," in SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders"; with steel-angle, top- and bottom-chord members, and end- and top-chord arrangements as indicated and required for secondary framing.
11. Non-High-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), carbon-steel, hex-head bolts; ASTM A 563 (ASTM A 563M) carbon-steel hex nuts; and ASTM F 844 plain (flat) steel washers.
- a. Finish: **[Plain] [Hot-dip zinc coating, ASTM A 153/A 153M, Class C] [Mechanically deposited zinc coating, ASTM B 695, Class 50].**
12. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.
- a. Finish: **[Plain] [Hot-dip zinc coating, ASTM A 153/A 153M, Class C] [Mechanically deposited zinc coating, ASTM B 695, Class 50].**
13. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy-hex steel structural bolts **[or tension-control, bolt-nut-washer assemblies with spline ends];** ASTM A 563 (ASTM A 563M) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers, plain.
14. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex-head steel structural bolts with spline ends.
- a. Finish: **[Plain] [Mechanically deposited zinc coating, ASTM B 695, Class 50] [Mechanically deposited zinc coating, ASTM B 695, Class 50, baked-epoxy coated].**
15. Unheaded Anchor Rods: **[ASTM F 1554, Grade 36] [ASTM A 572/A 572M, Grade 50 (345)] [ASTM A 36/A 36M] [ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6)].**
- a. Configuration: Straight.
- b. Nuts: ASTM A 563 (ASTM A 563M) **[heavy-]**hex carbon steel.
- c. Plate Washers: ASTM A 36/A 36M carbon steel.
- d. Washers: ASTM F 436 (ASTM F 436M) hardened carbon steel.

- e. Finish: **[Plain] [Hot-dip zinc coating, ASTM A 153/A 153M, Class C]**
[Mechanically deposited zinc coating, ASTM B 695, Class 50].
16. Headed Anchor Rods: **[ASTM F 1554, Grade 36]** **[ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6)].**
- a. Configuration: Straight.
 - b. Nuts: **ASTM A 563 (ASTM A 563M) [heavy-]**hex carbon steel.
 - c. Plate Washers: ASTM A 36/A 36M carbon steel.
 - d. Washers: **ASTM F 436 (ASTM F 436M)** hardened carbon steel.
 - e. Finish: **[Plain] [Hot-dip zinc coating, ASTM A 153/A 153M, Class C]**
[Mechanically deposited zinc coating, ASTM B 695, Class 50].
17. Threaded Rods: **[ASTM A 193/A 193M] [ASTM A 572/A 572M, Grade 50 (345)]**
[ASTM A 36/A 36M] [ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6)].
- a. Nuts: **ASTM A 563 (ASTM A 563M) [heavy-]**hex carbon steel.
 - b. Washers: **[ASTM F 436 (ASTM F 436M) hardened] [ASTM A 36/A 36M]**
carbon steel.
 - c. Finish: **[Plain] [Hot-dip zinc coating, ASTM A 153/A 153M, Class C]**
[Mechanically deposited zinc coating, ASTM B 695, Class 50].
18. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25] <Insert number>** percent.
- H. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.
- 1. Apply primer to primary and secondary framing to a minimum dry film thickness of **1 mil (0.025 mm)**.
 - a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of **0.5 mil (0.013 mm)** on each side.
 - 2. Prime galvanized members with specified primer after phosphoric acid pretreatment.
 - 3. Primer: SSPC-Paint 15, Type I, red oxide.
- 2.5 METAL ROOF PANELS
- A. Vertical-Rib, Standing-Seam Metal Roof Panels **<Insert drawing designation>**: Formed with vertical ribs at panel edges and **[intermediate stiffening ribs symmetrically spaced] [flat pan]** between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.

1. Material: [**Zinc-coated (galvanized)**] [**Aluminum-zinc alloy-coated**] steel sheet, [**0.022-inch** (0.56-mm)] [**0.028-inch** (0.71-mm)] [**0.034-inch** (0.86-mm)] nominal thickness.
 - a. Exterior Finish: [**Fluoropolymer**] [**Siliconized polyester**].
 - b. Color: [**As indicated by manufacturer's designations**] [**As selected by DEN Proejct Manager from manufacturer's full range**] <Insert color>.
 2. Clips: Manufacturer's standard, [**fixed type**] [**floating type to accommodate thermal movement**]; fabricated from [**zinc-coated (galvanized) steel**] [**aluminum-zinc alloy-coated steel**] [**stainless-steel**] [**zinc-coated (galvanized) steel, aluminum-zinc alloy-coated steel, or stainless-steel**] sheet.
 3. Joint Type: Panels snapped together.
 4. Joint Type: Mechanically seamed, [**single folded**] [**double folded**] [**folded according to manufacturer's standard**].
 5. Panel Coverage: [**16 inches** (406 mm)] <Insert dimension>.
 6. Panel Height: [**2 inches** (51 mm)] <Insert dimension>.
 7. Uplift Rating: [**UL 30**] [**UL 60**] [**UL 90**].
- B. Trapezoidal-Rib, Standing-Seam Metal Roof Panels <Insert drawing designation>:
Formed with raised trapezoidal ribs at panel edges and [**intermediate stiffening ribs symmetrically spaced**] [**flat pan**] between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.
1. Material: [**Zinc-coated (galvanized)**] [**Aluminum-zinc alloy-coated**] steel sheet, [**0.022-inch** (0.56-mm)] [**0.028-inch** (0.71-mm)] [**0.034-inch** (0.86-mm)] nominal thickness.
 - a. Exterior Finish: [**Fluoropolymer**] [**Siliconized polyester**].
 - b. Color: [**As indicated by manufacturer's designations**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 2. Clips: Manufacturer's standard, [**fixed type**] [**floating type to accommodate thermal movement**]; fabricated from [**zinc-coated (galvanized) steel**] [**aluminum-zinc alloy-coated steel**] [**stainless-steel**] [**zinc-coated (galvanized) steel, aluminum-zinc alloy-coated steel, or stainless-steel**] sheet.
 3. Joint Type: Panels snapped together.
 4. Joint Type: Mechanically seamed, [**single folded**] [**double folded**] [**folded according to manufacturer's standard**].
 5. Panel Coverage: [**24 inches** (610 mm)] <Insert dimension>.
 6. Panel Height: [**3 inches** (76 mm)] <Insert dimension>.
 7. Uplift Rating: [**UL 30**] [**UL 60**] [**UL 90**].
- C. Tapered-Rib-Profile, Lap-Seam Metal Roof Panels <Insert drawing designation>:
Formed with raised, trapezoidal major ribs and [**intermediate stiffening ribs symmetrically spaced**] [**flat pan**] between major ribs; designed to be installed by

lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.

1. Material: [**Zinc-coated (galvanized)**] [**Aluminum-zinc alloy-coated**] steel sheet, [0.022-inch (0.56-mm)] [0.028-inch (0.71-mm)] [0.034-inch (0.86-mm)] nominal thickness.
 - a. Exterior Finish: [**Fluoropolymer**] [**Siliconized polyester**].
 - b. Color: [**As indicated by manufacturer's designations**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 2. Major-Rib Spacing: [6 inches (152 mm)] [12 inches (305 mm)] <Insert dimension> o.c.
 3. Panel Coverage: [36 inches (914 mm)] <Insert dimension>.
 4. Panel Height: [0.75 inch (19 mm)] [1.125 inches (29 mm)] [1.188 inches (30 mm)] [1.25 inches (32 mm)] [1.5 inches (38 mm)] <Insert dimension>.
- D. Tapered-Rib-Profile, Metal Liner Panels <Insert drawing designation>: Formed with raised, trapezoidal major ribs and [**intermediate stiffening ribs symmetrically spaced**] [**flat pan**] between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
1. Material: [**Zinc-coated (galvanized)**] [**Aluminum-zinc alloy-coated**] steel sheet, [0.022-inch (0.56-mm)] [0.028-inch (0.71-mm)] [0.034-inch (0.86-mm)] nominal thickness.
 - a. Exterior Finish: [**Fluoropolymer**] [**Siliconized polyester**].
 - b. Color: [**As indicated by manufacturer's designations**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
 2. Major-Rib Spacing: [6 inches (152 mm)] [12 inches (305 mm)] <Insert dimension> o.c.
 3. Panel Coverage: [36 inches (914 mm)] <Insert dimension>.
 4. Panel Height: [1.25 inches (32 mm)] [1.5 inches (38 mm)] <Insert dimension>.
- E. Materials:
1. Metallic-Coated Steel Sheet: Restricted-flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, **G90** (Z275) coating designation; structural quality.
 - b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, **Class AZ50** coating designation, **Grade 40** (Class AZM150 coating designation, **Grade 275**); structural quality.
 - c. Surface: [**Smooth, flat**] [**Embossed**] finish.
- F. Finishes:

1. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - b. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - c. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than **0.2 mil** (0.005 mm) for primer and **0.8 mil** (0.02 mm) for topcoat.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of **0.5 mil** (0.013 mm).

2.6 METAL WALL PANELS

- A. Tapered-Rib-Profile, Exposed-Fastener Metal Wall Panels <**Insert drawing designation**>: Formed with raised, trapezoidal major ribs and [**intermediate stiffening ribs symmetrically spaced**] [**flat pan**] between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
 1. Material: [**Zinc-coated (galvanized)**] [**Aluminum-zinc alloy-coated**] steel sheet, [**0.022-inch** (0.56-mm)] [**0.028-inch** (0.71-mm)] [**0.034-inch** (0.86-mm)] nominal thickness.
 - a. Exterior Finish: [**Fluoropolymer**] [**Siliconized polyester**].
 - b. Color: [**As indicated by manufacturer's designations**] [**As selected by DEN Project Manager from manufacturer's full range**] <**Insert color**>.
 2. Major-Rib Spacing: [**6 inches** (152 mm)] [**12 inches** (305 mm)] <**Insert dimension**> o.c.
 3. Panel Coverage: [**36 inches** (914 mm)] <**Insert dimension**>.
 4. Panel Height: [**0.75 inch** (19 mm)] [**1.125 inches** (29 mm)] [**1.188 inches** (30 mm)] [**1.25 inches** (32 mm)] [**1.5 inches** (38 mm)] <**Insert dimension**>.
- B. Reverse-Rib-Profile, Exposed-Fastener Metal Wall Panels <**Insert drawing designation**>: Formed with recessed, trapezoidal major valleys and [**intermediate stiffening valleys symmetrically spaced**] [**flat pan**] between major valleys; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
 1. Material: [**Zinc-coated (galvanized)**] [**Aluminum-zinc alloy-coated**] steel sheet, [**0.022-inch** (0.56-mm)] [**0.028-inch** (0.71-mm)] [**0.034-inch** (0.86-mm)] nominal thickness.

- a. Exterior Finish: **[Fluoropolymer] [Siliconized polyester]**.
 - b. Color: **[As indicated by manufacturer's designations] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
2. Major-Rib Spacing: **[12 inches (305 mm)] <Insert dimension> o.c.**
 3. Panel Coverage: **[36 inches (914 mm)] <Insert dimension>**.
 4. Panel Height: **[1.125 inches (29 mm)] [1.188 inches (30 mm)] [1.25 inches (32 mm)] [1.5 inches (38 mm)] <Insert dimension>**.
- C. Concealed-Fastener Metal Wall Panels **<Insert drawing designation>**: Formed with vertical panel edges and **[a single wide recess, centered between panel edges] [flush surface]**; with flush joint between panels; with **1-inch- (25-mm-)** wide flange for attaching interior finish; designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners **[and factory-applied sealant]** in side laps.
1. Material: **[Zinc-coated (galvanized)] [Aluminum-zinc alloy-coated]** steel sheet, **[0.028-inch (0.71-mm)] [0.034-inch (0.86-mm)]** nominal thickness.
 - a. Exterior Finish: **[Fluoropolymer] [Siliconized polyester]**.
 - b. Color: **[As indicated by manufacturer's designations] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 2. Panel Coverage: **[16 inches (406 mm)] <Insert dimension>**.
 3. Panel Height: **[3 inches (76 mm)] <Insert dimension>**.
- D. Tapered-Rib-Profile, Metal Liner Panels **<Insert drawing designation>**: Formed with raised, trapezoidal major ribs and **[intermediate stiffening ribs symmetrically spaced] [flat pan]** between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
1. Material: **[Zinc-coated (galvanized)] [Aluminum-zinc alloy-coated]** steel sheet, **[0.022-inch (0.56-mm)] [0.028-inch (0.71-mm)] [0.034-inch (0.86-mm)]** nominal thickness.
 - a. Exterior Finish: **[Siliconized polyester] [Acrylic enamel]**.
 - b. Color: **[As indicated by manufacturer's designations] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.
 2. Major-Rib Spacing: **[6 inches (152 mm)] [12 inches (305 mm)] <Insert dimension> o.c.**
 3. Panel Coverage: **[36 inches (914 mm)] <Insert dimension>**.
 4. Panel Height: **[1.25 inches (32 mm)] [1.5 inches (38 mm)] <Insert dimension>**.
- E. Flush-Profile, Metal Liner Panels **<Insert drawing designation>**: **[Solid] [Perforated]** panels formed with vertical panel edges and **[intermediate stiffening ribs symmetrically spaced] [flat pan]** between panel edges; with flush joint between panels; designed for interior side of metal wall panel assemblies and installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching

through panel to supports using concealed fasteners[**and factory-applied sealant**] in side laps.

1. Material: [**Zinc-coated (galvanized)**] [**Aluminum-zinc alloy-coated**] steel sheet, [**0.028-inch** (0.71-mm)] [**0.034-inch** (0.86-mm)] nominal thickness.
 - a. Exterior Finish: [**Siliconized polyester**] [**Polyester**] [**Acrylic enamel**].
 - b. Color: [**As indicated by manufacturer's designations**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
2. Sound Absorption: NRC not less than [**0.65**] [**0.85**] [**1.00**] <Insert value> when tested according to ASTM C 423.
3. Panel Coverage: [**12 inches** (305 mm)] <Insert dimension>.
4. Panel Height: [**1.5 inches** (38 mm)] <Insert dimension>.

F. Materials:

1. Metallic-Coated Steel Sheet: Restricted-flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, **G90** (Z275) coating designation; structural quality.
 - b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, **Class AZ50 coating designation, Grade 40** (Class AZM150 coating designation, **Grade 275**); structural quality.
 - c. Surface: [**Smooth, flat**] [**Embossed**] finish.

G. Finishes:

1. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - b. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - c. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than **0.2 mil** (0.005 mm) for primer and **0.8 mil** (0.02 mm) for topcoat.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of **0.5 mil** (0.013 mm).

2.7 FOAM-INSULATION-CORE METAL WALL PANELS

- A. Description: Provide factory-formed and -assembled, metal wall panels fabricated from two metal facing sheets and an insulation core foamed in place during fabrication, with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.
1. Concealed-Fastener, Foam-Insulation-Core Metal Wall Panels <Insert drawing **designation**>: Formed with tongue-and-groove panel edges; designed for sequential installation by interlocking panel edges and mechanically attaching panels to supports using concealed clips or fasteners.
 - a. Facings: Fabricate panel with exterior and interior facings of same material and thickness.
 - b. Exterior Surface: [**Smooth, flat**] [**Striated**] [**Shallow ribs**] [**Shallow V grooves**].
 - c. Panel Coverage: [**36 inches (914 mm)**] [**42 inches (1067 mm)**] <Insert **dimension**> nominal.
 - d. Panel Thickness: [**2 inches (51 mm)**] [**2.5 inches (64 mm)**] [**3 inches (76 mm)**] [**4 inches (102 mm)**] [**5 inches (127 mm)**] [**6 inches (152 mm)**] <Insert **dimension**>.
 - e. Thermal-Resistance Value (R-Value): <Insert **R-value**>.
- B. Panel Performance:
1. Flatwise Tensile Strength: **30 psi (200 kPa)** when tested according to ASTM C 297/C 297M.
 2. Humid Aging: Volume increase not greater than 6.0 percent and no delamination or metal corrosion when tested for seven days at **140 deg F (60 deg C)** and 100 percent relative humidity according to ASTM D 2126.
 3. Heat Aging: Volume increase not greater than 2.0 percent and no delamination, surface blistering, or permanent bowing when tested for seven days at **200 deg F (93 deg C)** according to ASTM D 2126.
 4. Cold Aging: Volume decrease not more than 1.0 percent and no delamination, surface blistering, or permanent bowing when tested for seven days at minus **20 deg F (29 deg C)** according to ASTM D 2126.
 5. Fatigue: No evidence of delamination, core cracking, or permanent bowing when tested to a **20-lbf/sq. ft. (958-kPa)** positive and negative wind load and with deflection of L/180 for two million cycles.
 6. Autoclave: No delamination when exposed to **2-psi (13.8-kPa)** pressure at a temperature of **212 deg F (100 deg C)** for 2-1/2 hours.
 7. Fire-Test-Response Characteristics: Class A according to ASTM E 108.
- C. Polyisocyanurate Insulation-Core Performance:
1. Density: **2.0 to 2.6 lb/cu. ft. (32 to 42 kg/cu. m)** when tested according to ASTM D 1622.
 2. Compressive Strength: Minimum **20 psi (140 kPa)** when tested according to ASTM D 1621.
 3. Shear Strength: **26 psi (179 kPa)** when tested according to ASTM C 273/C 273M.

D. Materials:

1. Polyisocyanurate Insulation: Modified polyisocyanurate foam using a non-CFC blowing agent, foamed-in-place or board type as indicated, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.
 - a. Closed-Cell Content: 90 percent when tested according to ASTM D 6226.
2. Metallic-Coated Steel Sheet: Restricted-flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, **G90 (Z275)** coating designation; structural quality.
 - b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, **Class AZ50 coating designation, Grade 40** (Class AZM150 coating designation, Grade 275); structural quality.
 - c. Surface: **[Smooth, flat] [Embossed]** finish.

E. Finishes:

1. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - b. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - c. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than **0.2 mil (0.005 mm)** for primer and **0.8 mil (0.02 mm)** for topcoat.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of **0.5 mil (0.013 mm)**.

2.8 TRANSLUCENT PANELS

- A. Uninsulated Translucent Panels: Glass-fiber-reinforced polyester, translucent plastic; complying with ASTM D 3841, **[Type CC2 (general purpose)] [Type CC1 (limited flammability)]**, Grade 1 (weather resistant); smooth finish on both sides. Match profile of adjacent metal panels.
1. Roof Panel Weight: Not less than **8 oz./sq. ft. (2441 g/sq. m)**.
 2. Wall Panel Weight: Not less than **6 oz./sq. ft. (1831 g/sq. m)**.

3. Light Transmittance: Not less than **[55]** <Insert number> percent according to ASTM D 1494.
 4. Metal Edge: Fabricate full length of each side of panel with metal edge for seaming into standing-seam roof panel joint.
 5. Color: **[White]** <Insert color>.
- B. Insulated Translucent Panels: Fabricate insulating units of two sheets of glass-fiber-reinforced polyester, translucent plastic separated by an air space; complying with ASTM D 3841, Type CC1 (limited flammability), Grade 1 (weather resistant); smooth finish on both sides. Match profile of adjacent metal panels.
1. Exterior Panel Weight: Not less than **[8 oz./sq. ft. (2441 g/sq. m)]** **[6 oz./sq. ft. (1831 g/sq. m)]**.
 2. Interior Panel Weight: Not less than **[8 oz./sq. ft. (2441 g/sq. m)]** **[6 oz./sq. ft. (1831 g/sq. m)]** **[4 oz./sq. ft. (1221 g/sq. m)]**.
 3. Light Transmittance: Not less than **[42]** <Insert number> percent according to ASTM D 1494.
 4. Metal Edge: Fabricate full length of each side of panel with metal edge for seaming into standing-seam roof panel joint.
 5. Color: **[White]** <Insert color>.
- C. Mastic for Translucent Panels: Nonstaining, saturated vinyl polymer as recommended by translucent panel manufacturer for sealing laps.
- D. Performance:
1. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: **[25]** <Insert value> or less.
 - b. Smoke-Developed Index: **[450]** <Insert value> or less.
- 2.9 METAL SOFFIT PANELS
- A. General: Provide factory-formed metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners[**and factory-applied sealant**] in side laps. Include accessories required for weathertight installation.
- B. Metal Soffit Panels: Match profile and material of metal **[roof]** **[wall]** panels.
1. Finish: **[Match finish and color of metal roof panels]** **[Match finish and color of metal wall panels]** **[As indicated on Drawings]**.
- C. Tapered-Rib-Profile, Exposed-Fastener Metal Soffit Panels <Insert drawing designation>: Formed with raised, trapezoidal major ribs and **[intermediate stiffening ribs symmetrically spaced]** **[flat pan]** between major ribs; designed to be

installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.

1. Material: [**Zinc-coated (galvanized)**] [**Aluminum-zinc alloy-coated**] steel sheet, [0.022-inch (0.56-mm)] [0.028-inch (0.71-mm)] [0.034-inch (0.86-mm)] nominal thickness.
 - a. Exterior Finish: [**Fluoropolymer**] [**Siliconized polyester**].
 - b. Color: [**As indicated by manufacturer's designations**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
2. Major-Rib Spacing: [6 inches (152 mm)] [12 inches (305 mm)] <Insert dimension> o.c.
3. Panel Coverage: [36 inches (914 mm)] <Insert dimension>.
4. Panel Height: [0.75 inch (19 mm)] [1.125 inches (29 mm)] [1.188 inches (30 mm)] [1.25 inches (32 mm)] [1.5 inches (38 mm)] <Insert dimension>.

D. Concealed-Fastener Metal Soffit Panels <Insert drawing designation>: Formed with vertical panel edges and [**a single wide recess, centered between panel edges**] [**flush surface**]; with flush joint between panels; with 1-inch- (25-mm-) wide flange for attaching interior finish; designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners[**and factory-applied sealant**] in side laps.

1. Material: [**Zinc-coated (galvanized)**] [**Aluminum-zinc alloy-coated**] steel sheet, [0.028-inch (0.71-mm)] [0.034-inch (0.86-mm)] nominal thickness.
 - a. Exterior Finish: [**Fluoropolymer**] [**Siliconized polyester**].
 - b. Color: [**As indicated by manufacturer's designations**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.
2. Panel Coverage: [12 inches (305 mm)] [16 inches (406 mm)] <Insert dimension>.
3. Panel Height: [1 inch (25 mm)] [1.5 inches (38 mm)] <Insert dimension>.

2.10 THERMAL INSULATION

- A. Faced Metal Building Insulation: ASTM C 991, Type II, glass-fiber-blanket insulation; 0.5-lb/cu. ft. (8-kg/cu. m) density; 2-inch- (51-mm-) wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less.
- B. Unfaced Metal Building Insulation: ASTM C 991, Type I, or NAIMA 202, glass-fiber-blanket insulation; 0.5-lb/cu. ft. (8-kg/cu. m) density; 2-inch- (51-mm-) wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less.
 1. Vapor-Retarder Facing: ASTM C 1136, with permeance not greater than 0.02 perm (1.15 ng/Pa x s x sq. m) when tested according to ASTM E 96/E 96M, Desiccant Method.

- a. Composition: White metallized-polypropylene film facing, fiberglass scrim reinforcement, and kraft-paper backing.
 - b. Composition: Aluminum foil facing, elastomeric barrier coating, fiberglass scrim reinforcement, and kraft-paper backing.
 - c. Composition: White **[polypropylene] [vinyl]** film facing, fiberglass scrim reinforcement, and metallized-polyester film backing.
 - d. Composition: White polypropylene film facing and fiberglass-polyester-blend fabric backing.
- C. Mineral-Fiber-Blanket Insulation: ASTM C 665, type indicated below; consisting of fibers manufactured from glass, slag wool, or rock wool.
1. Nonreflective Faced: Type II (blankets with nonreflective membrane covering), Category 1 (membrane is a vapor retarder), Class A (membrane-faced surface with a flame-spread index of 25 or less).
 2. Reflective Faced: Type III (blankets with reflective membrane covering), Category 1 (membrane is a vapor retarder), Class A (membrane-faced surface with a flame-spread index of 25 or less).
 3. Unfaced: Type I (blankets without membrane covering), passing ASTM E 136 for combustion characteristics.
 - a. Vapor-Retarder Facing: ASTM C 1136, with permeance not greater than **0.02 perm** (1.15 ng/Pa x s x sq. m) when tested according to ASTM E 96/E 96M, Desiccant Method.
 - 1) Composition: White metallized-polypropylene film facing, fiberglass scrim reinforcement, and kraft-paper backing.
 - 2) Composition: Aluminum foil facing, elastomeric barrier coating, fiberglass scrim reinforcement, and kraft-paper backing.
 - 3) Composition: White **[polypropylene] [vinyl]** film facing, fiberglass scrim reinforcement, and metallized-polyester film backing.
 - 4) Composition: White polypropylene film facing and fiberglass-polyester blend fabric backing.
- D. Faced, Polyisocyanurate Board Insulation: ASTM C 1289, Type I (foil facing), Class 2, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, based on tests performed on unfaced core. Provide units tested for interior exposure without an approved thermal barrier.
- E. Retainer Strips: **0.025-inch** (0.64-mm) nominal-thickness, formed, metallic-coated steel or PVC retainer clips colored to match insulation facing.
- F. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
- 2.11 DOORS AND FRAMES
- A. Swinging Personnel Doors and Frames: As specified in Section 081113 "Hollow Metal Doors and Frames."

- B. Swinging Personnel Doors and Frames: Metal building system manufacturer's standard doors and frames; prepared and reinforced at strike and at hinges to receive factory- and field-applied hardware according to BHMA A156 Series.
1. Steel Doors: 1-3/4 inches (44 mm) thick; fabricated from 0.040-inch (1.02-mm) nominal-thickness, metallic-coated steel face sheets; of [**seamed**] [**seamless**], hollow-metal construction; with 0.064-inch (1.63-mm) nominal-thickness, inverted metallic-coated steel channels welded to face sheets at top and bottom of door.
 - a. Design: [**Flush panel**] [**As indicated**] <Insert design>.
 - b. Core: Kraft honeycomb with U-factor rating of at least 0.47 Btu/sq. ft. x h x deg F (2.67 W/sq. m x K).
 - c. Core: Polystyrene foam with U-factor rating of at least 0.16 Btu/sq. ft. x h x deg F (0.91 W/sq. m x K).
 - d. Core: Polyurethane foam with U-factor rating of at least 0.07 Btu/sq. ft. x h x deg F (0.40 W/sq. m x K).
 - e. Glazing Frames: Steel frames to receive field-installed glass.
 - f. Glazing: As specified in Section 088000 "Glazing."
 2. Steel Frames: Fabricate 2-inch- (51-mm-) wide face frames from 0.064-inch (1.63-mm) nominal-thickness, metallic-coated steel sheet.
 - a. Type: [**Knocked down for field assembly**] [**Factory welded**].
 3. Fabricate concealed stiffeners, reinforcement, edge channels, and moldings from either cold- or hot-rolled steel sheet.
 4. Hardware:
 - a. Provide hardware for each door leaf, as follows:
 - 1) Hinges: BHMA A156.1. Three [**plain**] [**antifriction**]-bearing, standard-weight, full-mortise, stainless-steel or bronze, template-type hinges; 4-1/2 by 4-1/2 inches (114 by 114 mm), with nonremovable pin.
 - 2) Lockset: BHMA A156.2. [**Key-in-lever cylindrical**] [**Mortise, with lever handle**] type.
 - 3) Exit Device: BHMA A156.3. Touch- or push-bar type.
 - 4) Threshold: BHMA A156.21. Extruded aluminum.
 - 5) Silencers: Pneumatic rubber; three silencers on strike jambs of single door frames and two silencers on heads of double door frames.
 - 6) Closer: BHMA A156.4. Surface-applied, standard-duty hydraulic type.
 - 7) Weather Stripping: Vinyl applied to head and jambs, with vinyl sweep at sill.
 - b. Provide each pair of double doors with the following hardware in addition to that specified for each leaf:
 - 1) Astragal: Removable type.
 - 2) Surface Bolts: Top and bottom of inactive door.

5. Anchors and Accessories: Manufacturer's standard units, galvanized according to ASTM A 123/A 123M.
 6. Fabrication: Fabricate doors and frames to be rigid; neat in appearance; and free from defects, warp, or buckle. Provide continuous welds on exposed joints; grind, dress, and make welds smooth, flush, and invisible.
- C. Horizontal-Sliding Doors: Manufacturer's standard horizontal-sliding door assembly including structural frame, door panels, brackets, guides, tracks, hardware, and installation accessories.
1. Door Frames: Channels and zees; fabricated from minimum 0.064-inch (1.63-mm) nominal-thickness, metallic-coated steel sheet or structural-steel shapes.
 2. Door Panels: Same material and finish as metal wall panels.
 3. Hardware: Manufacturer's standard metallic-coated steel track, bottom guides, lock angles for side closure, and brackets. Support each door leaf by two four-wheel trolleys. Provide metallic-coated steel handle for each leaf, and slide bolt or padlock hasp. Flash top of track with metallic-coated steel sheet hood.
- D. Materials:
1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
 2. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
 3. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with G60 (Z180) zinc (galvanized) or A60 (ZF180) zinc-iron-alloy (galvannealed) coating designation.
- E. Finishes for Personnel Doors and Frames:
1. Prime Finish: Factory-apply manufacturer's standard primer immediately after cleaning and pretreating.
 - a. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
 2. Factory-Applied Paint Finish: Manufacturer's standard, complying with SDI A250.3 for performance and acceptance criteria.
 - a. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>.**

2.12 WINDOWS

- A. Aluminum Windows: As specified in Section 085113 "Aluminum Windows."

- B. Aluminum Windows: Metal building system manufacturer's standard, with self-flashing mounting fins, and as follows:
1. Type, Performance Class, and Performance Grade: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 and as follows:
 - a. Horizontal-Sliding Units: **[HS-LC25] [HS-C30] <Insert designation>**.
 - b. Single-Hung Units: **[H-LC25] [H-C30] <Insert designation>**.
 - c. Fixed Units: **[F-LC25] [F-C30] <Insert designation>**.
 2. Aluminum Extrusions: **ASTM B 221 (ASTM B 221M)**, alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than **0.064-inch (1.63-mm)** thickness at any location for main frame and sash members.
 - a. Thermally Improved Construction: Fabricate window units with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.
 3. Mullions: Between adjacent windows, fabricated of extruded aluminum matching finish of window units.
 4. Fasteners, Anchors, and Clips: Nonmagnetic stainless steel, aluminum, or other noncorrosive material, compatible with aluminum window members, trim, hardware, anchors, and other components of window units. Fasteners shall not be exposed, except for attaching hardware.
 - a. Reinforcement: Where fasteners screw-anchor into aluminum less than **0.128 inch (3.26 mm)** thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, spline grommet nuts.
 5. Hardware: Manufacturer's standard; of aluminum, stainless steel, die-cast steel, malleable iron, or bronze; including the following:
 - a. Cam-action sweep sash lock and keeper at meeting rails.
 - b. Spring-loaded, snap-type lock at jambs.
 - c. Pole-operated, cam-action locking device on meeting rail where rail is more than **72 inches (1830 mm)** above floor.
 - d. Lift handles for single-hung units.
 - e. Nylon sash rollers for horizontal-sliding units.
 - f. Steel or bronze operating arms.
 6. Sliding-Type Weather Stripping: Woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric; complying with AAMA 701/702.
 7. Insect Screens: Provide removable insect screen on each operable exterior sash, with screen frame finished to match window unit, and as follows:

- a. Aluminum Wire Fabric: **18-by-18** (1.1-by-1.1-mm), **18-by-16** (1.1-by-1.3-mm), or **18-by-14** (1.1-by-1.5-mm) mesh of **0.013-inch-** (0.3-mm-) diameter, coated aluminum wire; complying with FS RR-W-365, Type VII.
 - b. Glass-Fiber Mesh Fabric: **18-by-16** (1.1-by-1.3-mm) or **18-by-14** (1.1-by-1.5-mm) mesh of PVC-coated, glass-fiber threads, woven and fused to form a fabric mesh; complying with ASTM D 3656.
 - c. Fabric: Manufacturer's standard aluminum wire fabric or glass-fiber mesh fabric.
- C. Glazing: Comply with requirements specified in Section 088000 "Glazing."
- D. Glazing:
1. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear), 3 mm thick.
 2. Heat-Treated Float Glass: ASTM C 1048, Type I, Quality-Q3, Class I (clear), Condition A, 3 mm thick.
 3. Tinted Float Glass: ASTM C 1036, Type I, Quality-Q3, Class 2, 3 mm thick.
 - a. Tint Color: **[Blue] [Blue-green] [Bronze] [Green] [Gray] [Manufacturer's standard color] <Insert color>**.
 4. Patterned Glass: ASTM C 1036, Type II, Quality-Q6, Class 1 (clear), Form 3, Pattern P3 (random), 3 mm thick.
 5. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of 2.5-mm-thick clear float glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
 6. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201.
 - a. Provide safety glazing labeling.
 7. Glazing Stops: Screw-applied or snap-on glazing stops coordinated with Section 088000 "Glazing" and with glazing system indicated. Match material and finish of window frames.
 8. Factory-Glazed Fabrication: Glaze window units in the factory to greatest extent possible and practical for applications indicated. Comply with requirements in Section 088000 "Glazing."
- E. Finish:
1. Mill finish.
 2. Baked-Enamel Finish: Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603 except with a minimum dry film thickness of **0.7 mil** (0.02 mm), medium gloss.
 - a. Color: **[As indicated by manufacturer's designations] [As selected by DEN Project Manager from manufacturer's full range] <Insert color>**.

2.13 ACCESSORIES

- A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
- B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.
1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
 2. Clips: Manufacturer's standard, formed from **[steel] [stainless-steel]** sheet, designed to withstand negative-load requirements.
 3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from **[steel] [stainless-steel sheet or nylon-coated aluminum]** sheet.
 4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum **1-inch- (25-mm-)** thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
 6. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide **1-inch (25-mm)** standoff; fabricated from extruded polystyrene.
- C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels unless otherwise indicated.
1. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum **1-inch- (25-mm-)** thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

- D. Flashing and Trim: Formed from **0.022-inch (0.56-mm)** nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match adjacent metal panels.
1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
 2. Opening Trim: Formed from [**0.022-inch (0.56-mm)**] [**0.034-inch (0.86-mm)**] nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.
- E. Gutters: Formed from **0.022-inch (0.56-mm)** nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum **96-inch- (2438-mm-)** long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."
1. Gutter Supports: Fabricated from same material and finish as gutters.
 2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.
- F. Downspouts: Formed from **0.022-inch (0.56-mm)** nominal-thickness, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum **10-foot- (3-m-)** long sections, complete with formed elbows and offsets.
1. Mounting Straps: Fabricated from same material and finish as gutters.
- G. Roof Ventilators: Gravity type, complete with hardware, flashing, closures, and fittings.
1. Circular-Revolving Type: Minimum [**20-inch- (508-mm-)**] **<Insert dimension>** diameter throat opening; fabricated from **0.028-inch (0.71-mm)** nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal roof panels; with matching base and rain cap.
 - a. Type: [**Directional**] [**Stationary**] revolving.
 - b. Bird Screening: Galvanized steel, **1/2-inch- (13-mm-)** square mesh, **0.041-inch (1.04-mm)** wire; or aluminum, **1/2-inch- (13-mm-)** square mesh, **0.063-inch (1.6-mm)** wire.
 - c. Dampers: Spring-loaded, butterfly type; pull-chain operation; with pull chain of length required to reach within **36 inches (914 mm)** of floor.
 - d. Reinforce and brace units, with joints properly formed and edges beaded to be watertight under normal positive-pressure conditions.
 - e. Mount ventilators on square-to-round bases for ridge or on-slope mounting, designed to match roof pitch and roll formed to match metal roof panel profile.

2. Continuous or Sectional-Ridge Type: Factory-engineered and -fabricated, continuous unit; fabricated from **0.022-inch (0.56-mm)** nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal roof panels. Fabricated in minimum **10-foot- (3-m-)** long sections. Provide throat size and total length indicated, complete with side baffles, ventilator assembly, end caps, splice plates, and reinforcing diaphragms.
 - a. Bird Screening: Galvanized steel, **1/2-inch- (13-mm-)** square mesh, **0.041-inch (1.04-mm)** wire; or aluminum, **1/2-inch- (13-mm-)** square mesh, **0.063-inch (1.6-mm)** wire.
 - b. Dampers: Manually operated, spring-loaded, vertically rising type; chain and worm gear operator; with pull chain of length required to reach within **36 inches (914 mm)** of floor.
 - c. Throat Size: [**9 inches (229 mm)**] [**12 inches (305 mm)**] [**9 or 12 inches (229 or 305 mm)**], **as standard with manufacturer, and as required to comply with ventilation requirements**].

- H. Louvers: Size and design indicated; self-framing and self-flashing. Fabricate welded frames from minimum **0.052-inch (1.32-mm)** nominal-thickness, metallic-coated steel sheet; finished to match metal wall panels. Form blades from **0.040-inch (1.02-mm)** nominal-thickness, metallic-coated steel sheet; folded or beaded at edges, set at an angle that excludes driving rains, and secured to frames by riveting or welding. Fabricate louvers with equal blade spacing to produce uniform appearance.
 1. Blades: Fixed.
 2. Blades: Adjustable type, with weather-stripped edges, and manually operated by hand crank or pull chain.
 3. Free Area: Not less than [**7.0 sq. ft. (0.65 sq. m)**] **<Insert dimension>** for **48-inch- (1220-mm-)** wide by **48-inch- (1220-mm-)** high louver.
 4. Bird Screening: Galvanized steel, **1/2-inch- (13-mm-)** square mesh, **0.041-inch (1.04-mm)** wire; with rewirable frames, removable and secured with clips; fabricated of same kind and form of metal and with same finish as louvers.
 - a. Mounting: [**Interior**] [**Exterior**] face of louvers.
 5. Vertical Mullions: Provide mullions at spacings recommended by manufacturer, or **72 inches (1830 mm)** o.c., whichever is less.

- I. Roof Curbs: Fabricated from minimum **0.052-inch (1.32-mm)** nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal roof panels; with welded top box and bottom skirt, and integral full-length cricket; capable of withstanding loads of size and height indicated.
 1. Curb Subframing: Fabricated from **0.064-inch (1.63-mm)** nominal-thickness, angle-, C-, or Z-shaped metallic-coated steel sheet.
 2. Insulation: **1-inch- (25-mm-)** thick, rigid type.

- J. Service Walkways: Fabricated from 0.052-inch (1.32-mm) nominal-thickness, metallic-coated steel plank grating; with slip-resistant pattern; [18-inch (457-mm)] [24-inch (610-mm)] [36-inch (914-mm)] overall width. Support walkways on framing system anchored to metal roof panels without penetrating panels; with predrilled holes and clamps or hooks for anchoring.
- K. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.
- L. Materials:
1. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
 - a. Fasteners for Metal Roof Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM sealing washer.
 - b. Fasteners for Metal Roof Panels: Self-drilling, Type 410 stainless-steel or self-tapping, Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM washer under heads of fasteners bearing on weather side of metal panels.
 - c. Fasteners for Metal Wall Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws[, **with EPDM sealing washers bearing on weather side of metal panels**].
 - d. Fasteners for Metal Wall Panels: Self-drilling, Type 410 stainless-steel or self-tapping, Type 304 stainless-steel or zinc-alloy-steel hex washer head[, **with EPDM sealing washers bearing on weather side of metal panels**].
 - e. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
 - f. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
 2. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
 3. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
 4. Metal Panel Sealants:
 - a. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene-compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.
 - b. Joint Sealant: ASTM C 920; one-part elastomeric polyurethane or polysulfide; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

2.14 SOURCE QUALITY CONTROL

- A. Testing Agency: **[Owner will engage] [Engage]** a qualified testing agency to evaluate product.
- B. Special Inspector: Owner will engage a qualified special inspector to perform the following tests and inspections and to submit reports. Special inspector will verify that manufacturer maintains detailed fabrication and quality-control procedures and will review the completeness and adequacy of those procedures to perform the Work.
 - 1. Special inspections will not be required if fabrication is performed by manufacturer registered and approved by authorities having jurisdiction to perform such Work without special inspection.
 - a. After fabrication, submit copy of certificate of compliance to authorities having jurisdiction, certifying that Work was performed according to Contract requirements.
- C. Testing: Test and inspect shop connections for metal buildings according to the following:
 - 1. Bolted Connections: Shop-bolted connections shall be **[tested and]** inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - 2. Welded Connections: In addition to visual inspection, shop-welded connections shall be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at inspector's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- D. Product will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

2.15 FABRICATION

- A. General: Design components and field connections required for erection to permit easy assembly.
 - 1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
 - 2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.

- B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.
- C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
 - 1. Make shop connections by welding or by using high-strength bolts.
 - 2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
 - 3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
 - 4. Weld clips to frames for attaching secondary framing.
 - 5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.
- D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll-forming or break-forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
 - 1. Make shop connections by welding or by using non-high-strength bolts.
 - 2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.
- E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
 - 1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.
 - 1. Engage land surveyor to perform surveying.

- C. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
- B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION OF STRUCTURAL FRAMING

- A. Erect metal building system according to manufacturer's written erection instructions and erection drawings.
- B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
- C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- D. Base[**and Bearing**] Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.
- F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to

maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.

1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for bolt type and joint type specified.
 - a. Joint Type: Snug tightened or pretensioned.
- G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
 1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
 2. Locate and space wall girts to suit openings such as doors and windows.
 3. Locate canopy framing as indicated.
 4. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
- H. Steel Joists[**and Joist Girders**]: Install joists[, **girders**,] and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders," joist manufacturer's written instructions, and requirements in this Section.
 1. Before installation, splice joists delivered to Project site in more than one piece.
 2. Space, adjust, and align joists accurately in location before permanently fastening.
 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
 4. Bolt joists to supporting steel framework using carbon-steel bolts unless otherwise indicated.
 5. Bolt joists to supporting steel framework using high-strength structural bolts unless otherwise indicated. Comply with RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for high-strength structural bolt installation and tightening requirements.
 6. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.
- I. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
 1. Tighten rod and cable bracing to avoid sag.
 2. Locate interior end-bay bracing only where indicated.
- J. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
- K. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

3.4 METAL PANEL INSTALLATION, GENERAL

- A. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.
1. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.
- B. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
 - a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.
 2. Install metal panels perpendicular to structural supports unless otherwise indicated.
 3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 5. Locate metal panel splices over, but not attached to, structural supports with end laps in alignment.
 6. Lap metal flashing over metal panels to allow moisture to run over and off the material.
- C. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.
1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
- D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- E. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.

1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.5 METAL ROOF PANEL INSTALLATION

- A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
1. Install ridge[**and hip**] caps as metal roof panel work proceeds.
 2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.
- B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.
1. Install clips to supports with self-drilling or self-tapping fasteners.
 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
 4. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so that clip, metal roof panel, and factory-applied sealant are completely engaged.
 5. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Predrill panels for fasteners.
 6. Provide metal closures at [**peaks**] [**rake edges**] [**rake walls**] [**and**] each side of ridge[**and hip**] caps.
- C. Lap-Seam Metal Roof Panels: Fasten metal roof panels to supports with exposed fasteners at each lapped joint, at location and spacing recommended by manufacturer.
1. Provide metal-backed sealing washers under heads of exposed fasteners bearing on weather side of metal roof panels.
 2. Provide sealant tape at lapped joints of metal roof panels and between panels and protruding equipment, vents, and accessories.
 3. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps and on side laps of nesting-type metal panels, on side laps of ribbed or fluted metal panels, and elsewhere as needed to make metal panels weatherproof to driving rains.
 4. At metal panel splices, nest panels with minimum **6-inch** (152-mm) end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.
- D. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

- E. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of **1/4 inch in 20 feet** (6 mm in 6 m) on slope and location lines as indicated and within **1/8-inch** (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.6 METAL WALL PANEL INSTALLATION

- A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
 2. Shim or otherwise plumb substrates receiving metal wall panels.
 3. When two rows of metal panels are required, lap panels **4 inches** (102 mm) minimum.
 4. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
 5. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Pre-drill panels.
 6. Flash and seal metal wall panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
 7. Install screw fasteners in pre-drilled holes.
 8. Install flashing and trim as metal wall panel work proceeds.
 9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated; or, if not indicated, as necessary for waterproofing.
 10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws.
 11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- B. Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.
- C. Insulated Metal Wall Panels: Install insulated metal wall panels on exterior side of girts. Attach panels to supports at each panel joint using concealed clip and fasteners at maximum **42 inches** (1067 mm) o.c., spaced not more than manufacturer's recommendation. Fully engage tongue and groove of adjacent insulated metal wall panels.
1. Install clips to supports with self-tapping fasteners.
 2. Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal wall panels as vapor seal; apply sealant to panel joint on exposed side of panels as weather seal.
- D. Installation Tolerances: Shim and align metal wall panels within installed tolerance of **1/4 inch in 20 feet** (6 mm in 6 m), nonaccumulative, on level, plumb, and on location

lines as indicated, and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.7 TRANSLUCENT PANEL INSTALLATION

- A. Translucent Panels: Attach translucent panels to structural framing with fasteners according to manufacturer's written instructions. Install panels perpendicular to supports unless otherwise indicated. Anchor translucent panels securely in place, with provisions for thermal and structural movement.
1. Provide end laps of not less than 6 inches (152 mm) and side laps of not less than 1-1/2-inch (38-mm) corrugations for metal roof panels.
 2. Provide end laps of not less than 4 inches (102 mm) and side laps of not less than 1-1/2-inch (38-mm) corrugations for metal wall panels.
 3. Align horizontal laps with adjacent metal panels.
 4. Seal intermediate end laps and side laps of translucent panels with translucent mastic.

3.8 METAL SOFFIT PANEL INSTALLATION

- A. Provide metal soffit panels the full width of soffits. Install panels perpendicular to support framing.
- B. Flash and seal metal soffit panels with weather closures where panels meet walls and at perimeter of all openings.

3.9 THERMAL INSULATION INSTALLATION

- A. General: Install insulation concurrently with metal panel installation, in thickness indicated to cover entire surface, according to manufacturer's written instructions.
1. Set vapor-retarder-faced units with vapor retarder toward warm side of construction unless otherwise indicated. Do not obstruct ventilation spaces except for firestopping.
 2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to the surrounding construction to ensure airtight installation.
 3. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths, with both sets of facing tabs sealed, to provide a complete vapor retarder.
 4. Install blankets straight and true in one-piece lengths. Install vapor retarder over insulation, with both sets of facing tabs sealed, to provide a complete vapor retarder.
- B. Blanket Roof Insulation: Comply with the following installation method:
1. Over-Framing Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal roof panels fastened to secondary framing.

2. **Between-Purlin Installation:** Extend insulation and vapor retarder between purlins. Carry vapor-retarder-facing tabs up and over purlin, overlapping adjoining facing of next insulation course and maintaining continuity of retarder. Hold in place with bands and crossbands below insulation.
 3. **Over-Purlin-with-Spacer-Block Installation:** Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Install layer of filler insulation over first layer to fill space formed by metal roof panel standoffs. Hold in place by panels fastened to standoffs.
 - a. **Thermal Spacer Blocks:** Where metal roof panels attach directly to purlins, install thermal spacer blocks.
 4. **Two-Layers-between-Purlin-with-Spacer-Block Installation:** Extend insulation and vapor retarder between purlins. Carry vapor-retarder-facing tabs up and over purlin, overlapping adjoining facing of next insulation course and maintaining continuity of retarder. Install layer of filler insulation over first layer to fill space between purlins formed by thermal spacer blocks. Hold in place with bands and crossbands below insulation.
 - a. **Thermal Spacer Blocks:** Where metal roof panels attach directly to purlins, install thermal spacer blocks.
 5. **Retainer Strips:** Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
- C. **Blanket Wall Insulation:** Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal wall panels fastened to secondary framing.
1. **Retainer Strips:** Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
 2. **Sound-Absorption Insulation:** Where sound-absorption requirement is indicated for metal liner panels, cover insulation with polyethylene film and provide inserts of wire mesh to form acoustical spacer grid.
- D. **Board Wall Insulation:** Extend board insulation in thickness indicated to cover entire wall. Hold in place by metal wall panels fastened to secondary framing. Comply with manufacturers' written instructions.
1. **Retainer Strips:** Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
- 3.10 **DOOR AND FRAME INSTALLATION**
- A. **General:** Install doors and frames plumb, rigid, properly aligned, and securely fastened in place according to manufacturers' written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each doorframe with elastomeric sealant used for metal wall panels.

- B. Personnel Doors and Frames: Install doors and frames according to SDI A250.8. Fit non-fire-rated doors accurately in their respective frames, with the following clearances:
1. Between Doors and Frames at Jambs and Head: **1/8 inch (3 mm)**.
 2. Between Edges of Pairs of Doors: **1/8 inch (3 mm)**.
 3. At Door Sills with Threshold: **3/8 inch (9.5 mm)**.
 4. At Door Sills without Threshold: **3/4 inch (19.1 mm)**.
 5. At fire-rated openings, install frames according to, and doors with clearances specified in, NFPA 80.
- C. Sliding Service Doors: Bolt support angles to opening head members through factory-punched holes. Bolt door tracks to support angles at maximum **24 inches (610 mm)** o.c. Set doors and operating equipment with necessary hardware, jamb and head mold stops, continuous hood flashing, anchors, inserts, hangers, and equipment supports.
- D. Field Glazing: Comply with installation requirements in Section 088000 "Glazing."
- E. Retain paragraph below if hardware is not specified.
- F. Door Hardware: Mount units at heights indicated in DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
1. Install surface-mounted items after finishes have been completed on substrates involved.
 2. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 3. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
 4. Set thresholds for exterior doors in full bed of butyl-rubber sealant complying with requirements specified in Section 079200 "Joint Sealants."

3.11 WINDOW INSTALLATION

- A. General: Install windows plumb, rigid, properly aligned, without warp or rack of frames or sash, and securely fasten in place according to manufacturer's written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each window frame with elastomeric sealant used for metal wall panels.
1. Separate dissimilar materials from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified in AAMA/WDMA/CSA 101/I.S.2/A440.
- B. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.
- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

- D. Mount screens directly to frames with tapped screw clips.
- E. Field Glazing: Comply with installation requirements in Section 088000 "Glazing."

3.12 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 - 2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 - 3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of **10 feet (3 m)** with no joints allowed within **24 inches (600 mm)** of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than **1 inch (25 mm)** deep, filled with mastic sealant (concealed within joints).
- C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than **36 inches (914 mm)** o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with **1-1/2-inch (38-mm)** telescoping joints. Provide fasteners designed to hold downspouts securely **1 inch (25 mm)** away from walls; locate fasteners at top and bottom and at approximately **60 inches (1524 mm)** o.c. in between.

1. Provide elbows at base of downspouts to direct water away from building.
 2. Tie downspouts to underground drainage system indicated.
- E. Circular Roof Ventilators: Set ventilators complete with necessary hardware, anchors, dampers, weather guards, rain caps, and equipment supports. Mount ventilators on flat level base. Install preformed filler strips at base to seal ventilator to metal roof panels.
- F. Continuous Roof Ventilators: Set ventilators complete with necessary hardware, anchors, dampers, weather guards, rain caps, and equipment supports. Join sections with splice plates and end-cap skirt assemblies where required to achieve indicated length. Install preformed filler strips at base to seal ventilator to metal roof panels.
- G. Louvers: Locate and place louver units level, plumb, and at indicated alignment with adjacent work.
1. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
 2. Provide perimeter reveals and openings of uniform width for sealants and joint fillers.
 3. Protect galvanized- and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of corrosion-resistant paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
 4. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.
- H. Roof Curbs: Install curbs at locations indicated on Drawings. Install flashing around bases where they meet metal roof panels.
- I. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.13 FIELD QUALITY CONTROL

- A. Special Inspections: **[Owner will engage] [Engage]** a qualified special inspector to perform the following special inspections:
1. Inspection of fabricators.
 2. Steel construction.
 3. **<Insert special inspections>**.
- B. Testing Agency: **[Owner will engage] [Engage]** a qualified testing agency to perform tests and inspections.
- C. Tests and Inspections:

1. High-Strength, Field-Bolted Connections: Connections shall be[**tested and**] inspected during installation according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
2. Welded Connections: In addition to visual inspection, field-welded connections shall be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at inspector's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.

D. Product will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.14 ADJUSTING

- A. Doors: After completing installation, test and adjust doors to operate easily, free of warp, twist, or distortion.
- B. Door Hardware: Adjust and check each operating item of door hardware and each door to ensure proper operation and function of every unit. Replace units that cannot be adjusted to operate as intended.
- C. Windows: Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and at weather stripping to ensure smooth operation and weathertight closure. Lubricate hardware and moving parts.
- D. [**Roof Ventilators**] [**and**] [**Adjustable Louvers**]: After completing installation, including work by other trades, lubricate, test, and adjust units to operate easily and be free of warp, twist, or distortion as needed to provide fully functioning units.
 1. Adjust louver blades to be weathertight when in closed position.

3.15 CLEANING AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- C. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing[, **bearing plates,**] and accessories.

1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- D. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- E. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- F. Doors and Frames: Immediately after installation, sand rusted or damaged areas of prime coat until smooth and apply touchup of compatible air-drying primer.
1. Immediately before final inspection, remove protective wrappings from doors and frames.
- G. Windows: Clean metal surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances. Clean factory-glazed glass immediately after installing windows.
- H. Louvers: Clean exposed surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.
1. Restore louvers damaged during installation and construction period so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by DEN Project Manager, remove damaged units and replace with new units.
 - a. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 133419

SECTION 133423 - FABRICATED STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes prefabricated **[steel]** **[aluminum]** control booths.
- B. Related Sections:
 - 1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts.
 - 2. Section 055000 "Metal Fabrications" for pipe bollards to protect control booths.
- C. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines."
- D. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Control booths shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to **[ASCE/SEI 7]** **<Insert requirement>**:
 - 1. Dead Loads: **<Insert loads>**.
 - 2. Live Loads: **<Insert loads>**.
 - 3. Roof Loads: **<Insert loads>**.
 - 4. Snow Loads: **<Insert loads>**.
 - 5. Seismic Loads: **<Insert loads>**.
 - 6. Wind Loads: **<Insert loads>**.
 - 7. **<Insert loads or load combinations>**.
 - 8. Deflection Limits: Design framing system to withstand design loads without deflections greater than the following:
 - a. **<Insert deflection limits>**.

- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): [120 deg F (67 deg C), **ambient**; 180 deg F (100 deg C)] <Insert temperature range>, material surfaces.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control booths.
 - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For control booths. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Initial Selection: For control booths with factory-applied color finishes.
- D. Samples for Verification: For exposed finishes, in manufacturer's standard sizes.
- E. Delegated-Design Submittal: For control booths indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For control booths to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.3, "Structural Welding Code - Sheet Steel."

- B. Regulatory Requirements: Comply with applicable provisions in **[the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines]** **[and]** **[ICC/ANSI A117.1]**.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Safety Glazing Products: Category II materials complying with testing requirements in 16 CFR 1201.
 - 1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of **[SGCC or another certification agency]** **[or]** **[manufacturer]** acceptable to authorities having jurisdiction.
- E. Preinstallation Conference: Conduct conference at **[Project site]** **[location and time as determined by DEN Project Manager]**<Insert location>.

1.8 COORDINATION

- A. Coordinate installation of anchorages for control booths. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair finish or replace wall panels that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Minimum **[five (5)]** <Insert number> years from date of Substantial Completion.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:

1. Sheet: **ASTM B 209** (ASTM B 209M).
 2. Extruded Shapes: **ASTM B 221** (ASTM B 221M).
 3. Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T4 or Alloy 6061-T6.
- B. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, commercial quality, **G90** (Z275) coating designation; mill phosphatized.
- C. Galvanized, Rolled Steel Tread Plate: ASTM A 786/A 786M, rolled from steel plate complying with ASTM A 572/A 572M, Grade **55** (380); hot-dip galvanized according to ASTM A 123/A 123M.
- D. Steel Structural Tubing: ASTM A 500, Grade B.
- E. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- F. Steel Mechanical Tubing: ASTM A 513, welded steel mechanical tubing.
- G. Zinc-Coated (Galvanized) Steel: Hot-dip galvanized according to ASTM A 123/A 123M.
- H. Stainless-Steel Sheet: ASTM A 666, Type 304.
- I. Plastic Laminate: NEMA LD 3, HGS or HGL grade.
- J. Plywood: DOC PS 1, Exterior grade.
- K. Particleboard: ANSI A208.1, Grade M-2.
- L. Clear Float Glass: ASTM C 1036, Type I, Class 1, Quality q3.
- M. Clear Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, and Quality q3.
- N. Insulating Glass: Units complying with ASTM E 774 for Class CBA and consisting of two lites of 2.5-mm-thick clear float glass and dehydrated air space, with a total overall unit thickness of **7/16 inch** (11 mm) and with manufacturer's standard dual seal.
- O. Ballistics-Resistant Glazing: Comply with requirements specified in Section 088000 "Glazing."
- P. Anchorages: Anchor bolts; [**hot-dip galvanized according to ASTM A 153/A 153M or ASTM F 2329**] [**stainless steel**].
- 2.2 PREFABRICATED CONTROL BOOTHS, GENERAL
- A. General: Provide a complete, integrated set of mutually dependent components that form a completely assembled, prefabricated control booth, ready for installation on Project site.

1. Building Style: **[Standard square corners]** **[Radius corners]** **[Round corners]** **[Butt-glazed corners]** **[Wraparound type, with single rounded building end]** **[Wraparound type, with both building ends rounded]** **[As indicated on Drawings]**.
 2. Doors: **[Sliding door on one side]** **[Sliding doors on both sides]** **[Swinging door on back]** **[As indicated on Drawings]**.
- B. Windows: Extruded-aluminum sash frames glazed with **[6-mm-thick, clear tempered glass]** **[clear insulating glass]** **[ballistics-resistant glazing, UL 752 Level <Insert number>]**.
1. Frame Finish: **[Mill]** **[Clear anodic]**.
 2. Provide insect screens for each operable window.
 3. Provide galvanized-steel security screens for each window.
 4. Corner Shape: **[Square]** **[Round]**.
- C. Horizontal Sliding Windows: Extruded-aluminum sash frames glazed with 3-mm-thick, clear tempered float glass. Equip windows with cam locks, weather stripping, and **[stainless-steel]** **[nylon]** ball-bearing rollers.
1. Frame Finish: **[Mill]** **[Clear anodic]**.
 2. Provide insect screens for each operable window.
 3. Corner Shape: **[Square]** **[Round]**.
- D. Work Counters: Full width of control booth, reinforced; with **16-inch-** (406-mm-) wide **[storage]** **[cash]** drawer below each counter, and an access opening for electrical cords at **[each]** rear corner of counter.
1. Material: **[0.078-inch-** (1.98-mm-) **thick, stainless-steel sheet]** **[0.079-inch** (2.01-mm) **nominal-thickness, galvanized-steel sheet]** **[1/2-inch-** (13-mm-) **thick particleboard with plastic-laminate finish]**.
 2. Depth: **[22 inches** (559 mm)] **[20 inches** (508 mm)] **[18 inches** (457 mm)].
- E. Electrical Power Service: 125-A, 120/240-V ac, single-phase, three-wire **[load center, with no fewer than four open circuits]** **[service with 8-16 circuit-breaker panel]**; located under one end of work counter. Run copper wiring in **1/2-inch** (13-mm) EMT conduit.
1. Provide **[one]** **<Insert number>** 120-V **[ground-fault circuit interrupter (GFCI)]** power receptacle(s).
- F. Lighting Fixtures: **[One]** **[Two]** ceiling-mounted fluorescent lighting fixture(s), **48 inches** (1219 mm) long, with acrylic lens and two 40-W lamps **[in each fixture]**. Provide single-pole switch mounted adjacent to door to control lighting fixture.
- G. Heating Unit: **[Wall]** **[Roof]**-mounted, thermostatically controlled, 110-V, 1500-W electric heater with fan-forced operation and with capacity of not less than **5000 Btu/h** (1465 W). Enclose in enameled-steel cabinet **[and mount under work counter]**.

- H. Cooling Unit: **[Wall] [Roof]**-mounted, thermostatically controlled air conditioner with cooling capacity of not less than **[13,500 Btu/h (3956 W)] <Insert value>**. Enclose in enameled-steel cabinet.
- I. Accessories: Provide the following for each control booth:
 - 1. Antifatigue mats.
 - 2. Exterior stainless-steel counter.
 - 3. **[Floor] [Wall-mounted]** safe.
 - 4. Signage: **<Insert requirements>**.
 - 5. Ventilation fan.
 - 6. Intercom.
 - 7. Traffic control lights.

2.3 PREFABRICATED STEEL CONTROL BOOTHS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AustinMohawk and Company, Inc.
 - 2. B.I.G. Enterprises, Inc.
 - 3. Canada Kiosk; an NRB company.
 - 4. Delta Scientific Corporation.
 - 5. Keystone Structures, Inc.
 - 6. Little Buildings, Inc.
 - 7. Mardan Fabricators.
 - 8. Parking Booth Company, Inc.
 - 9. Par-Kut International, Inc.
 - 10. Porta-King Building Systems.
 - 11. **<Insert manufacturer's name>**.
 - 12. or approved equal.
- B. Structural Framework: Fabricated from **2-by-2-by-0.075-inch** (50-by-50-by-1.90-mm) steel structural or mechanical tubing. Connect framework by welding.
- C. Base/Floor Assembly: **[4-inch- (102-mm-)] [3-inch- (76-mm-)]** high assembly consisting of perimeter frame welded to structural framework of booth. Fabricate frame from **2-by-4-inch** (51-by-102-mm) galvanized-steel structural tubing; **0.108-inch** (2.74-mm) nominal-thickness, C-shaped, galvanized-steel sheet channels; or galvanized structural-steel angles. Include anchor clips fabricated from **1/4-inch-** (6-mm-) thick galvanized-steel plate, predrilled and welded to exterior of integral floor frame.
 - 1. Finished Floor: **0.108-inch** (2.74-mm) nominal-thickness, galvanized, rolled steel tread plate.
 - 2. Subfloor and Finished Floor: Assembly consisting of **0.079-inch** (2.01-mm) nominal-thickness, galvanized-steel sheet underside with rigid insulation core; covered by **0.125-inch-** (3.18-mm-) thick, aluminum rolled tread plate; with overall assembly thickness of **2 inches** (51 mm).

3. Subfloor and Finished Floor: Assembly consisting of **[one]** **[two]** layer(s) of **3/4-inch-** (19-mm-) thick plywood or oriented strand board with **[0.125-inch-** (3.18-mm-) **thick, aluminum rolled tread plate]** **[vinyl composition flooring]** **[carpeting]**.
- D. Base/Floor Assembly: No perimeter frame, with finished floor fabricated from **0.108-inch** (2.74-mm) nominal-thickness, galvanized, rolled steel tread plate.
- E. Base/Floor Assembly: No perimeter frame, with surface of supporting concrete base as finished floor.
- F. Wall Panel Assembly: Assembly consisting of exterior face panel fabricated from **0.079-inch** (2.01-mm) nominal-thickness, galvanized-steel sheet; and interior face panel fabricated from **[0.064-inch** (1.63-mm)] **[0.052-inch** (1.32-mm)] nominal-thickness, galvanized-steel sheet; with **[2-inch-** (51-mm-)] **[3-inch-** (76-mm-)] **<Insert dimension>** thick, rigid fiberglass or polystyrene board insulation in cavity between exterior and interior face panels.
 1. Thermal Resistance Value (R-Value): **[R-7]** **<Insert R-value>**.
- G. Flat Roof/Ceiling Assembly: Consisting of exterior roof panels, interior ceiling panels, and insulation between exterior and interior panels; sloped to drain at booth perimeter.
 1. Exterior Roof Panel: Fabricated from **[0.079-inch** (2.01-mm)] **[0.064-inch** (1.63-mm)] nominal-thickness, galvanized-steel sheet; with **[painted finish]** **[EPDM membrane]**, continuously welded seams, and full-perimeter gutter.
 2. Interior Ceiling Panel: Fabricated from **0.079-inch** (2.01-mm) nominal-thickness, galvanized-steel sheet; with fiberglass insulation in cavity between ceiling and roof.
 - a. Thermal Resistance Value (R-Value): **[R-17]** **<Insert R-value>**.
 3. Insulated Exterior/Interior Panel: Fabricated from **[0.028-inch** (0.71-mm) **nominal-thickness, galvanized-steel]** **[0.032-inch-** (0.81-mm-) **thick, aluminum]** sheet faces and expanded-foam insulation core.
 - a. Thermal Resistance Value (R-Value): **[R-17]** **<Insert R-value>**.
 4. Canopy Fascia: Fabricated from **0.079-inch** (2.01-mm) nominal-thickness, galvanized-steel sheet, of **[manufacturer's standard design]** **[custom design indicated on Drawings]**.
 - a. Height: **[6 inches** (152 mm)] **[8 inches** (203 mm)] **<Insert dimension>**.
 - b. Overhang: **[3 inches** (76 mm) **beyond]** **[<Insert dimension> beyond]** **[Flush with]** face of walls below.
 5. Downspouts: Integral, extending **3 inches** (76 mm) beyond booth walls.
 6. Roof scuppers.
 7. Rooftop finial.

- H. Sliding Door: Top suspended from aluminum track with ball-bearing rollers; **1-3/4 inches** (44 mm) thick; tubular-frame design fabricated from **[clear-anodized aluminum] [galvanized steel]**; with top half of door glazed. Equip door with deadlock, lock support, guide hardware, and full weather stripping.
1. Glazing: **[Fixed] [Horizontal sliding]** unit with 6-mm-thick, clear tempered float glass.
 2. Deadlock: Mortised, laminated-hook bolt type with removable cylinder capable of being master keyed.
- I. Swinging Door: **1-3/4 inches** (44 mm) thick; tubular-frame design fabricated from **[clear-anodized aluminum] [galvanized steel]**; with top half of door glazed. Equip door with deadlock, three butt hinges, closer, and full weather stripping.
1. Glazing: **[Fixed] [Horizontal sliding]** unit with 6-mm-thick, clear tempered float glass.
 2. Deadlock: Mortised, with lever handle and removable cylinder capable of being master keyed.
- J. Finish: Finish exposed metal surfaces, including structural framework, walls, canopy, and ceiling with rust-inhibitive primer and one finish coat of industrial air-dry **[acrylic] [polyurethane]** enamel.
1. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range]**.

2.4 PREFABRICATED ALUMINUM CONTROL BOOTHS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AustinMohawk and Company, Inc.
 2. Keystone Structures, Inc.
 3. Mardan Fabricators.
 4. Portafab Corporation.
 5. Porta-King Building Systems.
 6. Starrco.
 7. **<Insert manufacturer's name>**.
 8. or approved equal.
- B. Structural Framework: Fabricated from **2-by-2-by-0.125-inch** (51-by-51-by-3.18-mm) aluminum tubing, channel, angle, or tee extrusions; with **[clear] [color]** anodic finish. Connect framework with **[exposed]** mechanical fasteners.
- C. Base/Floor Assembly: **4-inch-** (102-mm-) high assembly consisting of perimeter frame welded to structural framework of booth. Fabricate frame from **2-by-4-by-0.125-inch** (51-by-102-by-3.18-mm) aluminum tubing or aluminum angles. Include anchor clips

fabricated from **1/4-inch-** (6-mm-) thick aluminum, predrilled and welded to exterior of integral floor frame.

1. Subfloor and Finished Floor: Assembly consisting of **0.032-inch-** (0.81-mm-) thick, aluminum sheet underside, plywood and rigid insulation core; covered by **0.125-inch-** (3.18-mm-) thick, aluminum rolled tread plate; with overall assembly thickness of **2 inches** (51 mm).
 2. Subfloor and Finished Floor: Assembly consisting of **[one] [two]** layer(s) of **3/4-inch-** (19-mm-) thick plywood or oriented strand board with **[0.125-inch-** (3.18-mm-) **thick, aluminum rolled tread plate] [vinyl composition flooring] [carpeting]**.
- D. Base/Floor Assembly: No perimeter frame, with surface of supporting concrete base as finished floor.
- E. Wall Panel Assembly: Assembly consisting of exterior face panel fabricated from **[0.032-inch-** (0.81-mm-)] **[0.063-inch-** (1.60-mm-)] thick aluminum sheet, and interior face panel fabricated from **[0.032-inch-** (0.81-mm-)] **[0.050-inch-** (1.27-mm-)] thick aluminum sheet; with **2-inch-** (51-mm-) thick, polystyrene or polyisocyanurate board insulation in cavity between exterior and interior face panels.
1. Thermal Resistance Value (R-Value): **[R-7] <Insert R-value>**.
- F. Flat Roof/Ceiling Assembly: Consisting of exterior roof panels, interior ceiling panels, and insulation between exterior and interior panels; sloped to drain at booth perimeter.
1. Exterior Roof Panel: Fabricated from **0.032-inch-** (0.81-mm-) thick aluminum sheet with protective plastic sheet finish and full-perimeter gutter.
 2. Interior Ceiling Panel: Fabricated from **0.125-inch-** (3.18-mm-) thick hardboard; with polyisocyanurate board insulation in cavity between ceiling and roof.
 - a. Thermal Resistance Value (R-Value): **[R-19] <Insert R-value>**.
 3. Insulated Exterior/Interior Panel: Fabricated from **[0.032-inch-** (0.81-mm-) **thick, aluminum] [0.021-inch** (0.53-mm) **nominal-thickness, galvanized-steel]** sheet faces and expanded-foam insulation core.
 - a. Thermal Resistance Value (R-Value): **[R-19] <Insert R-value>**.
 4. Canopy Fascia: Fabricated from **0.063-inch-** (1.60-mm-) thick aluminum sheet, of **[manufacturer's standard design] [custom design indicated on Drawings]**.
 - a. Height: **[6 inches** (152 mm) **] [8 inches** (203 mm) **] <Insert dimension>**.
 - b. Overhang: **[3 inches** (76 mm) **beyond] [<Insert dimension> beyond] [Flush with]** face of walls below.
 5. Downspouts: Integral, extending **3 inches** (76 mm) beyond booth walls.
 6. Roof scuppers.
 7. Rooftop finial.

- G. Sliding Door: Top suspended from aluminum track with ball-bearing rollers; **1-3/4 inches** (44 mm) thick; tubular-frame design fabricated from aluminum matching exterior and interior wall panels; with top half of door glazed and with extruded-aluminum door frame. Equip door with deadlock, lock support, guide hardware, and full weather stripping.
1. Glazing: **[Fixed] [Horizontal sliding]** unit with 6-mm-thick, clear tempered float glass.
 2. Deadlock: Mortised, laminated-hook bolt type with removable cylinder capable of being master keyed.
- H. Swinging Door: **1-3/4 inches** (44 mm) thick; tubular-frame design fabricated from aluminum matching exterior and interior wall panels; with top half of door glazed and with extruded-aluminum doorframe. Equip door with deadlock, three butt hinges, closer, and full weather stripping.
1. Glazing: **[Fixed] [Horizontal sliding]** unit with 6-mm-thick, clear tempered float glass.
 2. Deadlock: Mortised, with lever handle and removable cylinder capable of being master keyed.
- I. Finish: Finish exposed metal surfaces, including structural framework, walls, canopy, and ceiling with **[clear anodizing] [color anodizing] [baked enamel or powder coat]**.
1. Color: **[As indicated by manufacturer's designations] [Match DEN Project Manager's samples] [As selected by DEN Project Manager from manufacturer's full range]**.

2.5 FABRICATION

- A. Fabricate control booths completely in factory.
- B. Preglaze windows and doors at factory.
- C. Prewire control booths at factory, ready for connection to service at Project site.
- D. Fabricate control booths with **[forklift pockets in base of booth] [removable lifting eye centered in roof]**.
- E. Accessible Control Booths: Where indicated to be accessible, fabricate control booths as follows:
1. Provide service windows located no higher than **34 inches** (865 mm) above exterior grade.
 2. Provide door opening with minimum **32-inch** (813-mm) clear width.
 3. Provide minimum **60-inch** (1525-mm) clear turning spacing within the booth.
 4. Provide minimum **27-inch** (685-mm) clearance beneath interior work surfaces. Locate work surfaces **28 inches** (710 mm) minimum and **34 inches** (865 mm) maximum above the floor.

5. Locate controls and operable parts no lower than **15 inches** (381 mm) and no higher than **48 inches** (1219 mm) above the floor where reach is unobstructed. Where side reach is obstructed, locate controls and operable parts no lower than **15 inches** (381 mm) and no higher than **46 inches** (1219 mm) above the floor.

2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 FINISHES

- A. **[Steel] [and] [Galvanized-Steel]** Factory Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>**.

2.8 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, **[AA-M12C22A41, Class I, 0.018 mm] [AA-M12C22A31, Class II, 0.010 mm]** or thicker.
- B. Color Anodic Finish: AAMA 611, **[AA-M12C22A42/A44, Class I, 0.018 mm] [AA-M12C22A32/A34, Class II, 0.010 mm]** or thicker.
 1. Color: **[Light bronze] [Medium bronze] [Dark bronze] [Black] <Insert color>**.
 2. Color: **[Match DEN Project Manager's sample] [As selected by DEN Project Manager from full range of industry colors and color densities]**.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils** (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 1. Color and Gloss: **[As indicated by manufacturer's designations] [Match DEN Project Manager's sample] [As selected by DEN Project Manager from manufacturer's full range] <Insert color and gloss>**.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install control booths according to manufacturer's written instructions.
- B. Accessible Control Booths: Install with interior floor surface at same elevation as adjacent paved surfaces.
- C. Set control booths plumb and aligned. Level baseplates true to plane with full bearing on concrete bases.
- D. Fasten control booths securely to **[cast-in anchor bolts] [concrete bases with expansion anchors]**.
- E. Connect electrical power service to power distribution system.

3.3 ADJUSTING

- A. Adjust doors, operable windows, and hardware to operate smoothly, easily, properly, and without binding. Confirm that locks engage accurately and securely without forcing or binding.
- B. Lubricate hardware and other moving parts.
- C. After completing installation, inspect exposed finishes and repair damaged finishes.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 133423

SECTION 142100 - ELECTRIC TRACTION ELEVATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes electric traction [**passenger**] [**and**] [**service**] elevators.
- B. Related Requirements:
 - 1. Section 015210 "Temporary Facilities" for temporary use of elevators for construction purposes.
 - 2. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
 - 3. Section 042000 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
 - 4. Section 051200 "Structural Steel Framing" for the following:
 - a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
 - b. Divider beams.
 - c. Hoist beams.
 - d. Structural-steel shapes for subsills.
 - 5. Section 055000 "Metal Fabrications" for the following:
 - a. Attachment plates and angle brackets for supporting guide-rail brackets.
 - b. Divider beams.
 - c. Hoist beams.
 - d. Structural-steel shapes for subsills.
 - e. Pit ladders.
 - f. Cants in hoistways made from steel sheet.
 - 6. Section 055213 "Pipe and Tube Railings" for railings between adjacent elevator pits.
 - 7. Section 057000 "Decorative Metal" for combination hall push-button stations.
 - 8. Section 099113 "Exterior Painting" for field painting of hoistway entrance doors and frames.
 - 9. Section 099123 "Interior Painting" for field painting of hoistway entrance doors and frames.

10. <Insert Section number>-<Insert Section title> for finish flooring in elevator cars.
11. Section 142113 "Electric Traction Freight Elevators" for electric traction elevators used primarily for carrying freight and inaccessible to the general public.
12. Section 221429 "Sump Pumps" for sump pumps, sumps, and sump covers in elevator pits.
13. Section 271500 "Communications Horizontal Cabling" for telephone service for elevators[**and for Internet connection to elevator controllers for remote monitoring of elevator performance**].
14. [Section 283111 "Digital, Addressable Fire-Alarm System"] [Section 283112 "Zoned (DC Loop)] Fire-Alarm System" for smoke detectors in elevator lobbies to initiate emergency recall operation[**and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation**] and for connection to elevator controllers.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 REFERENCES

- A. American National Standards Institute (ANSI):

1. A117.1 - Accessible and Usable Buildings and Facilities.

- B. American Society for Testing and Materials (ASTM):

1. A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. A366/366M - Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.
3. A786A/786M - Rolled Steel Floor Plates.
4. A793 - Rolled Floor Plate, Stainless Steel.
5. B36/36M - Brass Plate, Sheet, Strip, and Rolled Bar.
6. B151 - Nickel-Zinc Alloy (Nickel Silver) and Copper-Nickel Rod and Bar.
7. B151M - Copper-Nickel-Zinc Alloy (Nickel Silver) and Copper-Nickel Rod and Bar (Metric).
8. B455 - Copper-Zinc-Alloy (Leaded Brass) Extruded Shapes.
9. B632/632M - Aluminum-Alloy Rolled Tread Plate.
10. C1107 - Packaged Dry, Hydraulic-Cement Grout (Non-shrink).

- C. American Society of Mechanical Engineers (ASME):

1. A17.1 - Safety Code for Elevators and Escalators.

- D. National Electrical Manufacturers Association (NEMA):

1. LD3 - High Pressure Decorative Laminates.

- E. U.S. Architectural & Transportation Barriers Compliance Board:

1. ADA Accessibility Guidelines - August 1994 - American Disabilities Act (ADA),

Accessibility Guidelines for Buildings and Facilities.

1.4 ALLOWANCES

- A. Elevator Car Allowances: Provide finished passenger[**and service**] elevator cars under the Elevator Car Allowance specified in Section 012100 "Allowances."
Allowance includes furnishing and installing the following:

1. Car wall finishes including trim.
2. Car floor finishes.
3. Car ceiling finishes.
4. Car[**and hoistway**] door finishes.
5. Car doorsills.
6. Car light fixtures.
7. Handrails.
8. Cutouts and other provisions for installing elevator signal equipment in cars.

1.5 DEFINITIONS

- A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.
- B. Service Elevator: A passenger elevator that is also used to carry freight.
- C. Electric Traction Elevators: Elevators in which cars are hoisted by wire ropes using electrically driven traction sheaves and are defined to include driving machines; cars; hoistway doors; guide rails; guide-rail brackets; roping; buffers; counterweights; signals; control systems; electrical wiring within elevator system; and devices for operations, safety, security, required performance at rated speed and capacity, and for complete elevator installation.
1. Counterweight displacement switches, seismic switch, and other elevator safety equipment required by the "Code" for seismic risk zone 2 or greater are included.
- D. Defective Elevator Work: Operation or control system failures; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

1.6 ACTION SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures, hoistway entrances, and operation, control, and signal systems.
1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings:

1. Include plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment.
2. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, locations of equipment and signals, and maximum and average power demands.
3. Include large-scale layout of car-control station[**and standby power operation control panel**].

C. Samples for Initial Selection: For finishes involving color selection.

D. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; **3-inch**- (75-mm-) square Samples of sheet materials; and **4-inch** (100-mm) lengths of running trim members.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and **[machine room] [control closet]** layout and dimensions, as shown on Drawings, and electrical service[**including standby power generator**], as shown and specified, are adequate for elevator system being provided.

D. Sample Warranty: For special warranty.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.

B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

- C. Manufacturer shall furnish a letter stating all components are designed by an Engineer and are suitable for the intended purpose.
- D. Signage
- E. Maintenance manuals for each different electric traction elevator, including operation and maintenance instructions, parts listing with sources indicated, recommended parts inventory listing, emergency instructions, and similar information. Include all diagnostic and repair information available to manufacturer's and Installer's maintenance personnel. Submit for Owner's information at project closeout as specified in Division 01.
- F. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance service by skilled, competent employees of the elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Use parts and supplies as used in the manufacture and installation of original equipment.
 - 1. Perform maintenance, including emergency callback service, during normal working hours.
 - 2. Include 24-hour-per-day, 7-day-per-week emergency callback service.
 - 3. Response Time: 1 hour or less.
- B. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to DEN Project Manager, in the form of a standard [**one-year**] [**two-year**] [**five-year**] <Insert agreement period> maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.10 QUALITY ASSURANCE

- A. Installer Qualifications: Engage the elevator manufacturer or an experienced Installer approved by the elevator manufacturer who has completed elevator installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Regulatory Requirements: In addition to local governing regulations, comply with the applicable provisions of the following:
 - 1. ASME A17.1, "Safety Code for Elevators and Escalators," referred to as the "Code."

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off ground, under cover, and in a dry location.

1.12 COORDINATION

- A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- B. Coordinate locations and dimensions of other work relating to electric traction elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

1.13 WARRANTY

- A. Manufacturer's Standard Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
 - 2. Warranty Period: Minimum 12 months <Insert number> year(s) from date of Substantial Completion.

1.14 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ThyssenKrupp
 - 2. Dover Elevator Corp.

3. KONE Inc.
4. Otis Elevator Co.
5. Schindler Elevator Corp.
6. U.S. Elevator.
7. <Insert manufacturer's name>.
8. or approved equal.

B. Source Limitations: Obtain elevators from single manufacturer.

1. Major elevator components, including driving machines, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

B. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.

C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7] <Insert requirement> and shall comply with elevator safety requirements for seismic risk Zone 2 or greater in ASME A17.1/CSA B44.

1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified[**and the system will be fully operational after the seismic event**]."
2. Affected peak velocity acceleration (Av) for Project's location is [**less than 0.10 (seismic risk Zones 0 and 1)**] [**greater than or equal to 0.10, but less than 0.20 (seismic risk Zone 2)**] [**greater than or equal to 0.20 (seismic risk Zones 3 and 4)**].
3. Provide earthquake equipment required by ASME A17.1/CSA B44.
4. Provide seismic switch required by ASCE/SEI 7.
5. Design earthquake spectral response acceleration short period (Sds) for Project is <Insert value>.
6. Project Seismic Design Category: [A] [B] [C] [D] [E] [F].
7. Elevator Component Importance Factor: [1.5] [1.0].

2.3 MATERIALS AND COMPONENTS, GENERAL

A. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components, published by manufacturer as included in standard preengineered elevator systems and as required for a complete system.

B. Elevator Machines: (Geared) (Gearless) type.

1. At manufacturer's option, provide either variable-voltage, variable-frequency ac-type hoisting machine or variable-voltage dc type.
 2. Where elevator speed is 100 ft./min. (0.5 m/s) or less, provide variable-voltage geared machine.
 3. Where elevator speed is 100 ft./min. (0.5 m/s) or less, provide geared machine with ac-type single-speed or 2-speed motor as indicated.
- C. Power Control: Except as otherwise indicated, where variable voltage is required, provide solid-state power converters for use with motors on elevator machines (ac or dc).
1. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system from solid-state converters.
- D. Power Supply: (480 V, 60 Hz, 3 phase.) (208 V, 60 Hz, 3 phase.) (240 V, 60 Hz, 2 phase).
- E. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Specification Section.
- F. Machine Beams: Provide framing to support the elevator hoisting machine and deflector sheaves from the building structure. Comply with Division 05 for materials and fabrication.
- G. Guide Shoes/Rollers: Provide either sliding shoes or rollers for speeds of 200 ft./min. (1.02 m/s) and less, and rollers for speeds in excess of 200 ft./min. (1.02 m/s).
- H. Car Frame and Platform: Welded steel units.

2.4 ELEVATORS

- A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.
- B. Elevator Description:
1. Group Number: **<Insert a different number for each group of elevators that share a group operation system>**.
 2. Elevator Number(s): **<Insert elevator number(s) as shown on Drawings>**.
 3. Emergency Elevator Number(s): **<Insert elevator number(s) as shown on Drawings>**.
 4. Service Elevator Number(s): **<Insert elevator number(s) as shown on Drawings>**.
 5. Machine Location: **[Machine room above hoistway] [Hoistway; no machine room is provided]**.
 6. Machine Type: **[Geared] [Gearless]** traction.

7. Rated Load: [2000 lb (908 kg)] [2100 lb (953 kg)] [2500 lb (1135 kg)] [3000 lb (1362 kg)] [3500 lb (1589 kg)] [4000 lb (1816 kg)] [4500 lb (2043 kg)] [5000 lb (2270 kg)] **<Insert value>**.
8. Freight Loading Class for Service Elevator(s): Class A.
9. Rated Speed: [200 fpm (1.0 m/s)] [350 fpm (1.8 m/s)] [400 fpm (2.0 m/s)] [450 fpm (2.3 m/s)] [500 fpm (2.5 m/s)] [700 fpm (3.6 m/s)] [800 fpm (4.1 m/s)] [1000 fpm (5.1 m/s)] [1200 fpm (6.1 m/s)] [1400 fpm (7.1 m/s)] **<Insert value>**.
10. Operation System: [**Selective-collective automatic operation**] [**Group automatic operation**] [**Group automatic operation with demand-based dispatching**] [**Destination-based group automatic operation**].
11. Auxiliary Operations:
 - a. Standby power operation.
 - b. Standby-powered lowering.
 - c. Battery-powered lowering.
 - d. Earthquake Emergency Operation: Comply with requirements in ASME A17.1/CSA B44.
 - e. Automatic dispatching of loaded car.
 - f. Nuisance call cancel.
 - g. [**Emergency hospital**] [**Priority**] service at [all] **<Insert floor designations>** floors.
 - h. Independent service for [**service elevator**] [**one car in group**] [**all cars in group**].
 - i. Loaded-car bypass.
 - j. Distributed parking.
12. Security Features: [**Card-reader operation**] [**Keyswitch operation**] [**Keypad operation**] [**Car-to-lobby feature**].
13. Dual Car-Control Stations: Provide two car-control stations[**in each elevator**]; equip only one with required keyswitches if any.
14. Car Enclosures:
 - a. Inside Width: [64 inches (1626 mm)] [68 inches (1727 mm)] [80 inches (2032 mm)] [92 inches (2337 mm)] **<Insert dimension>** from sidewall to sidewall.
 - b. Inside Depth: [51 inches (1295 mm)] [53 inches (1346 mm)] [57 inches (1448 mm)] [65 inches (1651 mm)] [87-1/2 inches (2222 mm)] [90 inches (2286 mm)] [93 inches (2362 mm)] [93-1/2 inches (2375 mm)] [96 inches (2438 mm)] [101 inches (2565 mm)] [102 inches (2591 mm)] **<Insert dimension>** from back wall to front wall (return panels).
 - c. Inside Height: [88 inches (2235 mm)] [92 inches (2337 mm)] [94 inches (2388 mm)] [100 inches (2540 mm)] [104 inches (2642 mm)] [108 inches (2743 mm)] [112 inches (2845 mm)] **<Insert dimension>** to underside of ceiling.
 - d. Front Walls (Return Panels): [**Polished stainless steel, No. 8 finish**] [**Satin stainless steel, No. 4 finish**] [**Polished bronze, lacquered**] [**Satin bronze, lacquered**].
 - e. Car Fixtures: [**Polished stainless steel, No. 8 finish**] [**Satin stainless steel, No. 4 finish**] [**Polished bronze, lacquered**] [**Satin bronze, lacquered**].

- f. Side and Rear Wall Panels: [Enameled steel] [Plastic laminate] [Satin stainless steel, No. 4 finish] [Textured stainless steel] [Satin bronze, lacquered].
 - g. Reveals: [Enameled steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered].
 - h. Door Faces (Interior): [Enameled steel] [Primed steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Textured stainless steel] [Polished bronze, lacquered] [Satin bronze, lacquered] [Plastic laminate].
 - i. Doorsills: [Aluminum, mill finish] [Bronze, polished] [Nickel silver, polished].
 - j. Ceiling: [Luminous ceiling] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Reflective metallic-finish, plastic-laminate, stainless steel] [Reflective metallic-finish, plastic-laminate, bronze].
 - k. Handrails: [1-1/2 inches (38 mm) round] [1/2 by 2 inches (13 by 50 mm) rectangular] <Insert dimension> [mirror-polished stainless steel, No. 8 finish] [satin stainless steel, No. 4 finish] [mirror-polished bronze, lacquered] [satin bronze, lacquered], at [sides] [and] [rear] of car.
 - l. Floor: Manufacturer's standard carpet.
 - m. Floor prepared to receive carpet (specified in Section 096816 "Sheet Carpeting").
 - n. Floor prepared to receive resilient flooring (specified in Section 096500 "Resilient Flooring").
 - o. Floor recessed and prepared to receive [dimension stone tile (specified in Section 093033 "Stone Tiling")] [ceramic tile (specified in Section 093000 "Tiling")].
 - p. Floor Thickness, Including Setting Materials: <Insert thickness> above plywood subfloor.
15. Hoistway Entrances:
- a. Width: [36 inches (914 mm)] [42 inches (1067 mm)] [48 inches (1219 mm)] [54 inches (1372 mm)] <Insert dimension>.
 - b. Height: [84 inches (2134 mm)] [96 inches (2438 mm)] <Insert dimension>.
 - c. Type: [Single-speed side sliding] [Two-speed side sliding] [Single-speed center opening] [Two-speed center opening].
 - d. Frames [at First Floor] [at Basement Floors]: [Enameled steel] [Primed steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered].
 - e. Frames at Other Floors: [Enameled steel] [Primed steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered].
 - f. Doors[and Transoms] [at First Floor] [at Basement Floors]: [Enameled steel] [Primed steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Textured stainless steel] [Polished bronze, lacquered] [Satin bronze, lacquered] [Plastic laminate].
 - g. Doors[and Transoms] at Other Floors: [Enameled steel] [Primed steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4

- finish] [Textured stainless steel] [Polished bronze, lacquered] [Satin bronze, lacquered] [Plastic laminate].
- h. Sills [at First Floor] [at Basement Floors]: [Aluminum, mill finish] [Bronze, polished] [Nickel silver, polished].
 - i. Sills at Other Floors: [Aluminum, mill finish] [Bronze, polished] [Nickel silver, polished].
16. Hall Fixtures [at First Floor] [at Basement Floors]: [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered] [Recessed type with no exposed-metal surfaces].
17. Hall Fixtures at Other Floors: [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered] [Recessed type with no exposed-metal surfaces].
18. Additional Requirements:
- a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from [polished stainless steel, No. 8 finish] [satin stainless steel, No. 4 finish] [polished bronze, lacquered] [satin bronze, lacquered].
 - b. Provide hooks for protective pads[in all cars] and [one] [two] <Insert number> complete set(s) of full-height protective pads.

2.5 TRACTION SYSTEMS

- A. Elevator Machines: Variable-voltage, variable-frequency, ac-type hoisting machines[or variable-voltage dc-type hoisting machines] and solid-state power converters.
- 1. Provide [regenerative] [or] [nonregenerative] system.
 - 2. Limit total harmonic distortion of regenerated power to 5 percent per IEEE 519.
 - 3. Provide means for absorbing regenerated power when elevator system is operating on standby power.
 - 4. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system.
- B. Fluid for Hydraulic Buffers: If using hydraulic buffers, use only fire-resistant fluid.
- C. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.
- D. Machine Beams: Provide framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Section 055000 "Metal Fabrications" for materials and fabrication.
- E. Car Frame and Platform: Bolted- or welded-steel units.
- F. Guides: [Roller guides] [or] [polymer-coated, nonlubricated sliding guides]. Provide guides at top and bottom of car and counterweight frames.

2.6 OPERATION SYSTEMS

- A. General: Provide manufacturer's standard microprocessor operation systems as required to provide type of operation indicated.
- B. Group Automatic Operation with Demand-Based Dispatching: Provide[**reprogrammable**] group automatic system that assigns cars to hall calls based on a dispatching program designed to minimize passenger [**waiting time**] [**time to destination**]. System automatically adjusts to demand changes for different traffic conditions including heavy incoming, heavy two-way, heavy outgoing, and light off-hours as variations of normal two-way traffic.
- Products: Subject to compliance with requirements, provide one of the following:
 - ThyssenKrupp
 - Dover Elevator Corp.
 - KONE Inc.; KCM 831.
 - Otis Elevator Co.; Elevonic.
 - Schindler Elevator Corp.; Miconic TX.
 - U.S. Elevator.
 - <Insert manufacturer's name; product name or designation>**.
 - or approved equal.
- C. Destination-Based Group Automatic Operation: Provide reprogrammable group automatic system that assigns elevators leaving the main lobby in the up direction to a selected group of floors and directs passengers to an elevator serving their destination floor. System dispatches cars in a regulated sequence for optimum system efficiency; dispatch is based on origin and destination of calls. System automatically adjusts to changes in demand for different traffic conditions including heavy incoming, heavy two-way, heavy outgoing, and light off-hours as variations of normal two-way traffic.
- Products: Subject to compliance with requirements, provide one of the following:
 - KONE Inc.; Polaris Destination Control.
 - Otis Elevator Co.; Elevonic with Channeling Operation.
 - Schindler Elevator Corp.; Miconic 10.
 - <Insert manufacturer's name; product name or designation>**.
 - or approved equal.
- D. Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:
- Single-Car Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at [**main lobby**] [**fire command station**] **<Insert location>**. Manual operation causes automatic operation to cease.
 - Single-Car Standby-Powered Lowering: On activation of standby power, if car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is

- between floors, it is lowered to the next floor below, opens its doors, and shuts down.
3. Single-Car Battery-Powered Lowering: If power fails and car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to the next floor below, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
 4. Group Standby Power Operation: On activation of standby power, cars are returned to a designated floor and parked with doors open. One car is returned at a time, with priority given to loaded cars. If a car cannot be returned after two attempts, it is removed from the system. When all cars have been returned or removed from the system, one car is automatically placed in service. If car selected for service cannot operate within 60 seconds, the system removes car from service and places another car in service. Cars can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at **[main lobby] [fire command station] <Insert location>**. Manual operation causes automatic operation to cease.
 5. Group Standby Power Operation: On activation of standby power, cars are returned, one at a time, to a designated floor and parked with doors open. If a car cannot be returned, it is removed from the system. When all cars have been returned or removed from the system, one car can be put in service on standby power by a selector switch in control panel located at **[main lobby] [fire command station] <Insert location>**.
 6. Group Battery-Powered Lowering: If power fails, cars that are at a floor remain at that floor, open their doors, and shut down. Cars that are between floors are lowered one at a time to the next floor below, open their doors, and shut down. System includes rechargeable battery and automatic recharging system.
 7. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors begin closing.
 8. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls **[and predetermined weight]** can be adjusted.
 9. Loaded-Car Bypass: When car load exceeds 80 percent of rated capacity, car responds only to car calls, not to hall calls.
 10. Distributed Parking: When cars are not required for response to calls, they are parked with doors closed and distributed in predetermined zones throughout the building. One zone shall include the main floor and adjacent floors; remaining floors shall be divided into approximately equal zones.
 11. Independent Service: Keyswitch in car-control station removes car from group operation and allows it to respond only to car calls. Key cannot be removed from keyswitch when car is in independent service. When in independent service, doors close only in response to door close button.
 12. **[Emergency Hospital] [Priority] Service: Service is initiated by a [keyswitch] [card reader] [remote switch] at designated floors. One elevator is removed from group operation and directed to the floor where service was initiated. On arriving at the floor, elevator opens its doors and parks [and a lighted sign directs passengers to exit elevator]. Car is placed in operation by selecting a floor and pressing door close button or by operating keyswitch to put car in independent service. After responding to floor selected or being removed from independent service, car is returned to group operation. If car is not placed in operation within a preset time after being called, it is returned to group operation.**

13. Earthquake emergency operation.
 14. Fire recall position
- E. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.
1. Card-Reader Operation: System uses card readers at **[car-control stations]** **[and]** **[hall push-button stations]** to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space as indicated for card reader in car.
 - a. When system is activated, car calls to restricted landings do not register unless card is first inserted into card reader. Security access system determines which landings are restricted and which of those are accessible to cardholder.
 - b. Security access system equipment is **[specified in Section 281300 "Access Control."]** **[not in the Contract.]**
 2. Card-reader operation for access to restricted landings based on security system provided by others. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space in car as indicated for card reader.
 - a. When system is activated, car calls to restricted landings do not register unless card is first inserted into card reader. Security access system determines which landings are restricted and which of those are accessible to cardholder.
 3. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at car-control stations and hall push-button stations. Key is removable **[only in deactivated position]**.
 4. Secured landing feature that allows each landing to be secured or cleared. If a landing is secured, car buttons for that landing do not register a call unless a landing access code is entered within a predetermined time period after the landing button is pressed. When a secured landing button is pressed a "Restricted Floor" lamplights and remains lit until landing access code has been entered or predetermined time period has elapsed.
 5. Access codes are programmed at each car operating panel using a security keyswitch. Secured landing feature is activated and deactivated by a security keyswitch at the main landing.
 6. Anticrime feature activated by a keyswitch that causes all cars in a group to return immediately to a predetermined floor and open their doors for inspection. On deactivation by keyswitch, cars complete calls registered before keyswitch activation and resume normal operation.

7. Keypad Operation: Allows each landing to be restricted or unrestricted. When a restricted landing button is pressed, a "Restricted Floor" lamp lights and remains lit until landing access code has been entered into a keypad or predetermined time period has elapsed. Car calls for restricted landings do not register until landing access code is entered into keypad within predetermined time period after landing button is pressed.
 - a. Access codes are programmed at each car operating panel using a security keyswitch. Keypad operation can be activated and deactivated by security keyswitch at main landing.
8. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby that causes **[car] [all cars in a group]** to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

2.7 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.
- B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

2.8 CAR ENCLOSURES

- A. General: Provide **[enameled-steel car enclosures to receive removable] [steel-framed car enclosures with nonremovable]** wall panels, with **[removable]** car roof, access doors, power door operators, and ventilation.
 1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.
 2. See "Allowances" Paragraph in "Summary" Article for items to be provided under the Elevator Car Allowance. Provide items not included in the Elevator Car Allowance as needed for finished car **[including materials and finishes specified below]**.
- B. Materials and Finishes: Manufacturer's standards, but not less than the following:
 1. Subfloor: Exterior, underlayment grade plywood, not less than **5/8-inch** (15.9-mm) nominal thickness.
 2. Subfloor: Exterior, C-C Plugged grade plywood, not less than **7/8-inch** (22.2-mm) nominal thickness.
 3. Floor Finish: **[Specified in <Insert Section number>-<Insert Section title>] [Elevator manufacturer's standard level-loop nylon carpet; color as selected by DEN Project Manager from full range of industry colors]**.

4. Enameled-Steel Wall Panels: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by DEN Project Manager from manufacturer's full range.
5. Stainless-Steel Wall Panels: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
6. Bronze Wall Panels: Flush, hollow-metal construction; fabricated from bronze sheet.
7. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to **[1/2-inch (13-mm) fire-retardant-treated particleboard]** **[manufacturer's standard honeycomb core]** with **[plastic-laminate panel backing and]** manufacturer's standard protective edge trim. Panels have a flame-spread index of **[25]** **[75]** or less, when tested according to ASTM E 84. Plastic-laminate color, texture, and pattern as selected by DEN Project Manager from **[plastic-laminate]** **[elevator]** manufacturer's full range.
8. Fabricate car with recesses and cutouts for signal equipment.
9. Fabricate car doorframe integrally with front wall of car.
10. Enameled-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by DEN Project Manager from manufacturer's full range.
11. Primed-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet, with factory-applied, rust-resistant primer for field painting.
12. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated **[from stainless-steel sheet]** **[or]** **[by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning].**
13. Bronze Doors: Flush, hollow-metal construction; fabricated by laminating bronze sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
14. Plastic-Laminate Doors: Flush, hollow-metal construction; fabricated by laminating plastic laminate to exposed faces of enameled cold-rolled steel doors and covering edges with protective edge trim **[matching return panels]**. Plastic-laminate color, texture, and pattern as selected by DEN Project Manager from **[plastic-laminate]** **[elevator]** manufacturer's full range.
15. Unfinished-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet, with factory-applied enamel.
16. Sight Guards: Provide sight guards on car doors.
17. Sills: Extruded metal, with grooved surface, **1/4 inch** (6.4 mm) thick.
18. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
19. **[Metal]** **[Metallic-Finish, Plastic-Laminate]** Ceiling: Flush panels, with **[incandescent downlights in the center of]** **[four low-voltage downlights in]** each panel. **[Align ceiling panel joints with joints between wall panels.]**
20. Handrails: Manufacturer's standard handrails, of shape, metal, and finish indicated.

2.9 HOISTWAY ENTRANCES

- A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.
- Where gypsum board wall construction is indicated, frames shall be self-supporting with reinforced head sections.
- B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to **[NFPA 252]** **[or]** **[UL 10B]**.
- Fire-Protection Rating: **[1 hour]** **[1-1/2 hours]** **<Insert rating>** **[with 30-minute temperature rise of 450 deg F (250 deg C)]**.
- C. Materials and Fabrication: Manufacturer's standards, but not less than the following:
- Enameled-Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by DEN Project Manager from manufacturer's full range.
 - Primed-Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied, rust-resistant primer for field painting.
 - Steel Subframes: Formed from cold- or hot-rolled steel sheet, with factory-applied enamel finish or rust-resistant primer. Fabricate to receive applied finish as indicated.
 - Stainless-Steel Frames: Formed from stainless-steel sheet.
 - Bronze Frames: Formed from cold- or hot-rolled steel sheet, with enamel finish, and with formed-bronze sheet laminated to steel frames using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
 - Star of Life Symbol: Identify emergency elevators with star of life symbol, not less than **3 inches (76 mm)** high, on both inside surfaces of hoistway doorframes.
 - Enameled-Steel Doors **[and Transoms]**: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by DEN Project Manager from manufacturer's full range.
 - Primed-Steel Doors **[and Transoms]**: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied, rust-resistant primer for field painting.
 - Stainless-Steel Doors **[and Transoms]**: Flush, hollow-metal construction; fabricated **[from stainless-steel sheet] [or] [by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning]**.
 - Bronze Doors **[and Transoms]**: Flush, hollow-metal construction; fabricated by laminating bronze sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
 - Plastic-Laminate Doors **[and Transoms]**: Flush, hollow-metal construction; fabricated by laminating plastic laminate to exposed faces of enameled

- cold-rolled steel doors and covering edges with protective edge trim[**matching doorframes**]. Plastic-laminate color, texture, and pattern as selected by DEN Project Manager from [**plastic-laminate**] [**elevator**] manufacturer's full range.
12. Unfinished-Steel Doors[**and Transoms**]: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet, with factory-applied enamel.
 13. Sight Guards: Provide sight guards on doors matching door edges.
 14. Sills: Extruded metal, with grooved surface, **1/4 inch** (6.4 mm) thick.
 15. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

2.10 SIGNAL EQUIPMENT

- A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with [**long-life lamps and acrylic or other permanent, non-yellowing translucent plastic diffusers**] [**or**] [**LEDs**].
- B. General: Provide signal equipment designed for destination-based system. Fabricate lighted elements with [**long-life lamps and acrylic or other permanent, nonyellowing translucent plastic diffusers**] [**or**] [**LEDs**].
- C. Car-Control Stations: Provide manufacturer's standard [**recessed**] [**or**] [**semirecessed**] car-control stations. Include call buttons for each landing served and other buttons, switches, and controls required for specified car operation. Provide operating device symbols as required by the applicable codes. Mount in return panel adjacent to car door unless otherwise indicated.
 1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
 2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
- D. Swing-Return Car-Control Stations: Provide car control station fully recessed in hinged return panel adjacent to door of each car. Include call buttons for each landing served and other buttons, switches, and controls required for specified car operation. Provide operating device symbols as required by the applicable codes. Mark other buttons and switches with manufacturer's standard identification for required use or function.
 1. Mark buttons and switches for function. Use both tactile symbols and Braille.
 2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
 3. Mount controls as shown or scheduled and at heights complying with ANSI A117.1.
 4. Mount controls as shown or scheduled and at heights complying with ADA Accessibility Guidelines.
 5. Provide 2 car control stations in each passenger elevator; equip only 1 with required keyswitches, if any.

- E. Emergency Communication System: Elevators at DEN shall be equipped with a Talk-a-Phone model ETP103 OEM elevator telephone installed per manufacturer's instructions behind the control panel in each elevator car. DEN technologies will provide cabling and an analog telephone line from the DIA PABX system for each telephone. Telephones are powered from the PABX system, which in turn is backed up by battery. The PABX is programmed to rung down calls from the elevators to the 24/7 police positions at the airport communications centers. Elevator telephones are polled once per day using Talk-a-Phone Talk-a-Lert software to confirm health and status of the telephones. Technicians are dispatched to repair or replace any telephone that fails during a polling cycle. Telephone products from other vendors shall not be permitted, as they cannot be polled.
- F. Firefighters' Two-Way Telephone Communication Service: Provide [**flush-mounted cabinet**] [**telephone jack**] in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in [**Section 283111 "Digital, Addressable Fire-Alarm System."**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System."**]
- G. Car-Top Alarm: Provide switches on top emergency exits that will cause alarm to sound when cover is opened.
- H. Car Position Indicator: Provide [**illuminated**,]digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.
- I. Hall Push-Button Stations: [[**Provide one hall push-button station at each landing for each single elevator or group of elevators, but not less than one station for each four elevators in a group**] [**Provide hall push-button stations at each landing as indicated**]. For each group of passenger elevators, locate between 2 elevators at center of group or at location most convenient for approaching passengers.
1. Provide [**units with flat faceplate for mounting with body of unit recessed in wall**].
 2. Equip units with buttons for calling elevator and for indicating desired direction of travel.
 3. Provide 2-button stations at intermediate landings. Provide 1-button stations with direction indication at terminal landings.
 4. Equip units with [**buttons**] [**or**] [**touch screen**] for calling elevator and for indicating direction of travel or destination as required by system. Provide a signaling system to verify floor selection, where destination registration is required, and to direct passengers to appropriate car.
 - a. Provide a means for passengers to indicate that they have disabilities so control system can allow extra room in assigned car.
 - b. Provide for connecting units that require destination registration to building security access system so a card reader can be used to register calls.

- J. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in [**Section 283111 "Digital, Addressable Fire-Alarm System."**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System."**]
1. Possibly insert a provision for either an "In Use" signal or a digital display of car position for single elevators.
- K. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Match materials, finishes, and mounting method of hall push-button stations. Provide[**one of**] the following:
1. Place lanterns either above or beside each hoistway entrance, unless otherwise shown. Mount at minimum of 72 inches (1829 mm) above finished floor.
 2. Place lanterns in both jambs of entrance frame for each elevator. Mount at minimum of 72 inches (1829 mm) above finished floor.
 3. At manufacturer's option, for single elevators or for only 2 cars in a group, lanterns may be located in car door jambs instead of entrance jambs.
 4. With each lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
 5. At manufacturer's option, audible signals may be placed on each car.
- L. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
1. At manufacturer's option, audible signals may be placed on cars.
- M. Hall Position Indicators: Provide [**illuminated,**] digital-display-type position indicators, located above each hoistway entrance at ground floor. Match materials, finishes, and mounting method of hall push-button stations.
1. Integrate ground-floor hall lanterns with hall position indicators.
- N. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1/CSA B44, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed.[**For each elevator, provide illuminated signals that indicate when they are operational and when they are at the designated emergency return level with doors open.**]
- O. Fire-Command-Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.

- P. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

2.11 FINISH MATERIALS

- A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
- D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
- E. Textured Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304 with embossed texture rolled into exposed surface.
1. Product: Subject to compliance with requirements, provide "<Insert product name>" by <Insert manufacturer's name>.
 2. Metal surface is [satin polished] [satin relieved] [titanium nitride colored] [oxide colored] [satin polished and titanium nitride colored] [satin relieved and titanium nitride colored] [satin polished and oxide colored] [satin relieved and oxide colored] [color coated and satin relieved] [color coated and bright relieved] after texturing.
- F. Stainless-Steel Bars: ASTM A 276, Type 304.
- G. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
- H. Bronze Plate and Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal).
- I. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (architectural bronze).
- J. Bronze Tubing: [ASTM B 135](#) (ASTM B 135M), Alloy UNS No. C23000 (red brass, 85 percent copper).
- K. Aluminum Extrusions: [ASTM B 221](#) (ASTM B 221M), Alloy 6063.
- L. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500 or No. C77600.
- M. Plastic Laminate: High-pressure type complying with NEMA LD 3, [Type HGS for flat applications] [Type HGL for flat applications] [Type HGP for postformed applications] [and] [Type BKV for panel backing].

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Examine hoistways, hoistway openings, pits, and machine rooms as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions and recommendations.
- B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators. Comply with Section 059990 "Welding".
- C. Coordination: Coordinate elevator work with work of other trades for proper time and sequence to avoid construction delays. Use established benchmarks, lines, and levels to ensure dimensional coordination of the Work.
- D. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- E. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.
- F. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- G. Leveling Tolerance: $1/8$ inch (3 mm), up or down, regardless of load and travel direction.
- H. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- I. Locate hall signal equipment for elevators as follows unless otherwise indicated:

1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
2. Place hall lanterns either above or beside each hoistway entrance.
3. Mount hall lanterns at a minimum of **72 inches** (1829 mm) above finished floor.

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
- B. Operating Test: Load [**elevator**] [**each elevator**] [**one elevator of each type, capacity, speed, and travel distance**] to rated capacity and operate continuously for 30 minutes over full travel distance, stopping at each level and proceeding immediately to the next. Record temperature rise of elevator machine during 30-minute test period. Record failure to perform as required.
- C. Advise Owner, DEN Project Manager, and authorities having jurisdiction a minimum of 72 hours in advance of dates and times that tests are to be performed on elevators.

3.4 PROTECTION

- A. Temporary Use: [**Limit temporary use for construction purposes to one elevator.**] Do not use elevators for construction purposes unless approved by DEN Project Manager, and unless cars are provided with temporary enclosures, either within finished cars or in place of finished cars, to protect finishes from damage. Comply with the following requirements for [**each**] elevator used for construction purposes:
 1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
 2. Provide strippable protective film on entrance and car doors and frames.
 3. Provide padded wood bumpers on entrance doorframes covering jambs and frame faces.
 4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
 - a. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so that no evidence remains of correction work. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required and approved by DEN Project Manager.
 5. Do not load elevators beyond their rated weight capacity.
 6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation

at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate[, **adjust, and maintain**] elevator(s).
 1. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train DEN personnel in procedures to follow in identifying sources of operational failures or malfunctions. Confer with DEN Project Manager on requirements for a complete elevator maintenance program.
 2. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.
- B. Check operation of[**each**] elevator with DEN Project Manager's personnel present before date of Substantial Completion[**and again not more than one month before end of warranty period**]. Determine that operation systems and devices are functioning properly.

3.6 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 <**Insert number**> months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Parts and supplies shall be manufacturer's authorized replacement parts and supplies as used in the manufacture and installation of original equipment.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 142100

SECTION 142113 - ELECTRIC TRACTION FREIGHT ELEVATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes electric traction freight elevators.
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
 - 2. Section 042000 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
 - 3. Section 051200 "Structural Steel Framing" for the following:
 - a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
 - b. Divider beams.
 - c. Hoist beams.
 - d. Structural-steel shapes for subsills[**and hoistway doorframes**] that are part of steel frame.
 - 4. Section 055000 "Metal Fabrications" for the following:
 - a. Attachment plates and angle brackets for supporting guide-rail brackets.
 - b. Divider beams.
 - c. Hoist beams.
 - d. Structural-steel shapes for [**subsills**] [**and**] [**hoistway doorframes**].
 - e. Pit ladders.
 - f. Cants in hoistways made from steel sheet.
 - 5. Section 055213 "Pipe and Tube Railings" for railings between adjacent elevator pits.
 - 6. Section 099113 "Exterior Painting" for field painting of hoistway entrance doors and frames.
 - 7. Section 099123 "Interior Painting" for field painting of hoistway entrance doors and frames.

8. Section 271500 "Communications Horizontal Cabling" for telephone service for elevators[**and for Internet connection to elevator controllers for remote monitoring of elevator performance**].
9. **[Section 283111 "Digital, Addressable Fire-Alarm System"] [Section 283112 "Zoned (DC Loop) Fire-Alarm System"]** for smoke detectors in elevator lobbies to initiate emergency recall operation[**and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation**] and for connection to elevator controllers.

C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 REFERENCES

A. American National Standards Institute (ANSI):

1. A117.1 - Accessible and Usable Buildings and Facilities.

B. American Society for Testing and Materials (ASTM):

1. A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. A366/366M - Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.
3. A786A/786M - Rolled Steel Floor Plates.
4. A793 - Rolled Floor Plate, Stainless Steel.
5. B36/36M - Brass Plate, Sheet, Strip, and Rolled Bar.
6. B151 - Nickel-Zinc Alloy (Nickel Silver) and Copper-Nickel Rod and Bar.
7. B151M - Copper-Nickel-Zinc Alloy (Nickel Silver) and Copper-Nickel Rod and Bar (Metric).
8. B455 - Copper-Zinc-Alloy (Leaded Brass) Extruded Shapes.
9. B632/632M - Aluminum-Alloy Rolled Tread Plate.
10. C1107 - Packaged Dry, Hydraulic-Cement Grout (Non-shrink).

C. American Society of Mechanical Engineers (ASME):

1. A17.1 - Safety Code for Elevators and Escalators.

D. National Electrical Manufacturers Association (NEMA):

1. LD3 - High Pressure Decorative Laminates.

E. U.S. Architectural & Transportation Barriers Compliance Board:

1. ADA Accessibility Guidelines - August 1994 - American Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities.

1.4 DEFINITIONS

A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

- B. Electric Traction Elevators: Elevators in which cars are hoisted by wire ropes using electrically driven traction sheaves and are defined to include driving machines; cars; hoistway doors; guide rails; guide-rail brackets; roping; buffers; counterweights; signals; control systems; electrical wiring within elevator system; and devices for operations, safety, security, required performance at rated speed and capacity, and for complete elevator installation.
 - 1. Counterweight displacement switches, seismic switch, and other elevator safety equipment required by the "Code" for seismic risk zone 2 or greater are included.
- C. Defective Elevator Work: Operation or control system failures; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

1.5 ACTION SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information.
 - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment.
 - 2. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, locations of equipment and signals, and maximum and average power demands.
- C. Samples for Initial Selection: For finishes involving color selection.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and **[machine room]** **[control closet]** layout and dimensions, as shown on

Drawings, and electrical service[**including standby power generator**], as shown and specified, are adequate for elevator system being provided.

- D. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.
- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
- C. Manufacturer shall furnish a letter stating all components are designed by an Engineer and are suitable for the intended purpose.
- D. Signage.
- E. Maintenance manuals for each different electric traction elevator, including operation and maintenance instructions, parts listing with sources indicated, recommended parts inventory listing, emergency instructions, and similar information. Include all diagnostic and repair information available to manufacturer's and Installer's maintenance personnel. Submit for Owner's information at project closeout as specified in Division 01.
- F. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance service by skilled, competent employees of the elevator Installer. Include monthly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Use parts and supplies as used in the manufacture and installation of original equipment.
 - 1. Perform maintenance, including emergency callback service, during normal working hours.
 - 2. Include 24-hour-per-day, 7-day-per-week emergency callback service.
 - 3. Response Time: 1 hour or less.
- B. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to DEN Project Manager, in the form of a standard [**one-year**] [**two-year**]

[five-year] <Insert agreement period> maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Engage the elevator manufacturer or an experienced Installer approved by the elevator manufacturer who has completed elevator installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Regulatory Requirements: In addition to local governing regulations, comply with the applicable provisions of the following:
 - 1. ASME A17.1, "Safety Code for Elevators and Escalators," referred to as the "Code."

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.11 COORDINATION

- A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- B. Coordinate locations and dimensions of other work relating to electric traction freight elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

1.12 WARRANTY

- A. Manufacturer's Standard Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
 - 2. Warranty Period: Minimum 12 months <Insert number> year(s) from date of Substantial Completion.

1.13 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Dover Elevator Corp.
 2. KONE Inc.
 3. Otis Elevator Co.
 4. U.S. Elevator
 5. **<Insert manufacturer's name>**.
 6. or approved equal.
- B. Source Limitations: Obtain freight elevators from single manufacturer.
1. Major elevator components, including driving machines, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- B. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.
- C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7] <Insert requirement>** and shall comply with elevator safety requirements for seismic risk Zone 2 or greater in ASME A17.1/CSA B44.
1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified **[and the system will be fully operational after the seismic event].**"
 2. Affected peak velocity acceleration (Av) for Project's location is **[less than 0.10 (seismic risk Zones 0 and 1)] [greater than or equal to 0.10, but less than 0.20 (seismic risk Zone 2)] [greater than or equal to 0.20 (seismic risk Zones 3 and 4)].**
 3. Provide earthquake equipment required by ASME A17.1/CSA B44.
 4. Provide seismic switch required by ASCE/SEI 7.

5. Design earthquake spectral response acceleration short period (Sds) for Project is **<Insert value>**.
6. Project's Seismic Design Category: **[A] [B] [C] [D] [E] [F]**.
7. Elevator Component Importance Factor: **[1.5] [1.0]**.

2.3 MATERIALS AND COMPONENTS, GENERAL

- A. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components, published by manufacturer as included in standard preengineered elevator systems and as required for a complete system.
- B. Elevator Machines: (Geared) (Gearless) type.
 1. At manufacturer's option, provide either variable-voltage, variable-frequency ac-type hoisting machine or variable-voltage dc type.
 2. Where elevator speed is 100 ft./min. (0.5 m/s) or less, provide variable-voltage geared machine.
 3. Where elevator speed is 100 ft./min. (0.5 m/s) or less, provide geared machine with ac-type single-speed or 2-speed motor as indicated.
- C. Power Control: Except as otherwise indicated, where variable voltage is required, provide solid-state power converters for use with motors on elevator machines (ac or dc).
 1. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system from solid-state converters.
- D. Power Supply: (480 V, 60 Hz, 3 phase.) (208 V, 60 Hz, 3 phase.) (240 V, 60 Hz, 2 phase).
- E. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Specification Section.
- F. Machine Beams: Provide framing to support the elevator hoisting machine and deflector sheaves from the building structure. Comply with Division 05 for materials and fabrication.
- G. Guide Shoes/Rollers: Provide either sliding shoes or rollers for speeds of 200 ft./min. (1.02 m/s) and less, and rollers for speeds in excess of 200 ft./min. (1.02 m/s).
- H. Car Frame and Platform: Welded steel units.

2.4 FREIGHT ELEVATORS

- A. Elevator System, General: Manufacturer's standard electric traction freight elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.

B. Elevator Description:

1. Elevator Number(s): **<Insert elevator number(s) as shown on Drawings>**.
2. Elevator Type: **[Geared] [Gearless]** traction.
3. Machine Location: **[Machine room above hoistway] [Hoistway; no machine room is provided]**.
4. Rated Load: **[2000 lb (908 kg)] [2500 lb (1135 kg)] [3000 lb (1362 kg)] [4000 lb (1816 kg)] [5000 lb (2270 kg)] [6000 lb (2720 kg)] [8000 lb (3632 kg)] [10,000 lb (4540 kg)] <Insert value>**.
5. Freight Loading Class: **[Class A] [Class B] [Class C1] [Class C2] [Class C3]**.
6. Rated Speed: **[75 fpm (0.38 m/s)] [100 fpm (0.51 m/s)] [150 fpm (0.76 m/s)] [200 fpm (1.0 m/s)] [350 fpm (1.8 m/s)] <Insert value>**.
7. Operation System: **[Single automatic] [Car-switch automatic floor stop] [Selective-collective automatic]**.
8. Auxiliary Operations:
 - a. Standby power operation.
 - b. Earthquake emergency operation.
 - c. Load-weighing device.
9. Security Feature: **[Card-reader] [Keyswitch]** operation.
10. Auxiliary Car-Control Station: Provide additional car-control station mounted on side of car at height to facilitate operation by forklift-truck operator without leaving truck.
11. Car Enclosures:
 - a. Platform Width: **[64 inches (1626 mm)] [76 inches (1930 mm)] [88 inches (2235 mm)] [100 inches (2540 mm)] <Insert dimension>**.
 - b. Platform Depth: **[84 inches (2134 mm)] [96 inches (2438 mm)] [120 inches (3048 mm)] [144 inches (3658 mm)] [168 inches (4267 mm)] <Insert dimension>**.
 - c. Ceiling Height: **[84 inches (2134 mm)] [96 inches (2438 mm)] [108 inches (2743 mm)] <Insert dimension>**.
 - d. Walls and Ceiling: **[Prime-painted steel] [Prime-painted, metallic-coated steel] [Satin stainless steel, No. 4 finish] [Textured stainless steel]**.
 - e. Car Fixtures: Satin stainless steel, No. 4 finish.
 - f. Floor: **[Rolled steel floor plate] [Aluminum-alloy rolled tread plate] [Rolled stainless-steel floor plate] <Insert material>**.
 - g. Car Gate Type: **[Vertical biparting] [Single-speed vertical lift] [Two-speed vertical lift]**.
 - h. Car Gate Operation: **[Manual] [Power operated]**.
 - i. Car Gate Material: **[Prime-painted steel] [Satin stainless steel, No. 4 finish]**.
 - j. Car Sill: Steel angle.
 - k. Lighting: **[One] [Two] [Three] 48-inch (1219-mm), [suspended,] [surface-mounted,] two-tube fluorescent light fixture(s) with [white reflectors] [and] [wire lamp guards]**.
 - l. Lighting: **[One] [Two] 48-inch (1219-mm), recessed, [two] [three]-tube fluorescent light fixture(s) with UV-stabilized acrylic diffusers not less than 0.125 inch (3.2 mm) thick.**

12. Hoistway Entrances:
 - a. Width: [60 inches (1524 mm)] [72 inches (1829 mm)] [96 inches (2438 mm)] <Insert dimension>.
 - b. Height: [84 inches (2134 mm)] [96 inches (2438 mm)] <Insert dimension>.
 - c. Door Type: [Vertical biparting] [Single-speed vertical lift] [Two-speed vertical lift].
 - d. Fire-Protection Rating: [1 hour] [1-1/2 hours] <Insert rating>[with 30-minute temperature rise of 450 deg F (250 deg C)].
 - e. Door Operation: [Manual] [Power operated].
 - f. Door Material: [Prime-painted steel] [Satin stainless steel, No. 4 finish].
 - g. Doorframe Material: [Prime-painted steel] [Satin stainless steel, No. 4 finish].
 - h. Door[frames and] sills are specified in [Section 051200 "Structural Steel Framing"] [Section 055000 "Metal Fabrications."]
13. Hall Fixtures: Satin stainless steel, No. 4 finish.
14. Auxiliary Hall Stations: Provide additional pendant-mounted, hall push-button stations[**where indicated**], mounted at height to facilitate operation by forklift-truck operator without leaving truck.
15. Additional Requirements:
 - a. Door reopening device.

2.5 TRACTION SYSTEMS

- A. Elevator Machines: At manufacturer's option, provide variable-voltage, variable-frequency, ac-type or variable-voltage, dc-type hoisting machines. Provide solid-state power converters.
 1. Limit total harmonic distortion of regenerated power to 5 percent per IEEE 519.
 2. Provide means for absorbing regenerated power when elevator system is operating on standby power.
 3. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system from solid-state converters.
- B. Fluid for Hydraulic Buffers: If using hydraulic buffers, use only fire-resistant fluid.
- C. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.
- D. Machine Beams: Provide framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Section 055000 "Metal Fabrications" for materials and fabrication.
- E. Car Frame and Platform: Welded[**or bolted**]-steel units.

1. Provide special heavy-duty units where indicated for power truck loading, designed to withstand impacts and wheel loadings indicated.

F. Guides: **[Roller guides] [or] [polymer-coated, nonlubricated sliding guides]**. Provide guides at top and bottom of car and counterweight frames.

2.6 OPERATION SYSTEMS

A. General: Provide manufacturer's standard microprocessor operation systems as required to provide type of operation indicated.

B. Single-Car Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power by a switch in control panel located at **[main lobby] [fire command station] <Insert location>**.

C. Group Standby Power Operation: On activation of standby power, cars are returned one car at a time to a designated floor and parked with doors open. If a car cannot be returned, it is removed from the system. One car is selected for service on standby power by a switch in the control panel located at **[main lobby] [fire command station] <Insert location>**.

D. Earthquake Emergency Operation: Comply with requirements in ASME A17.1/CSA B44.

E. Fire recall position.

F. Load-Weighing Device: When car load exceeds 80 percent of rated capacity, a signal lamp lights and remains lit in the car-control station; when car load exceeds rated capacity, car does not respond to car or hall calls.

G. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.

1. Card-Reader Operation: System uses card readers at **[car-control stations] [and] [hall push-button stations]** to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. **[Allow space as indicated for card reader in car] [Provide stripe-swipe card reader integral with each car-control station]**.

a. When system is activated, car calls to restricted landings do not register unless card is first inserted into card reader. Security access system determines which landings are restricted and which of those are accessible to cardholder.

b. Security access system equipment is **[specified in Section 281300 "Access Control."]** **[not in the Contract.]**

2. Card-reader operation for access to restricted landings based on security system

provided by others. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space in car as indicated for card reader.

- a. When system is activated, car calls to restricted landings do not register unless card is first inserted into card reader. Security access system determines which landings are restricted and which of those are accessible to cardholder.
3. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at [**car-control stations**] [**and**] [**hall push-button stations**]. Key is removable [**only in deactivated position**] [**in either position**].
4. Secured landing feature that allows each landing to be secured or cleared. If a landing is secured, car buttons for that landing do not register a call unless a landing access code is entered within a predetermined time period after the landing button is pressed. When a secured landing button is pressed a "Restricted Floor" lamp lights and remains lit until landing access code has been entered or predetermined time period has elapsed.
5. Access codes are programmed at each car operating panel using a security keyswitch. Secured landing feature is activated and deactivated by a security keyswitch at the main landing.
6. Anticrime feature activated by a keyswitch that causes all cars in a group to return immediately to a predetermined floor and open their doors for inspection. On deactivation by keyswitch, cars complete calls registered before keyswitch activation and resume normal operation.

2.7 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening device with a uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.

2.8 CAR ENCLOSURES

- A. General: Provide car enclosures as indicated, including ventilation, lighting, finishes, access doors, thresholds, trim, and accessories. Fabricate with recesses and cutouts for signal equipment.
 1. Provide power door operators with linkages for hoistway door operation.
 2. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.
- B. Materials and Fabrication: Provide manufacturer's standard, flush panel, welded construction made from metal sheet, of metal indicated, not less than **0.067 inch** (1.7 mm) and reinforced at **16-inch** (406-mm) maximum spacing.

1. Provide perforated panels for ceiling and for walls above **72 inches** (1829 mm) from car floor, unless required to be solid by ASME A17.1/CSA B44.

2.9 HOISTWAY ENTRANCES

- A. General: Structural-steel frames and sills for hoistway entrances are specified in **[Section 051200 "Structural Steel Framing"] [Section 055000 "Metal Fabrications."]**
- B. Unless otherwise indicated, provide hoistway entrance doors of type indicated below, with truckable sill bars and resilient safety meeting-rail gaskets.
 1. Equip for power operation by coordinated linkage with power-operated car door.
 2. Where gypsum board wall construction is indicated, provide fire-resistance-rated, hollow-metal, door-and-frame hoistway entrances. Provide self-supporting frames with reinforced head sections.
- C. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as close-to-neutral pressure as possible according to **[NFPA 252] [or] [UL 10B]**.
- D. Materials and Fabrication: Provide manufacturer's standards, but not less than the following:
 1. Metal Door Panels: Constructed of metal sheets, flush on room side, welded and reinforced in steel framing with vertical reinforcing spaced not more than **24 inches** (610 mm) o.c. Fabricate panel faces from metal sheet, of metal indicated, not less than **0.097 inch** (2.5 mm) thick.

2.10 SIGNAL EQUIPMENT

- A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements of acrylic or other permanent, non-yellowing translucent plastic.
- B. Car-Control Stations: Provide manufacturer's standard car-control station. Include call buttons for each landing served and other buttons, switches, and controls required for specified car operation. Provide operating device symbols as required by the applicable codes. Mount adjacent to car door unless otherwise indicated.
 1. Mark buttons and switches for function. Use both tactile symbols and Braille.
 2. Mount controls at heights complying with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.
- C. Emergency Communication System: Elevators at DEN shall be equipped with a Talk-a-Phone model ETP103 OEM elevator telephone installed per manufacturer's instructions behind the control panel in each elevator car. DEN technologies will

provide cabling and an analog telephone line from the DIA PABX system for each telephone. Telephones are powered from the PABX system, which in turn is backed up by battery. The PABX is programmed to rung down calls from the elevators to the 24/7 police positions at the airport communications centers. Elevator telephones are polled once per day using Talk-a-Phone Talk-a-Lert software to confirm health and status of the telephones. Technicians are dispatched to repair or replace any telephone that fails during a polling cycle. Telephone products from other vendors shall not be permitted, as they cannot be polled.

- D. Firefighters' Two-Way Telephone Communication Service: Provide [**flush-mounted cabinet**] [**telephone jack**] in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in [**Section 283113 "Digital, Addressable Fire-Alarm System"**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System."**]
- E. Car-Top Alarm: Provide switches on top emergency exits that will cause alarm to sound when cover is opened
- F. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station.
- G. Hall Push-Button Stations: Provide hall push-button station at each landing as indicated.
 - 1. Provide single-button stations with [**position**] [**"in-use"**] indicator.
- H. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in [**Section 283113 "Digital, Addressable Fire-Alarm System"**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System."**]

2.11 FINISH MATERIALS

- A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
- D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, commercial steel, with **G60** (Z180) zinc coating (galvanized) or **A60** (ZF180) zinc-iron-alloy coating (galvannealed).
- E. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
- F. Textured Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304 with embossed texture rolled into exposed surface.
 - 1. Product: Subject to compliance with requirements, provide "<Insert product name>" by <Insert manufacturer's name>.

- G. Stainless-Steel Bars: ASTM A 276, Type 304.
- H. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
- I. Rolled Steel Floor Plate: ASTM A 786/A 786M.
- J. Rolled Stainless-Steel Floor Plate: ASTM A 793.
- K. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Pattern 1, Alloy 6061-T6.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Examine hoistways, hoistway openings, pits, and machine rooms as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions.
- B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.
- C. Coordination: Coordinate elevator work with work of other trades for proper time and sequence to avoid construction delays. Use established benchmarks, lines, and levels to ensure dimensional coordination of the Work.
- D. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- E. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.
- F. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final

adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
- B. Operating Test: Load [**elevator**] [**each elevator**] [**one elevator of each type, capacity, speed, and travel distance**] to rated capacity and operate continuously for 30 minutes over full travel distance, stopping at each level and proceeding immediately to the next. Record temperature rise of elevator machine during 30-minute test period. Record failure to perform as required.
- C. Advise Owner, DEN Project Manager, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.4 PROTECTION

- A. Temporary Use: [**Limit temporary use for construction purposes to one elevator.**] Do not use elevators for construction purposes unless approved by DEN Project Manager, and unless cars are provided with temporary enclosures, either within finished cars or in place of finished cars, to protect finishes from damage. Comply with the following requirements for [**each**] elevator used for construction purposes:
 - 1. Provide protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
 - 2. Do not load elevators beyond their rated weight capacity.
 - 3. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
 - 4. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required and approved by DEN Project Manager.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate[, **adjust, and maintain**] elevator(s).
 - 1. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train DEN personnel in procedures to follow in identifying sources of operational

- failures or malfunctions. Confer with DEN Project Manager on requirements for a complete elevator maintenance program.
2. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

- B. Check operation of[**each**] elevator with DEN Project Manager's personnel present and before date of Substantial Completion[**and not more than one month before end of warranty period**]. Determine that operation systems and devices are functioning properly.

3.6 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12<**Insert number**> months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies as used in the manufacture and installation of original equipment.
 1. Perform maintenance during normal working hours.
 2. Perform emergency callback service during normal working hours with response time of [**two**] <**Insert number**> hours or less.
 3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of [**two**] <**Insert number**> hours or less.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 142113

SECTION 142400 - HYDRAULIC ELEVATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes hydraulic [**passenger**] [**and**] [**service**] elevators.
- B. Related Requirements:
 - 1. Section 015000 "Temporary Facilities and Controls" for temporary use of elevators for construction purposes.
 - 2. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
 - 3. Section 042000 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
 - 4. Section 051200 "Structural Steel Framing" for the following:
 - a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
 - b. Divider beams.
 - c. Hoist beams.
 - d. Structural-steel shapes for subsills that are part of steel frame.
 - 5. Section 055000 "Metal Fabrications" for the following:
 - a. Attachment plates and angle brackets for supporting guide-rail brackets.
 - b. Divider beams.
 - c. Hoist beams.
 - d. Structural-steel shapes for subsills.
 - e. Pit ladders.
 - f. Cants in hoistways made from steel sheet.
 - 6. Section 055213 "Pipe and Tube Railings" for railings between adjacent elevator pits.
 - 7. Section 057000 "Decorative Metal" for combination hall push-button stations.
 - 8. **<Insert Section number>-<Insert Section title>** for finish flooring in elevator cars.
 - 9. Section 099113 "Exterior Painting" for field painting of hoistway entrance doors and frames.

10. Section 099123 "Interior Painting" for field painting of hoistway entrance doors and frames.
11. Section 142413 "Hydraulic Freight Elevators" for hydraulic elevators used primarily for carrying freight and inaccessible to the general public.
12. Section 221429 "Sump Pumps" for sump pumps, sumps, and sump covers in elevator pits.
13. Section 271500 "Communications Horizontal Cabling" for telephone service for elevators.
14. **[Section 283111 "Digital, Addressable Fire-Alarm System"] [Section 283112 "Zoned (DC Loop) Fire-Alarm System"]** for smoke detectors in elevator lobbies to initiate emergency recall operation **[and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation]** and for connection to elevator controllers.
15. Section 31200 "Earth Moving" for excavating well hole to accommodate cylinder assembly.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 REFERENCES

- A. American National Standards Institute (ANSI):

1. A117.1 - Accessible and Usable Buildings and Facilities.

- B. American Society for Testing and Materials (ASTM):

1. A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. A366/366M - Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.
3. A786A/786M - Rolled Steel Floor Plates.
4. A793 - Rolled Floor Plate, Stainless Steel.
5. B36/36M - Brass Plate, Sheet, Strip, and Rolled Bar.
6. B151 - Nickel-Zinc Alloy (Nickel Silver) and Copper-Nickel Rod and Bar.
7. B151M - Copper-Nickel-Zinc Alloy (Nickel Silver) and Copper-Nickel Rod and Bar (Metric).
8. B455 - Copper-Zinc-Alloy (Leaded Brass) Extruded Shapes.
9. B632/632M - Aluminum-Alloy Rolled Tread Plate.
10. C1107 - Packaged Dry, Hydraulic-Cement Grout (Non-shrink).

- C. American Society of Mechanical Engineers (ASME):

1. A17.1 - Safety Code for Elevators and Escalators.

- D. National Electrical Manufacturers Association (NEMA):

1. LD3 - High Pressure Decorative Laminates.

- E. U.S. Architectural & Transportation Barriers Compliance Board:

1. ADA Accessibility Guidelines - August 1994 - American Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities.

1.4 ALLOWANCES

- A. Elevator Car Allowances: Provide finished passenger[**and service**] elevator cars under the Elevator Car Allowance specified in Section 012100 "Allowances."
Allowance includes furnishing and installing the following:

1. Car wall finishes including trim.
2. Car floor finishes.
3. Car ceiling finishes.
4. Car[**and hoistway**] door finishes.
5. Car doorsills.
6. Car light fixtures.
7. Handrails.
8. Cutouts and other provisions for installing elevator signal equipment in cars.

1.5 UNIT PRICES

- A. Unit Prices: Rock excavation for cylinder well holes is paid for under the unit price indicated in the Contract and as specified in Section 012200 "Unit Prices."

1.6 DEFINITIONS

- A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.
- B. Service Elevator: A passenger elevator that is also used to carry freight.
- C. Defective Elevator Work: Operation or control system failures; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

1.7 ACTION SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures, hoistway entrances, and operation, control, and signal systems.
 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings:
 1. Include plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment.

2. Include large-scale layout of car-control station[**and standby power operation control panel**].
3. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, locations of equipment and signals, and maximum and average power demands.

C. Samples for Initial Selection: For finishes involving color selection.

D. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; **3-inch-** (75-mm-) square Samples of sheet materials; and **4-inch** (100-mm) lengths of running trim members.

1.8 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service[**including standby power generator**], as shown and specified, are adequate for elevator system being provided.

D. Sample Warranty: For special warranty.

1.9 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.

B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

C. Manufacturer shall furnish a letter stating all components are designed by an Engineer and are suitable for the intended purpose.

D. Signage

- E. Maintenance manuals for each different electric traction elevator, including operation and maintenance instructions, parts listing with sources indicated, recommended parts inventory listing, emergency instructions, and similar information. Include all diagnostic and repair information available to manufacturer's and Installer's maintenance personnel. Submit for Owner's information at project closeout as specified in Division 01.
- F. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.10 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance service by skilled, competent employees of the elevator Installer. Include monthly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Use parts and supplies as used in the manufacture and installation of original equipment.
 - 1. Perform maintenance, including emergency callback service, during normal working hours.
 - 2. Include 24-hour-per-day, 7-day-per-week emergency callback service.
 - 3. Response Time: 1 hour or less.
- B. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard [**one-year**] [**two-year**] [**five-year**] <Insert **agreement period**> maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.11 QUALITY ASSURANCE

- A. Installer Qualifications: Engage the elevator manufacturer or an experienced Installer approved by the elevator manufacturer who has completed elevator installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Regulatory Requirements: In addition to local governing regulations, comply with the applicable provisions of the following:
 - 1. ASME A17.1, "Safety Code for Elevators and Escalators," referred to as the "Code."

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.13 COORDINATION

- A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- B. Furnish well casing and coordinate delivery with related excavation work.
- C. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

1.14 WARRANTY

- A. Manufacturer's Standard Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
 - 2. Warranty Period: Minimum 12 months<Insert number> year(s) from date of Substantial Completion.

1.15 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ThyssenKrupp
2. Dover Elevator Co.
3. KONE Inc.
4. Otis Elevator Co.
5. Schindler Elevator Corp.
6. U.S. Elevator
7. <Insert manufacturer's name>.
8. or approved equal.

B. Source Limitations: Obtain elevators[, **including electric traction passenger elevators specified in Section 142100 "Electric Traction Elevators,"**] from single manufacturer.

1. Major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

B. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.

C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7]** <Insert requirement> and shall comply with elevator safety requirements for seismic risk Zone 2 or greater in ASME A17.1/CSA B44.

1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified[**and the system will be fully operational after the seismic event**]."
2. Affected peak velocity acceleration (Av) for Project's location is [**less than 0.10 (seismic risk Zones 0 and 1)**] [**greater than or equal to 0.10, but less than 0.20 (seismic risk Zone 2)**] [**greater than or equal to 0.20 (seismic risk Zones 3 and 4)**].
3. Provide earthquake equipment required by ASME A17.1/CSA B44.
4. Provide seismic switch required by ASCE/SEI 7.
5. Design earthquake spectral response acceleration short period (Sds) for Project is <Insert value>.
6. Project's Seismic Design Category: **[A] [B] [C] [D] [E] [F]**.
7. Elevator Component Importance Factor: **[1.5] [1.0]**.

2.3 MATERIALS AND COMPONENTS, GENERAL

A. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components, published by manufacturer as

included in standard preengineered elevator systems and as required for a complete system.

- B. Power Supply: (480 V, 60 Hz, 3 phase.) (208 V, 60 Hz, 3 phase.) (240 V, 60 Hz, 2 phase).
- C. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Specification Section.
- D. Machine Beams: Provide framing to support the elevator hoisting machine and deflector sheaves from the building structure. Comply with DIVISION 5 for materials and fabrication.
- E. Guide Shoes/Rollers: Provide either sliding shoes or rollers for speeds of 200 ft./min. (1.02 m/s) and less, and rollers for speeds in excess of 200 ft./min. (1.02 m/s).
- F. Car Frame and Platform: Welded steel units.

2.4 ELEVATORS

- A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturers' standard components shall be used, as included in standard elevator systems and as required for complete system.
- B. Elevator Description:
 - 1. Group Number: **<Insert a different number for each group of elevators that share a group operation system>**.
 - 2. Elevator Number(s): **<Insert elevator number(s) as shown on Drawings>**.
 - 3. Emergency Elevator Number(s): **<Insert elevator number(s) as shown on Drawings>**.
 - 4. Service Elevator Number(s): **<Insert elevator number(s) as shown on Drawings>**.
 - 5. Type: Under-the-car single cylinder.
 - 6. Type: Holeless, beside-the-car, single-acting, [**single**] [**dual**] cylinder.
 - 7. Type: Holeless, beside-the-car, telescoping, [**single**] [**dual**] cylinder.
 - 8. Type: Holeless, beside-the-car, roped hydraulic, [**single**] [**dual**] cylinder.
 - 9. Rated Load: [**2000 lb (908 kg)**] [**2100 lb (953 kg)**] [**2500 lb (1135 kg)**] [**3000 lb (1362 kg)**] [**3500 lb (1589 kg)**] [**4000 lb (1816 kg)**] [**4500 lb (2043 kg)**] [**5000 lb (2270 kg)**] **<Insert value>**.
 - 10. Freight Loading Class for Service Elevators: Class A.
 - 11. Rated Speed: [**75 or 80 fpm (0.38 or 0.41 m/s)**] [**100 fpm (0.51 m/s)**] [**125 fpm (0.64 m/s)**] [**150 fpm (0.76 m/s)**] [**175 fpm (0.89 m/s)**] [**200 fpm (1.0 m/s)**] **<Insert value>**.
 - 12. Operation System: [**Single automatic**] [**Selective-collective automatic**] [**Group automatic**].
 - 13. Auxiliary Operations:
 - a. Standby power operation.

- b. Standby-powered lowering.
 - c. Battery-powered lowering.
 - d. Automatic dispatching of loaded car.
 - e. Nuisance call cancel.
 - f. **[Emergency hospital] [Priority] service at [all] <Insert floor designations> floors.**
 - g. Independent service for **[service elevator] [one car in group] [all cars in group]**.
 - h. Loaded-car bypass.
14. Security Features: **[Card-reader operation] [Keyswitch operation] [Keypad operation] [Car-to-lobby feature]**.
15. Dual Car-Control Stations: Provide two car-control stations **[in each elevator]**; equip only one with required keyswitches, if any.
16. Car Enclosures:
- a. Inside Width: **[64 inches (1626 mm)] [68 inches (1727 mm)] [80 inches (2032 mm)] [92 inches (2337 mm)] <Insert dimension>** from side wall to side wall.
 - b. Inside Depth: **[51 inches (1295 mm)] [53 inches (1346 mm)] [57 inches (1448 mm)] [65 inches (1651 mm)] [87-1/2 inches (2222 mm)] [90 inches (2286 mm)] [93 inches (2362 mm)] [93-1/2 inches (2375 mm)] [96 inches (2438 mm)] [101 inches (2565 mm)] [102 inches (2591 mm)] <Insert dimension>** from back wall to front wall (return panels).
 - c. Inside Height: **[88 inches (2235 mm)] [92 inches (2337 mm)] [94 inches (2388 mm)] [100 inches (2540 mm)] [104 inches (2642 mm)] [108 inches (2743 mm)] [112 inches (2845 mm)] <Insert dimension>** to underside of ceiling.
 - d. Front Walls (Return Panels): **[Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered]** with integral car doorframes.
 - e. Car Fixtures: **[Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered]**.
 - f. Side and Rear Wall Panels: **[Enameled steel] [Plastic laminate] [Satin stainless steel, No. 4 finish] [Textured stainless steel] [Satin bronze, lacquered]**.
 - g. Reveals: **[Enameled steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered]**.
 - h. Door Faces (Interior): **[Enameled steel] [Primed steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Textured stainless steel] [Polished bronze, lacquered] [Satin bronze, lacquered] [Plastic laminate]**.
 - i. Doorsills: **[Aluminum, mill finish] [Bronze, polished] [Nickel silver, polished]**.
 - j. Ceiling: **[Luminous ceiling] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Reflective metallic-finish, plastic-laminate, stainless steel] [Reflective metallic-finish, plastic-laminate, bronze]**.
 - k. Handrails: **[1-1/2 inches (38 mm) round] [1/2 by 2 inches (13 by 50 mm) rectangular] <Insert dimension(s)> [mirror-polished stainless steel,**

- No. 8 finish] [satin stainless steel, No. 4 finish] [mirror-polished bronze, lacquered] [satin bronze, lacquered], at [sides] [and] [rear] of car.**
- l. Floor: Manufacturer's standard carpet.
 - m. Floor prepared to receive carpet (specified in Section 096816 "Sheet Carpeting").
 - n. Floor prepared to receive resilient flooring (specified in Section 096500 "Resilient Flooring").
 - o. Floor recessed and prepared to receive **[dimension stone tile (specified in Section 093033 "Stone Tiling")] [ceramic tile (specified in Section 093000 "Tiling")]**.
 - p. Floor Thickness, Including Setting Materials: **<Insert thickness>** above plywood subfloor.
17. Hoistway Entrances:
- a. Width: **[36 inches (914 mm)] [42 inches (1067 mm)] [48 inches (1219 mm)] [54 inches (1372 mm)] <Insert dimension>**.
 - b. Height: **[84 inches (2134 mm)] [96 inches (2438 mm)] <Insert dimension>**.
 - c. Type: **[Single-speed side sliding] [Two-speed side sliding] [Single-speed center opening] [Two-speed center opening]**.
 - d. Frames **[at First Floor] [at Basement Floors]: [Enameled steel] [Primed steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered]**.
 - e. Frames at Other Floors: **[Enameled steel] [Primed steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered]**.
 - f. Doors **[and Transoms] [at First Floor] [at Basement Floors]: [Enameled steel] [Primed steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Textured stainless steel] [Polished bronze, lacquered] [Satin bronze, lacquered] [Plastic laminate]**.
 - g. Doors **[and Transoms] at Other Floors: [Enameled steel] [Primed steel] [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Textured stainless steel] [Polished bronze, lacquered] [Satin bronze, lacquered] [Plastic laminate]**.
 - h. Sills **[at First Floor] [at Basement Floors]: [Aluminum, mill finish] [Bronze, polished] [Nickel silver, polished]**.
 - i. Sills at Other Floors: **[Aluminum, mill finish] [Bronze, polished] [Nickel silver, polished]**.
18. Hall Fixtures **[at First Floor] [at Basement Floors]: [Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered] [Recessed type with no exposed-metal surfaces]**.
19. Hall Fixtures at Other Floors: **[Polished stainless steel, No. 8 finish] [Satin stainless steel, No. 4 finish] [Polished bronze, lacquered] [Satin bronze, lacquered] [Recessed type with no exposed-metal surfaces]**.
20. Additional Requirements:
- a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from **[polished stainless steel, No. 8 finish] [satin stainless**

steel, No. 4 finish] [polished bronze, lacquered] [satin bronze, lacquered].

- b. Provide hooks for protective pads[**in all cars**] and [**one**] [**two**] <Insert number> complete set(s) of full-height protective pads.

2.5 SYSTEMS AND COMPONENTS

- A. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations.
1. Pump shall be [**submersible type with submersible squirrel-cage induction motor, and shall be suspended inside oil tank from vibration isolation mounts**] [or] [**shall be tank-top-mounted type with fan-cooled, squirrel-cage induction motor, and shall be mounted on oil tank with vibration isolation mounts and enclosed in prime-painted steel enclosure lined with 1-inch-(25-mm-) thick, glass-fiber insulation board**].
 2. Motor shall have [**wye-delta**] [or] [**solid-state**] starting.
 3. Motor shall have variable-voltage, variable-frequency control.
- B. Hydraulic Silencers: System shall have hydraulic silencer containing pulsation-absorbing material in blowout-proof housing at pump unit.
- C. Piping: Size, type, and weight of piping as recommended by elevator manufacturer, with flexible connectors to minimize sound and vibration transmissions from power unit.
1. Cylinder units shall be connected with dielectric couplings.
 2. Casing for Underground Piping: Schedule 40 PVC pipe complying with ASTM D 1785, joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.
- D. Hydraulic Fluid: Elevator manufacturer's standard [**fire-resistant**] fluid with additives as needed to prevent oxidation of fluid, corrosion of cylinder and other components, and other adverse effects.
- E. Hydraulic Fluid: Nontoxic, biodegradable[, **fire-resistant**] fluid made from vegetable oil with antioxidant, anticorrosive, antifoaming, and metal-passivating additives and approved by elevator manufacturer for use with elevator equipment.
1. Product: Subject to compliance with requirements, provide "Hydro Safe" by Hydro Safe Oil Division, Inc.
- F. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.
- G. Protective Cylinder Casing: PVC or HDPE pipe casing complying with ASME A17.1/CSA B44, of sufficient size to provide not less than **1-inch** (25-mm) clearance

from cylinder and extending above pit floor. Casing shall have means of monitoring effectiveness to comply with ASME A17.1/CSA B44.

- H. Corrosion-Protective Filler: A nontoxic, petroleum-based gel formulated for filling the space between hydraulic cylinder and protective casing. Filler shall be electrically nonconductive, displace or absorb water, and gel or solidify at temperatures below **60 deg F** (16 deg C).
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hydro Safe Oil Division, Inc.; No-Ox-Id Liquid Elevator Casing Filler E-800.
 - b. Union-Gard, a division of Dome Services L.L.C.; Union-Gard 160.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
 - I. Car Frame and Platform: Welded[**or bolted**] steel units.
 - J. Guides: Roller guides; polymer-coated, nonlubricated sliding guides; or sliding guides with guide-rail lubricators. Provide guides at top and bottom of car and counterweight frames.

2.6 OPERATION SYSTEMS

- A. General: Provide manufacturer's standard microprocessor operation system as required to provide type of operation indicated.
- B. Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:
1. Single-Car Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at **[main lobby] [fire command station] <Insert location>**. Manual operation causes automatic operation to cease.
 2. Single-Car Standby-Powered Lowering: On activation of standby power, if car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to a preselected floor, opens its doors, and shuts down. If car is below the preselected floor, it is lowered to the next lower floor, opens its doors, and shuts down.
 3. Single-Car Standby-Powered Lowering: On activation of standby power, car is lowered to the lowest floor, opens its doors, and shuts down.
 4. Single-Car Battery-Powered Lowering: If power fails and car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to a preselected floor, opens its doors, and shuts down. If car is below the preselected floor, it is lowered to the next lower floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.

5. Single-Car Battery-Powered Lowering: When power fails, car is lowered to the lowest floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
6. Group Standby Power Operation: On activation of standby power, cars are returned to a designated floor and parked with doors open. Only one car is moved upward at a time, with priority given to loaded cars. If a car cannot be returned after two attempts, it is removed from the system. When all cars have been returned or removed from the system, one car is automatically placed in service. If car selected for service cannot operate within 60 seconds, the system removes car from service and places another car in service. Cars can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at **[main lobby] [fire command station] <Insert location>**. Manual operation causes automatic operation to cease.
7. Group Standby Power Operation: On activation of standby power, cars are returned to lowest floor and parked with doors open. If a car cannot be returned, it is removed from the system. One car is selected for service on standby power by a switch located at **[main lobby] [fire command station] <Insert location>**.
8. Group Standby-Powered Lowering: On activation of standby power, cars that are at a floor remain at that floor, open their doors, and shut down. Cars that are between floors are lowered to a preselected floor, open their doors, and shut down. Cars that are below the preselected floor are lowered to the next lower floor, open their doors, and shut down.
9. Group Standby-Powered Lowering: On activation of standby power, cars are lowered to the lowest floor, open their doors, and shut down.
10. Group Battery-Powered Lowering: If power fails, cars that are at a floor remain at that floor, open their doors, and shut down. Cars that are between floors are lowered to a preselected floor, open their doors, and shut down. Cars that are below the preselected floor are lowered to the next lower floor, open their doors, and shut down. System includes rechargeable battery and automatic recharging system.
11. Group Battery-Powered Lowering: When power fails, cars are lowered to the lowest floor, open their doors, and shut down. System includes rechargeable battery and automatic recharging system.
12. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors start closing.
13. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls **[and predetermined weight]** can be adjusted.
14. Loaded-Car Bypass: When car load exceeds 80 percent of rated capacity, car responds only to car calls, not to hall calls.
15. Independent Service: Keyswitch in car-control station removes car from group operation and allows it to respond only to car calls. Key cannot be removed from keyswitch when car is in independent service. When in independent service, doors close only in response to door close button.
16. **[Emergency Hospital] [Priority] Service**: Service is initiated by a **[keyswitch] [card reader] [remote switch]** at designated floors. One elevator is removed from group operation and directed to the floor where service was initiated. On arriving at the floor, elevator opens its doors and parks **[and a lighted sign directs passengers to exit elevator]**. Car is placed in operation by selecting a

floor and pressing door close button or by operating keyswitch to put car in independent service. After responding to floor selected or being removed from independent service, car is returned to group operation. If car is not placed in operation within a preset time after being called, it is returned to group operation.

17. Earthquake emergency operation.
18. Fire recall position

C. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.

1. Card-Reader Operation: System uses card readers at [**car-control stations**] [**and**] [**hall push-button stations**] to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space as indicated for card reader in car.
 - a. When system is activated, car calls to restricted landings do not register unless card is first inserted into card reader. Security access system determines which landings are restricted and which of those are accessible to cardholder.
2. Card-reader operation for access to restricted landings based on security system provided by others. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space in car as indicated for card reader.
 - a. When system is activated, car calls to restricted landings do not register unless card is first inserted into card reader. Security access system determines which landings are restricted and which of those are accessible to cardholder.
3. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at car-control stations and hall push-button stations. Key is removable only in deactivated position.
4. Secured landing feature that allows each landing to be secured or cleared. If a landing is secured, car buttons for that landing do not register a call unless a landing access code is entered within a predetermined time period after the landing button is pressed. When a secured landing button is pressed a "Restricted Floor" lamplights and remains lit until landing access code has been entered or predetermined time period has elapsed.
5. Access codes are programmed at each car operating panel using a security keyswitch. Secured landing feature is activated and deactivated by a security keyswitch at the main landing.
6. Anticrime feature activated by a keyswitch that causes all cars in a group to return immediately to a predetermined floor and open their doors for inspection.

On deactivation by keyswitch, cars complete calls registered before keyswitch activation and resume normal operation.

7. Keypad Operation: Allows each landing to be restricted or unrestricted. When a restricted landing button is pressed, a "Restricted Floor" lamp lights and remains lit until landing access code has been entered into a keypad or predetermined time period has elapsed. Car calls for restricted landings do not register until landing access code is entered into keypad within predetermined time period after landing button is pressed.
 - a. Access codes are programmed at each car operating panel using a security keyswitch. Keypad operation can be activated and deactivated by security keyswitch at main landing.
8. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes **[car] [all cars in a group]** to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

2.7 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.
- B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

2.8 CAR ENCLOSURES

- A. General: Provide **[enameled-steel car enclosures to receive removable] [steel-framed car enclosures with nonremovable]** wall panels, with **[removable]** car roof, access doors, power door operators, and ventilation.
 1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.
 2. See "Allowances" Paragraph in "Summary" Article for items to be provided under the Elevator Car Allowance. Provide items not included in the Elevator Car Allowance as needed for finished car **[including materials and finishes specified below]**.
- B. Materials and Finishes: Manufacturer's standards, but not less than the following:
 1. Subfloor: Exterior, underlayment grade plywood, not less than **5/8-inch** (15.9-mm) nominal thickness.
 2. Subfloor: Exterior, C-C Plugged grade plywood, not less than **7/8-inch** (22.2-mm) nominal thickness.

3. Floor Finish: [**Specified in <Insert Section number>-<Insert Section title>**] [**Elevator manufacturer's standard level-loop nylon carpet; color as selected by DEN Project Manager from manufacturer's full range**].
4. Enameled-Steel Wall Panels: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by DEN Project Manager from manufacturer's full range.
5. Stainless-Steel Wall Panels: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
6. Bronze Wall Panels: Flush, hollow-metal construction; fabricated from bronze sheet.
7. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to [**1/2-inch (13-mm) fire-retardant-treated particleboard**] [**manufacturer's standard honeycomb core**] with [**plastic-laminate panel backing and**] manufacturer's standard protective edge trim. Panels have a flame-spread index of [**25**] [**75**] or less, when tested according to ASTM E 84. Plastic-laminate color, texture, and pattern as selected by DEN Project Manager from [**plastic-laminate**] [**elevator**] manufacturer's full range.
8. Fabricate car with recesses and cutouts for signal equipment.
9. Fabricate car doorframe integrally with front wall of car.
10. Enameled-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by DEN Project Manager from manufacturer's full range.
11. Primed-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied, rust-resistant primer for field painting.
12. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated [**from stainless-steel sheet**] [**or**] [**by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning**].
13. Bronze Doors: Flush, hollow-metal construction; fabricated by laminating bronze sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
14. Plastic-Laminate Doors: Flush, hollow-metal construction; fabricated by laminating plastic laminate to exposed faces of enameled cold-rolled steel doors and covering edges with protective edge trim [**matching return panels**]. Plastic-laminate color, texture, and pattern as selected by DEN Project Manager from [**plastic-laminate**] [**elevator**] manufacturer's full range.
15. Unfinished-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet, with factory-applied enamel.
16. Sight Guards: Provide sight guards on car doors.
17. Sills: Extruded metal, with grooved surface, **1/4 inch (6.4 mm)** thick.
18. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
19. [**Metal**] [**Metallic-Finish, Plastic-Laminate**] Ceiling: Flush panels, with [**incandescent downlights in the center of**] [**four low-voltage downlights in**] each panel. [**Align ceiling panel joints with joints between wall panels.**]
20. Handrails: Manufacturer's standard handrails, of shape, metal, and finish indicated.

2.9 HOISTWAY ENTRANCES

- A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.
- Where gypsum board wall construction is indicated, frames shall be self-supporting with reinforced head sections.
- B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to **[NFPA 252]** **[or]** **[UL 10B]**.
- Fire-Protection Rating: **[1 hour]** **[1-1/2 hours]** **<Insert rating>** **[with 30-minute temperature rise of 450 deg F (250 deg C)]**.
- C. Materials and Fabrication: Manufacturer's standards, but not less than the following:
- Enameled-Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by DEN Project Manager from manufacturer's full range.
 - Primed-Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied, rust-resistant primer for field painting.
 - Steel Subframes: Formed from cold- or hot-rolled steel sheet, with factory-applied enamel finish or rust-resistant primer. Fabricate to receive applied finish as indicated.
 - Stainless-Steel Frames: Formed from stainless-steel sheet.
 - Bronze Frames: Formed from cold- or hot-rolled steel sheet, with enamel finish, and with formed-bronze sheet laminated to steel frames using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
 - Star of Life Symbol: Identify emergency elevators with star of life symbol, not less than **3 inches** (76 mm) high, on both inside surfaces of hoistway doorframes.
 - Enameled-Steel Doors **[and Transoms]**: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by DEN Project Manager from manufacturer's full range.
 - Primed-Steel Doors **[and Transoms]**: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied, rust-resistant primer for field painting.
 - Stainless-Steel Doors **[and Transoms]**: Flush, hollow-metal construction; fabricated **[from stainless-steel sheet]** **[or]** **[by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning]**.
 - Bronze Doors **[and Transoms]**: Flush, hollow-metal construction; fabricated by laminating bronze sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
 - Plastic-Laminate Doors **[and Transoms]**: Flush, hollow-metal construction; fabricated by laminating plastic laminate to exposed faces of enameled

- cold-rolled steel doors and covering edges with protective edge trim[**matching doorframes**]. Plastic-laminate color, texture, and pattern as selected by DEN Project Manager from [**plastic-laminate**] [**elevator**] manufacturer's full range.
12. Unfinished-Steel Doors[**and Transoms**]: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet, with factory-applied enamel.
 13. Sight Guards: Provide sight guards on doors matching door edges.
 14. Sills: Extruded metal, with grooved surface, **1/4 inch** (6.4 mm) thick.
 15. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

2.10 SIGNAL EQUIPMENT

- A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with [**long-life lamps and acrylic or other permanent, non-yellowing translucent plastic diffusers**] [**or**] [**LEDs**].
- B. Car-Control Stations: Provide manufacturer's standard [**recessed**] [**or**] [**semirecessed**] car-control stations. Include call buttons for each landing served and other buttons, switches, and controls required for specified car operation. Provide operating device symbols as required by the applicable codes. Mount in return panel adjacent to car door unless otherwise indicated.
 1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
 2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
- C. Swing-Return Car-Control Stations: Provide car control station fully recessed in hinged return panel adjacent to door of each car. Include call buttons for each landing served and other buttons, switches, and controls required for specified car operation. Provide operating device symbols as required by the applicable codes. Mark other buttons and switches with manufacturer's standard identification for required use or function
 1. Mark buttons and switches for function. Use both tactile symbols and Braille.
 2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
 3. Mount controls as shown or scheduled and at heights complying with ANSI A117.1.
 4. Mount controls as shown or scheduled and at heights complying with ADA Accessibility Guidelines.
 5. Provide 2 car control stations in each passenger elevator; equip only 1 with required keyswitches, if any.
- D. Emergency Communication System: Elevators at DEN shall be equipped with a Talk-a-Phone model ETP103 OEM elevator telephone installed per manufacturer's instructions behind the control panel in each elevator car. DEN technologies will

provide cabling and an analog telephone line from the DIA PABX system for each telephone. Telephones are powered from the PABX system, which in turn is backed up by battery. The PABX is programmed to rung down calls from the elevators to the 24/7 police positions at the airport communications centers. Elevator telephones are polled once per day using Talk-a-Phone Talk-a-Lert software to confirm health and status of the telephones. Technicians are dispatched to repair or replace any telephone that fails during a polling cycle. Telephone products from other vendors shall not be permitted, as they cannot be polled.

- E. Firefighters' Two-Way Telephone Communication Service: Provide [**flush-mounted cabinet**] [**telephone jack**] in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in [**Section 283111 "Digital, Addressable Fire-Alarm System"**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System."**]
- F. Car-Top Alarm: Provide switches on top emergency exits that will cause alarm to sound when cover is opened.
- G. Car Position Indicator: Provide [**illuminated,**] digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.
- H. Hall Push-Button Stations: [**Provide one hall push-button station at each landing for each single elevator or group of elevators, but not less than one station for each four elevators in a group**] [**Provide hall push-button station at each landing as indicated**]. For each group of passenger elevators, locate between 2 elevators at center of group or at location most convenient for approaching passengers.
 - 1. Provide [**units with flat faceplate for mounting with body of unit recessed in wall**].
 - 2. Equip units with buttons for calling elevator and for indicating applicable direction of travel.
 - 3. Provide 2-button stations at intermediate landings. Provide 1-button stations with direction indication at terminal landings.
 - 4. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in [**Section 283111 "Digital, Addressable Fire-Alarm System"**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System."**]Possibly insert a provision for either an "In Use" signal or a digital display of car position for single elevators.
- I. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Match materials, finishes, and mounting method of hall push-button stations. Provide[**one of**] the following:
 - 1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
 - 2. Units with flat faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.
 - 3. Units mounted in both jambs of entrance frame[**for each elevator**].

4. Units mounted in both car door jambs[; **may be used only for single elevators or for two-car groups**].
 - J. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
 1. At manufacturer's option, audible signals may be placed on cars.
 - K. Hall Position Indicators: Provide [**illuminated**,]digital-display-type position indicators, located above each hoistway entrance at ground floor. Provide units with flat faceplate for mounting and with body of unit recessed in wall. Match materials, finishes, and mounting method of hall push-button stations.
 1. Integrate ground-floor hall lanterns with hall position indicators.
 - L. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1/CSA B44, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed.[**For each elevator, provide illuminated signals that indicate when they are operational and when they are at the designated emergency return level with doors open.**]
 - M. Fire-Command-Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.
 - N. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.
- 2.11 FINISH MATERIALS
- A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.
 - B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
 - C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
 - D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
 - E. Textured Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304 with embossed texture rolled into exposed surface.

1. Product: Subject to compliance with requirements, provide "<Insert product name>" by <Insert manufacturer's name>.
 2. Metal surface is [satin polished] [satin relieved] [titanium nitride colored] [oxide colored] [satin polished and titanium nitride colored] [satin relieved and titanium nitride colored] [satin polished and oxide colored] [satin relieved and oxide colored] [color coated and satin relieved] [color coated and bright relieved] after texturing.
- F. Stainless-Steel Bars: ASTM A 276, Type 304.
- G. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
- H. Bronze Plate and Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal).
- I. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (architectural bronze).
- J. Bronze Tubing: [ASTM B 135](#) (ASTM B 135M), Alloy UNS No. C23000 (red brass, 85 percent copper).
- K. Aluminum Extrusions: [ASTM B 221](#) (ASTM B 221M), Alloy 6063.
- L. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500 or No. C77600.
- M. Plastic Laminate: High-pressure type complying with NEMA LD 3, [Type HGS for flat applications] [Type HGL for flat applications] [Type HGP for postformed applications] [and] [Type BKV for panel backing].

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Excavation for Cylinder: Drill well hole in [each] elevator pit to accommodate installation of cylinder; comply with applicable requirements in Section 312000 "Earth Moving."
- B. Provide [waterproof] well casing [as necessary] to retain well-hole walls.

- C. Install cylinder in protective casing within well hole. Before installing protective casing, remove water and debris from well hole[**and provide permanent waterproof seal at bottom of well casing**].
1. Fill void space between protective casing and cylinder with corrosion-protective filler.
 2. Align cylinders and fill space around protective casing with fine sand.
- D. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor. Seal between **[well] [protective]** casing and pit floor with **4 inches** (100 mm) of nonshrink, nonmetallic grout.
- E. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.
- F. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS workmanship and welding operator qualification standards.
- G. Coordination: Coordinate elevator work with work of other trades for proper time and sequence to avoid construction delays. Use established benchmarks, lines, and levels to ensure dimensional coordination of the Work.
- H. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- I. Install piping above the floor, where possible. Install underground piping in casing.
- J. Lubricate operating parts of systems as recommended by manufacturers.
- K. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- L. Leveling Tolerance: **1/4 inch** (6 mm), up or down, regardless of load and travel direction.
- M. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- N. Locate hall signal equipment for elevators as follows, unless otherwise indicated:
1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
 2. Place hall lanterns either above or beside each hoistway entrance.
 3. Mount hall lanterns at a minimum of **72 inches** (1829 mm) above finished floor.

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
- B. Operating Test: Load [elevator] [each elevator] [one elevator of each type, **capacity, speed, and travel distance**] to rated capacity and operate continuously for 30 minutes over full travel distance, stopping at each level and proceeding immediately to the next. Record temperature rise of elevator machine during 30-minute test period. Record failure to perform as required.
- C. Advise Owner, DEN Project Manager, and authorities having jurisdiction a minimum of 72 hours in advance of dates and times that tests are to be performed on elevators.

3.4 PROTECTION

- A. Temporary Use: [**Limit temporary use for construction purposes to one elevator.**] Do not use elevators for construction purposes unless approved by DEN Project Manager, and unless cars are provided with temporary enclosures, either within finished cars or in place of finished cars, to protect finishes from damage. Comply with the following requirements for[**each**] elevator used for construction purposes:
 - 1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
 - 2. Provide strippable protective film on entrance and car doors and frames.
 - 3. Provide padded wood bumpers on entrance doorframes covering jambs and frame faces.
 - 4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
 - a. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so that no evidence remains of correction work. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required and approved by DEN Project Manager.
 - 5. Do not load elevators beyond their rated weight capacity.
 - 6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
 - 7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate[, **adjust, and maintain**] elevator(s).
1. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train DEN personnel in procedures to follow in identifying sources of operational failures or malfunctions. Confer with DEN Project Manager on requirements for a complete elevator maintenance program.
 2. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.
- B. Check operation of[**each**] elevator with Owner's personnel present before date of Substantial Completion[**and again not more than one month before end of warranty period**]. Determine that operation systems and devices are functioning properly.

3.6 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12<Insert number> months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies as used in the manufacture and installation of original equipment.
1. Perform maintenance during normal working hours.
 2. Perform emergency callback service during normal working hours with response time of [**two**] <Insert number> hours or less.
 3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of [**two**] <Insert number> hours or less.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

A. METHOD OF PAYMENT

- B. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 142400

SECTION 142413 - HYDRAULIC FREIGHT ELEVATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes hydraulic freight elevators.
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
 - 2. Section 042000 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry.
 - 3. Section 051200 "Structural Steel Framing" for the following:
 - a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
 - b. Divider beams.
 - c. Hoist beams.
 - d. Structural-steel shapes for subsills[**and entrance frames**] that are part of steel frame.
 - 4. Section 055000 "Metal Fabrications" for the following:
 - a. Attachment plates and angle brackets for supporting guide-rail brackets.
 - b. Divider beams.
 - c. Hoist beams.
 - d. Structural-steel shapes for [**subsills**] [**and**] [**entrance frames**].
 - e. Pit ladders.
 - f. Cants in hoistways made from steel sheet.
 - 5. Section 055213 "Pipe and Tube Railings" for railings between adjacent elevator pits.
 - 6. Section 099113 "Exterior Painting" for field painting of hoistway entrance doors and frames.
 - 7. Section 099123 "Interior Painting" for field painting of hoistway entrance doors and frames.
 - 8. Section 102213 "Wire Mesh Partitions" for guards between adjacent elevator pits.

9. Section 271500 "Communications Horizontal Cabling" for telephone service for elevators.
 10. **[Section 283111 "Digital, Addressable Fire-Alarm System"] [Section 283112 "Zoned (DC Loop) Fire-Alarm System"]** for smoke detectors in elevator lobbies to initiate emergency recall operation[**and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation**] and for connection to elevator controllers.
 11. Section 31200 "Earth Moving" for excavating well hole to accommodate cylinder assembly.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.
- D. Unit Prices: Rock excavation for cylinder well holes is paid for under the unit price indicated in the Contract and as specified in Section 012200 "Unit Prices."
- 1.3 REFERENCES
- A. American National Standards Institute (ANSI):
1. A117.1 - Accessible and Usable Buildings and Facilities.
- B. American Society for Testing and Materials (ASTM):
1. A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 2. A366/366M - Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.
 3. A786A/786M - Rolled Steel Floor Plates.
 4. A793 - Rolled Floor Plate, Stainless Steel.
 5. B36/36M - Brass Plate, Sheet, Strip, and Rolled Bar.
 6. B151 - Nickel-Zinc Alloy (Nickel Silver) and Copper-Nickel Rod and Bar.
 7. B151M - Copper-Nickel-Zinc Alloy (Nickel Silver) and Copper-Nickel Rod and Bar (Metric).
 8. B455 - Copper-Zinc-Alloy (Leaded Brass) Extruded Shapes.
 9. B632/632M - Aluminum-Alloy Rolled Tread Plate.
 10. C1107 - Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
- C. American Society of Mechanical Engineers (ASME):
1. A17.1 - Safety Code for Elevators and Escalators.
- D. National Electrical Manufacturers Association (NEMA):
1. LD3 - High Pressure Decorative Laminates.
- E. U.S. Architectural & Transportation Barriers Compliance Board:
1. ADA Accessibility Guidelines - August 1994 - American Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities.

1.4 DEFINITIONS

- A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.
- B. Defective Elevator Work: Operation or control system failures; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

1.5 ACTION SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information.
 - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment.
 - 2. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, locations of equipment and signals, and maximum and average power demands.
- C. Samples for Initial Selection: For finishes involving color selection.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service[**including standby power generator**], as shown and specified, are adequate for elevator system being provided.
- D. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.
- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
- C. Manufacturer shall furnish a letter stating all components are designed by an Engineer and are suitable for the intended purpose.
- D. Signage
- E. Maintenance manuals for each different electric traction elevator, including operation and maintenance instructions, parts listing with sources indicated, recommended parts inventory listing, emergency instructions, and similar information. Include all diagnostic and repair information available to manufacturer's and Installer's maintenance personnel. Submit for Owner's information at project closeout as specified in Division 01.
- F. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance service by skilled, competent employees of the elevator Installer. Include monthly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Use parts and supplies as used in the manufacture and installation of original equipment.
 - 1. Perform maintenance, including emergency callback service, during normal working hours.
 - 2. Include 24-hour-per-day, 7-day-per-week emergency callback service.
 - 3. Response Time: 1 hour or less.
- B. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard [**one-year**] [**two-year**] [**five-year**] <Insert **agreement period**> maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Engage the elevator manufacturer or an experienced Installer approved by the elevator manufacturer who has completed elevator installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Regulatory Requirements: In addition to local governing regulations, comply with the applicable provisions of the following:
 - 1. ASME A17.1, "Safety Code for Elevators and Escalators," referred to as the "Code."

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.11 COORDINATION

- A. Coordinate installation of sleeves, block outs, and items that are embedded in concrete or masonry for elevator equipment. Furnish templates and installation instructions and deliver to Project site in time for installation.
- B. Furnish well casing and coordinate delivery with related excavation work.
- C. Coordinate locations and dimensions of other work relating to hydraulic freight elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

1.12 WARRANTY

- A. Manufacturer's Standard Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
 - 2. Warranty Period: Minimum 12<Insert number> year(s) from date of Substantial Completion.

1.13 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. KONE Inc.
2. Otis Elevator Co.
3. Schindler Elevator Corp.
4. Schindler Elevator Corp.
5. U.S. Elevator.
6. **<Insert manufacturer's name>**.
7. or approved equal.

- B. Source Limitations: Obtain freight elevators[, **including electric traction freight elevators specified in Section 142100 "Electric Traction Elevators,"**] from single manufacturer.

1. Major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- B. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.
- C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7] <Insert requirement>** and shall comply with elevator safety requirements for seismic risk Zone 2 or greater in ASME A17.1/CSA B44.
1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified[**and the system will be fully operational after the seismic event.**]"
 2. Affected peak velocity acceleration (Av) for Project's location is [**less than 0.10 (seismic risk Zones 0 and 1)**] [**greater than or equal to 0.10, but less than**

0.20 (seismic risk Zone 2)] [greater than or equal to 0.20 (seismic risk Zones 3 and 4)].

3. Provide earthquake equipment required by ASME A17.1/CSA B44.
4. Provide seismic switch required by ASCE/SEI 7.
5. Design earthquake spectral response acceleration short period (Sds) for Project is **<Insert value>**.
6. Project's Seismic Design Category: **[A] [B] [C] [D] [E] [F]**.
7. Elevator Component Importance Factor: **[1.5] [1.0]**.

2.3 MATERIALS AND COMPONENTS, GENERAL

- A. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components, published by manufacturer as included in standard preengineered elevator systems and as required for a complete system.
- B. Power Supply: (480 V, 60 Hz, 3 phase.) (208 V, 60 Hz, 3 phase.) (240 V, 60 Hz, 2 phase).
- C. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Specification Section.
- D. Machine Beams: Provide framing to support the elevator hoisting machine and deflector sheaves from the building structure. Comply with DIVISION 05 for materials and fabrication.
- E. Guide Shoes/Rollers: Provide either sliding shoes or rollers for speeds of 200 ft./min. (1.02 m/s) and less, and rollers for speeds in excess of 200 ft./min. (1.02 m/s).
- F. Car Frame and Platform: Welded steel units.

2.4 FREIGHT ELEVATORS

- A. Elevator System, General: Manufacturer's standard hydraulic freight elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.
- B. Elevator Description:
 1. Elevator Number(s): **<Insert elevator number(s) as shown on Drawings>**.
 2. Type: Under-the-car **[single] [or] [dual]** cylinder.
 3. Type: Holeless, beside-the-car, single-acting, **[single] [dual]** cylinder.
 4. Type: Holeless, beside-the-car, telescoping, **[single] [dual]** cylinder.
 5. Type: Holeless, beside-the-car, roped hydraulic, **[single] [dual]** cylinder.
 6. Rated Load: **[2000 lb (908 kg)] [2500 lb (1135 kg)] [3000 lb (1362 kg)] [4000 lb (1816 kg)] [5000 lb (2270 kg)] [6000 lb (2720 kg)] [8000 lb (3632 kg)] [10,000 lb (4540 kg)]**
<Insert value>.
 7. Freight Loading Class: **[Class A] [Class B] [Class C1] [Class C2] [Class C3]**.

8. Rated Speed (Up): [50 fpm (0.25 m/s)] [75 or 80 fpm (0.38 or 0.41 m/s)] [100 fpm (0.51 m/s)] <Insert value>.
9. Operational Speed (Down): [Approximately 30 percent more than] [Same as] rated speed (up).
10. Operation System: [Single automatic] [Car-switch automatic floor stop] [Selective-collective automatic].
11. Auxiliary Operations:
 - a. Battery-powered lowering.
 - b. Standby power operation.
 - c. Load-weighing device.
12. Security Features: [Card-reader] [Keyswitch] operation.
13. Auxiliary Car-Control Station: Provide additional car-control station mounted on side of car at height to facilitate operation by forklift-truck operator without leaving truck.
14. Car Enclosures:
 - a. Platform Width: [60 inches (1524 mm)] [64 inches (1626 mm)] [66 inches (1676 mm)] [76 inches (1930 mm)] [78 inches (1981 mm)] [88 inches (2235 mm)] [100 inches (2540 mm)] [102 inches (2591 mm)] [124 inches (3150 mm)] [126 inches (3200 mm)] <Insert dimension>.
 - b. Platform Depth: [72 inches (1829 mm)] [84 inches (2134 mm)] [96 inches (2438 mm)] [120 inches (3048 mm)] [144 inches (3658 mm)] [168 inches (4267 mm)] <Insert dimension>.
 - c. Ceiling Height: [84 inches (2134 mm)] [96 inches (2438 mm)] [108 inches (2743 mm)] <Insert dimension>.
 - d. Walls and Ceiling: [Prime-painted steel] [Prime-painted, metallic-coated steel] [Satin stainless steel, No. 4 finish] [Textured stainless steel].
 - e. Car Fixtures: Satin stainless steel, No. 4 finish.
 - f. Floor: [Rolled steel floor plate] [Aluminum-alloy rolled tread plate] [Rolled stainless-steel floor plate] <Insert material>.
 - g. Car Gate Type: [Vertical biparting] [Single-speed vertical lift] [Two-speed vertical lift].
 - h. Car Gate Operation: [Manual] [Power operated].
 - i. Car Gate Material: [Prime-painted steel] [Satin stainless steel, No. 4 finish].
 - j. Car Sill: Steel angle.
 - k. Lighting: [One] [Two] [Three] 48-inch (1219-mm), [suspended,] [surface-mounted,] two-tube fluorescent light fixture(s) with [white reflectors] [and] [wire lamp guards].
 - l. Lighting: [One] [Two] 48-inch (1219-mm), recessed, [two] [three]-tube fluorescent light fixture(s) with UV-stabilized acrylic diffusers not less than 0.125 inch (3.2 mm) thick.
15. Hoistway Entrances:
 - a. Width: [56 inches (1422 mm)] [60 inches (1524 mm)] [62 inches (1575 mm)] [72 inches (1829 mm)] [96 inches (2438 mm)] [98 inches (2489 mm)] [120 inches (3048 mm)] [122 inches (3099 mm)] <Insert dimension>.

- b. Height: [84 inches (2134 mm)] [96 inches (2438 mm)] <Insert dimension>.
 - c. Door Type: [Vertical biparting] [Single-speed vertical lift] [Two-speed vertical lift].
 - d. Fire-Protection Rating: [1 hour] [1-1/2 hours] <Insert rating>[with 30-minute temperature rise of 450 deg F (250 deg C)].
 - e. Door Operation: [Manual] [Power operated].
 - f. Door Material: [Prime-painted steel] [Satin stainless steel, No. 4 finish].
 - g. Doorframe Material: [Prime-painted steel] [Satin stainless steel, No. 4 finish].
 - h. Door[frames and] sills are specified in [Section 051200 "Structural Steel Framing"] [Section 05500 "Metal Fabrications."]
16. Hall Fixtures: Satin stainless steel, No. 4 finish.
17. Auxiliary Hall Stations: Provide additional pendant-mounted, hall push-button stations[**where indicated**] mounted at height to facilitate operation by forklift-truck operator without leaving truck.
18. Additional Requirements:
- a. Door reopening device.

2.5 SYSTEMS AND COMPONENTS

- A. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations.
- 1. Pump shall be [submersible type with submersible squirrel-cage induction motor, and shall be suspended inside oil tank from vibration isolation mounts] [or] [tank-top-mounted type with fan-cooled, squirrel-cage induction motor and shall be mounted on oil tank with vibration isolation mounts and enclosed in prime-painted steel enclosure lined with 1-inch- (25-mm-) thick, glass-fiber insulation board].
 - 2. Motor shall have [wye-delta] [or] [solid-state] starting.
- B. Hydraulic Silencers: System shall have hydraulic silencer containing pulsation-absorbing material in blowout-proof housing at pump unit.
- C. Piping: Size, type, and weight of piping as recommended by elevator manufacturer, with flexible connectors to minimize sound and vibration transmissions from power unit.
- 1. Cylinder units shall be connected with dielectric couplings.
 - 2. Casing for Underground Piping: Schedule 40 PVC pipe complying with ASTM D 1785, joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.
- D. Hydraulic Fluid: Elevator manufacturer's standard [**fire-resistant**] fluid with additives as needed to prevent oxidation of fluid, corrosion of cylinder and other components, and other adverse effects.

- E. Hydraulic Fluid: Nontoxic, biodegradable[, **fire-resistant**] fluid made from vegetable oil with antioxidant, anticorrosive, antifoaming, and metal-passivating additives and approved by elevator manufacturer for use with elevator equipment.
1. Product: Subject to compliance with requirements, provide "Hydro Safe" by Hydro Safe Oil Division, Inc.
- F. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.
- G. Protective Cylinder Casing: PVC or HDPE pipe casing complying with ASME A17.1/CSA B44, of sufficient size to provide not less than **1-inch (25-mm)** clearance from cylinder and extending above pit floor. Casing shall have method of monitoring effectiveness of complying with ASME A17.1/CSA B44.
- H. Corrosion-Protective Filler: A nontoxic, petroleum-based gel formulated for filling the space between hydraulic cylinder and protective casing. Filler shall be electrically nonconductive, displace or absorb water, and gel or solidify at temperatures below **60 deg F (16 deg C)**.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hydro Safe Oil Division, Inc.; No-Ox-Id Liquid Elevator Casing Filler E-800.
 - b. Union-Gard, a division of Dome Services L.L.C.; Union-Gard 160.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
- I. Car Frame and Platform: Welded[**or bolted**] steel units.
1. Provide special heavy-duty units where indicated for power truck loading, designed to withstand impacts and wheel loadings indicated.
- J. Guides: Roller guides; polymer-coated, nonlubricated sliding guides; or sliding guides with guide-rail lubricators. Provide guides at top and bottom of car and counterweight frames.

2.6 OPERATION SYSTEMS

- A. General: Provide manufacturer's standard microprocessor operation system as required to provide type of operation indicated.
- B. Battery-Powered Lowering: When power fails, car is lowered to the lowest floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
- C. Single-Car Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power by a switch in control panel located at [**main lobby**] [**fire command station**] **<Insert location>**.

- D. Group Standby Power Operation: On activation of standby power, cars are returned one car at a time to a designated floor and parked with doors open. If a car cannot be returned, it is removed from the system. One car is selected for service on standby power by a switch in control panel located at **[main lobby] [fire command station] <Insert location>**.
- E. Load-Weighing Device: When car load exceeds 80 percent of rated capacity, a signal light is lit in the car-control station; when car load exceeds rated capacity, car does not respond to car or hall calls.
- F. Earthquake emergency operation.
- G. Fire recall position.
- H. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.
1. Card-Reader Operation: System uses card readers at **[car-control stations] [and] [hall push-button stations]** to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. **[Allow space as indicated for card reader in car] [Provide stripe-swipe card reader integral with each car-control station]**.
 - a. When system is activated, car calls to restricted landings do not register unless card is first inserted into card reader. Security access system determines which landings are restricted and which of those are accessible to cardholder.
 - b. Security access system equipment is **[specified in Section 281300 "Access Control."]** **[not in the Contract.]**
 2. Card-reader operation for access to restricted landings based on security system provided by others. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space in car as indicated for card reader.
 - a. When system is activated, car calls to restricted landings do not register unless card is first inserted into card reader. Security access system determines which landings are restricted and which of those are accessible to cardholder.
 3. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at **[car-control stations] [and] [hall push-button stations]**. Key is removable **[only in deactivated position] [in either position]**.
 4. Secured landing feature that allows each landing to be secured or cleared. If a landing is secured, car buttons for that landing do not register a call unless a landing access code is entered within a predetermined time period after the landing button is pressed. When a secured landing button is pressed a

- "Restricted Floor" lamp lights and remains lit until landing access code has been entered or predetermined time period has elapsed.
5. Access codes are programmed at each car operating panel using a security keyswitch. Secured landing feature is activated and deactivated by a security keyswitch at the main landing.
 6. Anticrime feature activated by a keyswitch that causes all cars in a group to return immediately to a predetermined floor and open their doors for inspection. On deactivation by keyswitch, cars complete calls registered before keyswitch activation and resume normal operation.
 7. Keypad Operation: Allows each landing to be restricted or unrestricted. When a restricted landing button is pressed, a "Restricted Floor" lamp lights and remains lit until landing access code has been entered into a keypad or predetermined time period has elapsed. Car calls for restricted landings do not register until landing access code is entered into keypad within predetermined time period after landing button is pressed.
 - a. Access codes are programmed at each car operating panel using a security keyswitch. Keypad operation can be activated and deactivated by security keyswitch at main landing.
 8. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes **[car] [all cars in a group]** to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

2.7 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening devices with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.

2.8 CAR ENCLOSURES

- A. General: Provide car enclosures as indicated, including ventilation, lighting, finishes, access doors, thresholds, trim, and accessories. Fabricate with recesses and cutouts for signal equipment.
 1. Provide power door operators with linkages for hoistway door operation.
 2. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.
- B. Materials and Fabrication: Provide manufacturer's standard, flush panel, welded construction made from metal sheet, of metal indicated, not less than **0.067 inch** (1.7 mm) and reinforced at **16-inch** (406-mm) maximum spacing.
 1. Provide perforated panels for ceiling and for walls above **72 inches** (1829 mm) from car floor unless required to be solid by ASME A17.1/CSA B44.

2.9 HOISTWAY ENTRANCES

- A. General: Structural-steel frames and sills for hoistway entrances are specified in **[Section 051200 "Structural Steel Framing"] [Section 05500 "Metal Fabrications."]**
- B. Unless otherwise indicated, provide hoistway entrance doors of type indicated below, with truckable sill bars and resilient safety meeting-rail gaskets.
 - 1. Equip for power operation by coordinated linkage with power-operated car door.
 - 2. Where gypsum board wall construction is indicated, provide fire-resistance-rated, hollow-metal, door-and-frame hoistway entrances. Provide self-supporting frames with reinforced head sections.
- C. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as-close-to-neutral pressure as possible according to **[NFPA 252] [or] [UL 10B]**.
- D. Materials and Fabrication: Provide manufacturer's standards, but not less than the following:
 - 1. Metal Door Panels: Constructed of metal sheets, flush on room side, welded and reinforced in steel framing with vertical reinforcing spaced not more than **24 inches** (610 mm) o.c. Fabricate panel faces from metal sheet, of metal indicated, not less than **0.097 inch** (2.5 mm) thick.

2.10 SIGNAL EQUIPMENT

- A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements of acrylic or other permanent, nonyellowing translucent plastic.
- B. Car-Control Stations: Provide manufacturer's standard car-control station. Mount adjacent to car door unless otherwise indicated. Include call buttons for each landing served and other buttons, switches, and controls required for specified car operation. Provide operating device symbols as required by the applicable codes.
 - 1. Mark buttons and switches for function. Use both tactile symbols and Braille.
 - 2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
 - 3. Mount controls at heights complying with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.
- C. Emergency Communication System: Elevators at DEN shall be equipped with a Talk-a-Phone model ETP103 OEM elevator telephone installed per manufacturer's instructions behind the control panel in each elevator car. DEN technologies will

provide cabling and an analog telephone line from the DIA PABX system for each telephone. Telephones are powered from the PABX system, which in turn is backed up by battery. The PABX is programmed to rung down calls from the elevators to the 24/7 police positions at the airport communications centers. Elevator telephones are polled once per day using Talk-a-Phone Talk-a-Lert software to confirm health and status of the telephones. Technicians are dispatched to repair or replace any telephone that fails during a polling cycle. Telephone products from other vendors shall not be permitted, as they cannot be polled.

- D. Firefighters' Two-Way Telephone Communication Service: Provide [**flush-mounted cabinet**] [**telephone jack**] in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in [**Section 283111 "Digital, Addressable Fire-Alarm System"**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System."**]
- E. Car-Top Alarm: Provide switches on top emergency exits that will cause alarm to sound when cover is opened.
- F. Car Position Indicator: Provide illuminated digital-type car position indicator, located above car door or above car-control station.
- G. Hall Push-Button Stations: Provide hall push-button stations at each landing as indicated.
 - 1. Provide single-button stations with [**position**] [**"in-use"**] indicator.
- H. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in [**Section 283111 "Digital, Addressable Fire-Alarm System"**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System."**]

2.11 FINISH MATERIALS

- A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
- D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, commercial steel, with **G60** (Z180) zinc coating (galvanized) or **A60** (ZF180) zinc-iron-alloy coating (galvannealed).
- E. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
- F. Textured Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304 with embossed texture rolled into exposed surface.
 - 1. Product: Subject to compliance with requirements, provide "<**Insert product name**>" by <**Insert manufacturer's name**>.

- G. Stainless-Steel Bars: ASTM A 276, Type 304.
- H. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
- I. Rolled Steel Floor Plate: ASTM A 786/A 786M.
- J. Rolled Stainless-Steel Floor Plate: ASTM A 793.
- K. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Pattern 1, Alloy 6061-T6.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Excavation for Cylinder: Drill well hole in **[each]** elevator pit to accommodate installation of cylinder; comply with applicable requirements in Section 312000 "Earth Moving."
- B. If retaining first paragraph below, usually delete "waterproof" option and retain "as necessary" option. Well casing is essentially part of Contractor's means and methods unless required by authorities having jurisdiction; however, requiring a well casing helps prevent disputes if cylinder well-hole excavation is not being provided by elevator Installer.
- C. Provide **[waterproof]** well casing **[as necessary]** to retain well-hole walls.
- D. Install cylinder in protective casing within well hole. Before installing protective casing, remove water and debris from well hole **[and provide permanent waterproof seal at bottom of well casing]**.
 - 1. Fill void space between protective casing and cylinder with corrosion-protective filler.
 - 2. Align cylinders and fill space around protective casing with fine sand.

- E. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor. Seal between **[well] [protective]** casing and pit floor with **4 inches** (100 mm) of nonshrink, nonmetallic grout.
- F. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.
- G. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS workmanship and welding operator qualifications standards.
- H. Coordination: Coordinate elevator work with work of other trades for proper time and sequence to avoid construction delays. Use established benchmarks, lines, and levels to ensure dimensional coordination of the Work.
- I. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- J. Install piping above the floor, where possible. Install underground piping in casing.
- K. Lubricate operating parts of systems as recommended by manufacturers.
- L. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
- B. Operating Test: Load **[elevator] [each elevator] [one elevator of each type, capacity, speed, and travel distance]** to rated capacity and operate continuously for 30 minutes over full travel distance, stopping at each level and proceeding immediately to the next. Record temperature rise of elevator machine during 30-minute test period. Record failure to perform as required.
- C. Advise Owner, DEN Project Manager, and authorities having jurisdiction a minimum of 72 hours in advance of dates and times that tests are to be performed on elevators.

3.4 PROTECTION

- A. Temporary Use: [**Limit temporary use for construction purposes to one elevator.**] Do not use elevators for construction purposes unless approved by DEN Project Manager, and unless cars are provided with temporary enclosures, either within finished cars or in place of finished cars, to protect finishes from damage. Comply with the following requirements for[**each**] elevator used for construction purposes:
1. Provide protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
 - a. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so that no evidence remains of correction work. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required and approved by DEN Project Manager.
 2. Do not load elevators beyond their rated weight capacity.
 3. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
 4. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate[, **adjust, and maintain**] elevator(s).
1. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train DEN personnel in procedures to follow in identifying sources of operational failures or malfunctions. Confer with DEN Project Manager on requirements for a complete elevator maintenance program.
 2. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.
- B. Check operation of[**each**] elevator with Owner's personnel present and before date of Substantial Completion[**and not more than one month before end of warranty period**]. Determine that operation systems and devices are functioning properly.

3.6 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12<Insert number> months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies as used in the manufacture and installation of original equipment.
1. Perform maintenance during normal working hours.
 2. Perform emergency callback service during normal working hours with response time of [two] <Insert number> hours or less.
 3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of [two] <Insert number> hours or less.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 142413

SECTION 143100 - ESCALATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes [**standard**] [**and**] [**high-traffic,**] [**interior**] [**and**] [**exterior**] escalators.
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
 - 2. Section 051200 "Structural Steel Framing" for attachment plates, angle brackets, and other preparation of structural steel to support escalator trusses.
 - 3. Section 083113 "Access Doors and Frames" for wall and ceiling access panels and access doors in escalator enclosures.
 - 4. Section 101400 "Signage" for "Caution" signs required by ASME A17.1/CSA B44.
 - 5. [**Section 283111 "Digital, Addressable Fire-Alarm System"**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System"**] for smoke detectors that activate escalator alarm and, after at least 15 seconds, cause the interruption of power to the escalator motor and brake and for connection to escalator controllers.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. High-Traffic Escalators: Designed specifically for high-traffic-volume use that produces dense occupancy resulting in structural, machinery, and brake loads much higher than normal.

1.4 ACTION SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, safety features, finishes, and similar information.
 - 1. Include data substantiating that materials comply with requirements.

- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details indicating coordination with building structure and relationships with other construction.
 - 2. Indicate maximum loads imposed on building structure at points of support, and power requirements.
 - 3. Indicate access and ventilation for escalator machine space.
- C. Samples for Initial Selection: For exposed materials involving color selection.
- D. Samples for Verification: For exposed escalator finishes, **3-inch-** (75-mm-) square Samples of sheet materials, and **4-inch** (100-mm) lengths of running trim members.
- E. Delegated-Design Submittal: For escalators.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Seismic Qualification Certificates: For escalator equipment, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Manufacturer Certificates: Signed by manufacturer certifying that escalator layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for escalator system being provided.
- D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For escalators to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.
- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted escalator use.
- C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard [**one-year**] [**two-year**] [**five-year**] <Insert

agreement period> maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

- D. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Escalator manufacturer[**or an authorized representative who is trained and approved by manufacturer**].

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.9 COORDINATION

- A. Coordinate installation of sleeves, block outs, escalator equipment with integral anchors, and other items that are embedded in concrete or masonry for escalator equipment. Furnish templates, sleeves, escalator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- B. Coordinate locations and dimensions of other work relating to escalators including sumps and floor drains in pits; electrical service; and electrical outlets, lights, and switches in pits.

1.10 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace escalator work that fails in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
 2. Warranty Period: Minimum **<Insert number>** year(s) from date of Substantial Completion.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419

"Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Fujitec America, Inc.
 2. KONE Inc.
 3. Mitsubishi Electric Corporation.
 4. Otis Elevator Co.
 5. Schindler Elevator Corp.
 6. ThyssenKrupp Elevator.
 7. **<Insert manufacturer's name>**.
 8. or approved equal.
- B. Source Limitations: Obtain escalators[**and moving walks, specified in another Section,**] from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- B. Braking Performance: Provide brakes that stop escalator in up-running mode at a rate no greater than **3 ft./s²** (0.91 m/s²).
- C. Braking Performance: Provide brakes that produce a stopping force on escalator in up-running mode that is one-third that used in down-running mode.
- D. Step/Skirt Performance Index: Not more than 0.15.
- E. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design escalators.
- F. Seismic Performance: Escalators shall withstand the effects of earthquake motions determined according to [**ASCE/SEI 7**] **<Insert requirement>**.
1. Design earthquake spectral response acceleration short period (Sds) for Project is **<Insert value>**.
 2. Project's Seismic Design Category: [**A**] [**B**] [**C**] [**D**] [**E**] [**F**].
 3. Escalator Component Importance Factor: 1.0.
- G. Structural and Mechanical Performance for High-Traffic Escalators: For the purposes of structural design, driving machine and power transmission calculations, and brake

calculations, design high-traffic escalators for loads not less than **[two]** <Insert **number**> times the design loads required by ASME A17.1/CSA B44.

- H. Structural Performance of Balustrades, Deck Barricades, and Handrails: Provide components and assemblies capable of withstanding the effects of loads indicated in ASCE/SEI 7 for handrail assemblies and guardrail systems.

2.3 ESCALATORS

- A. Escalators, General: Manufacturer's standard escalators complying with requirements. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard escalator systems and as required for complete system.
- B. High-Traffic Escalators, General: Manufacturer's high-traffic escalators complying with requirements. Unless otherwise indicated, manufacturer's heavy-duty components shall be used, as included in standard high-traffic escalator systems and as required for complete system.
- C. Design and equip escalators to run in either direction.
- D. Provide escalators with **[two]** **[three]** **[four]** flat steps at top and bottom landings.
- E. Rated Speed: **[90 fpm (0.46 m/s)]** **[or]** **[100 fpm (0.5 m/s)]**.

2.4 COMPONENTS

- A. Fabricate exposed metalwork, including deck covers, balustrade panels, and trim to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use; increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as necessary. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
- B. Opaque Balustrades: Manufacturer's standard profile or arrangement of moving handrails on fully paneled guide rail with interior balustrade panels, deck covers, skirts, trim, and accessories. **[Prepared for exterior finish below the deck covers; exterior finish specified in another Section.]**
- C. Transparent Balustrades: Manufacturer's standard profile or arrangement of moving handrails on guide rail that is supported by tempered glass panels, with deck covers, skirts, trim, and accessories. **[Prepared for exterior finish below the deck covers; exterior finish specified in another Section.]**
- D. Direction Indicator Lights: Provide red and green indicator lights at least **2 inches** (50 mm) in diameter in **[right-hand]** **[both]** balustrade newels at both upper and lower landings. Green light indicates entrance end, and red light indicates exit end. When escalator is stopped, red lights are illuminated at both ends.
- E. Guards at Ceiling Intersection: Clear plastic.

- F. Handrails: Smooth, jointless, reinforced neoprene.
1. Color: **[Black]** **[Match DEN Project Manager's sample]** **[As selected by DEN Project Manager from manufacturer's full range]** <Insert color>.
- G. Deck Covers and Trim: **[Satin stainless steel]** **[Polished stainless steel]** **[Gold-colored, satin stainless steel]** **[Gold-colored, polished stainless steel]** **[Satin bronze]**.
- H. Antislid Devices: **[Satin stainless steel]** **[Polished stainless steel]** **[Gold-colored, satin stainless steel]** **[Gold-colored, polished stainless steel]** **[Satin bronze]**.
- I. Balustrade Interior Panels: **[Satin stainless steel]** **[Polished stainless steel]** **[Gold-colored, satin stainless steel]** **[Gold-colored, polished stainless steel]** **[Satin bronze]**.
- J. Balustrade Exterior Panels[and Escalator Soffits]: **[Satin stainless steel]** **[Polished stainless steel]** **[Gold-colored, satin stainless steel]** **[Gold-colored, polished stainless steel]** **[Satin bronze]**.
- K. Skirt Panels[, if Applicable]: **[Satin stainless steel]** **[Polished stainless steel]** **[Satin stainless steel with exposed surface coated with clear PTFE]** **[Steel panels with exposed surface coated with PTFE]** **[Manufacturer's standard low-friction material]**.
- L. Skirt Deflector Devices: Manufacturer's standard brush-type device.
- M. Steps: One-piece, die-cast aluminum with demarcation grooves at front and rear of tread surface.
1. Finish: Powder-coated, **[gray]** **[black]** <Insert color>.
2. Step Demarcation: **1-1/2- to 2-inch-** (38- to 50-mm-) wide yellow stripe at sides and backs of step treads.
3. Nosing Demarcation: **2-inch-** (50-mm-) wide yellow stripe at nosings of step treads.
- N. Combs: **[Integrally colored structural plastic]** **[Cast aluminum]** **[Cast aluminum with powder-coated finish]**.
1. Comb Color: **[Yellow]** **[Black]** **[Gray]** **[Red]** <Insert color>.
- O. Combplate Lights: Provide recessed light fixtures with flush lenses mounted in skirt panels at each side of combplates, designed to illuminate combplate steps.
- P. Floor Plates: **[Cast or extruded aluminum]** **[Stainless steel]** with grooved or patterned surface[and with abrasive material embedded in or metallically bonded to floor-plate surface].

2.5 FEATURES

- A. Operational Control: Provide key-operated starter switches[**and key-operated switches for directional control**] located on exterior deck above newel base at both upper and lower landings of escalators.
- B. Fault Indicator: Provide escalators with a microprocessor unit that monitors safety devices, motor temperature, and escalator speed and records in nonvolatile memory the date, time, and device identification if a safety device is activated or escalator malfunctions.
 - 1. Provide built-in[**or plug-in**] unit to display recorded information.
- C. Reduced-Current Starting: Provide escalator motors with wye-delta or solid-state starting.
- D. Energy-Saving Feature: Provide escalator motors and controls designed for motors running on partial windings (at reduced power) when not under full load.
- E. Provide motors complying with NEMA MG 1, Insulation Class B.
- F. Brake-Saving Feature: Provide stopping mechanism that allows escalator to coast to a stop before applying brakes, unless stopping is initiated by a safety device.
- G. Equip step drive mechanism with automatic step-chain lubricators.
- H. Oil Drip Pan: Provide metal pan under full width and length of escalator to collect and hold oil and grease drippings from lubricated components. Design and fabricate drip pan to sustain a load of **250 lbf** (1.1 kN) on a **1.0-sq. ft.** (0.9-sq. m) area at any location without permanent deflection.
- I. Overspeed Governor: Provide units with overspeed governor that is activated if speed of steps exceeds rated speed by more than 20 percent.
- J. Upper-Landing, Step Upthrust Device: Activated if a step is displaced against upthrust track at upper curve in passenger-carrying line of track system.
- K. Comb-Step Impact Device: Activated if a horizontal force in direction of travel is applied exceeding **400 lbf** (1780 N) at either side or exceeding **800 lbf** (3560 N) at center of front edge of combplate, or a resultant force in upward direction is applied exceeding **150 lbf** (688 N) at center of front edge of combplate.
- L. Comb-Step Impact Device: Activated if a horizontal force in direction of travel is applied exceeding **112 lbf** (500 N) at either side or exceeding **225 lbf** (1000 N) at center of front edge of combplate, or a resultant force in upward direction is applied exceeding **150 lbf** (688 N) at center of front edge of combplate.

2.6 EXTERIOR ESCALATORS

- A. Fabricate exposed components from [**stainless steel**] [**bronze**] unless otherwise indicated.
- B. Hot-dip galvanize escalator trusses and other structural components to comply with ASTM A 123/A 123M. Use only stainless-steel or zinc-plated fasteners.
- C. Fabricate oil drip pan from galvanized-steel sheet. Provide drain and oil/water separator in oil drip pan.
- D. Provide drains, weeps, and drips to prevent water accumulation on horizontal surfaces and to direct water away from electrical equipment and moving parts.
- E. Provide enclosures complying with NEMA 250, Type 4 for electrical connections, switches, and equipment.
- F. Provide totally enclosed motors complying with NEMA MG 1, Insulation Class B.
- G. Equip step drive mechanism with automatic step-chain lubricators.
- H. Provide electric heaters with integral thermostats in escalator truss space to maintain temperature above 40 deg F (4.4 deg C).
- I. Equip combplates with 400-W electric heaters to prevent ice and snow accumulation.

2.7 MATERIALS

- A. Stainless Steel: ASTM A 240/A 240M, [**Type 304**] [**Type 316**] [**Type 304, except use Type 316 for exterior escalators**].
 - 1. Satin Finish: No. 4 directional satin.
 - 2. Polished Finish: No. 8 mirror polish.
 - 3. Gold-Colored Satin Finish: No. 4 directional satin with gold-colored oxide or titanium nitride finish.
 - 4. Gold-Colored Mirror Finish: No. 8 mirror polish with gold-colored oxide or titanium nitride finish.
- B. Satin Bronze Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal), fine satin finish, lacquered.
- C. Satin Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (architectural bronze), fine satin finish, lacquered.
- D. Steel Sheet: Cold-rolled steel sheet, ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
- E. Clear Tempered Glass: ASTM C 1048, Condition A (uncoated surfaces), Type 1 (transparent glass, flat), Class 1 (clear), Quality q3 (glazing, select), Kind FT (fully tempered), [**10.0**] [**12.0**] mm thick.

- F. Tinted Tempered Glass: ASTM C 1048, Condition A (uncoated surfaces), Type 1 (transparent glass, flat), Class 2 (tinted), Quality q3 (glazing, select), Kind FT (fully tempered), [10.0] [12.0] mm thick.
1. Color: [Bronze] [Gray] [Green] <Insert color>.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine escalator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine supporting structure, machine spaces, and pits; verify critical dimensions; and examine conditions under which escalators are to be installed.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions.
- B. Set escalators true to line and level, properly supported, and anchored to building structure. Use established benchmarks, lines, and levels to ensure dimensional coordination of the Work.
- C. Adjust installed components for smooth, efficient operation, complying with required tolerances and free of hazardous conditions. Lubricate operating parts, including bearings, tracks, chains, guides, and hardware. Test operating devices, equipment, signals, controls, and safety devices. [**Install oil drip pans and verify that no oil drips outside of pans.**]
- D. Repair damaged finishes so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of escalator installation and before permitting escalator use, perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by authorities having jurisdiction.
 1. For escalators specified to comply with requirements more stringent than those of ASME A17.1/CSA B44, perform tests for compliance with specified

requirements. Test safety devices that are not required by ASME A17.1/CSA B44 as well as those that are.

- B. Advise Owner, DEN Project Manager, and authorities having jurisdiction in advance of dates and times that tests are to be performed.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate[, **adjust, and maintain**] escalators.
 - 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.
- B. Check operation of escalators with Owner's personnel present before date of Substantial Completion[**and again not more than one month before end of warranty period**]. Determine that operation systems and devices are functioning properly.

3.5 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12<Insert number> months' full maintenance by skilled employees of escalator Installer. Include monthly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper escalator operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 1. Perform maintenance during normal working hours.
 - 2. Perform emergency callback service during normal working hours with response time of **[two]** <Insert number> hours or less.
 - 3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of **[two]** <Insert number> hours or less.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work

described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 143100

SECTION 143200 - MOVING WALKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes [**interior**] [**and**] [**exterior**] moving walks.
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
 - 2. Section 051200 "Structural Steel Framing" for attachment plates, angle brackets, and other preparation of structural steel to support moving walk trusses.
 - 3. Section 083113 "Access Doors and Frames" for wall and ceiling access panels and access doors in moving walk enclosures.
 - 4. Section 101400 "Signage" for "Caution" signs required by ASME A17.1/CSA B44.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, safety features, finishes, and similar information.
 - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details indicating coordination with building structure and relationships with other construction.
 - 2. Indicate maximum loads imposed on building structure at points of support, and power requirements.
 - 3. Indicate access and ventilation for moving walk machine space.
- C. Samples for Verification: For exposed finishes, **3-inch-** (75-mm-) square Samples of sheet materials and **4-inch** (100-mm) lengths of running trim members.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Manufacturer Certificates: Signed by manufacturer certifying that moving walk layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for moving walks being provided.
- C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For moving walks to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.
- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted use of moving walks.
- C. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard [**one-year**] [**two-year**] [**five-year**] <Insert **agreement period**> maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.
- D. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Moving walk manufacturer[**or an authorized representative who is trained and approved by manufacturer**].

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.8 COORDINATION

- A. Coordinate installation of sleeves, block outs, moving walk equipment with integral anchors, and other items that are embedded in concrete or masonry for moving walk

equipment. Furnish templates, sleeves, moving walk equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

- B. Coordinate locations and dimensions of other work relating to moving walks including sumps and floor drains in pits; electrical service; and electrical outlets, lights, and switches in pits.

1.9 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace moving walk work that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
 - 2. Warranty Period: Minimum **<Insert number>** year(s) from date of Substantial Completion.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Fujitec America, Inc.
 - 2. KONE Inc.
 - 3. Mitsubishi Electric Corporation.
 - 4. Otis Elevator Co.
 - 5. Schindler Elevator Corp.
 - 6. ThyssenKrupp Elevator.
 - 7. Westmont Industries.
 - 8. **<Insert manufacturer's name>**.
 - 9. or approved equal.
- B. Source Limitations: Obtain moving walks[**and escalators, specified in another Section,**] from a single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- B. Structural Performance of Balustrades, Deck Barricades, and Handrails: Provide components and assemblies capable of withstanding the effects of loads indicated in ASCE/SEI 7 for handrail assemblies and guardrail systems.

2.3 MOVING WALKS

- A. Moving Walks, General: Manufacturer's standard [**pallet-**] [**or**] [**belt-**]type moving walks complying with requirements. Unless otherwise indicated, manufacturer's standard components shall be used as included in standard moving walk systems and as required for complete system.
- B. Design and equip moving walks to run in either direction.
- C. Rated Speed: [90 fpm (0.45 m/s)] [100 fpm (0.5 m/s)] [120 fpm (0.6 m/s)] [130 fpm (0.66 m/s)] [150 fpm (0.76 m/s)] <Insert value>.

2.4 COMPONENTS

- A. Fabricate exposed metalwork, including deck covers, balustrade panels, and trim to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use; increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as necessary. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
- B. Opaque Balustrades: Manufacturer's standard profile or arrangement of moving handrails on fully paneled guide rail with interior balustrade panels, deck covers, skirts, trim, and accessories. [**Prepared for exterior finish below the deck covers; exterior finish specified in another Section.**]
- C. Transparent Balustrades: Manufacturer's standard profile or arrangement of moving handrails on guide rail that is supported by [**clear**] [**tinted**] tempered glass panels, with deck covers, skirts, trim, and accessories. [**Prepared for exterior finish below the deck covers; exterior finish specified in another Section.**]
- D. Direction Indicator Lights: Provide red and green indicator lights at least **2 inches** (50 mm) in diameter in [**right-hand**] [**both**] balustrade newels at both landings. Green light indicates entrance end, and red light indicates exit end. When moving walk is stopped, red lights are illuminated at both ends.
- E. Handrails: Smooth, jointless, reinforced neoprene.
 - 1. Color: [**Black**] [**Match DEN Project Manager's sample**] [**As selected by DEN Project Manager from manufacturer's full range**] <Insert color>.

- F. Deck Covers and Trim: [**Satin stainless steel**] [**Polished stainless steel**] [**Gold-colored, satin stainless steel**] [**Gold-colored, polished stainless steel**] [**Satin bronze**].
- G. Balustrade Interior Panels: [**Satin stainless steel**] [**Polished stainless steel**] [**Gold-colored, satin stainless steel**] [**Gold-colored, polished stainless steel**] [**Satin bronze**].
- H. Balustrade Exterior Panels: [**Satin stainless steel**] [**Polished stainless steel**] [**Gold-colored, satin stainless steel**] [**Gold-colored, polished stainless steel**] [**Satin bronze**].
- I. Skirt Panels, if Applicable: [**Polished stainless steel**] [**Satin stainless steel with exposed surface coated with clear PTFE**] [**Steel panels with exposed surface coated with PTFE**].
1. Clearance between skirt panels or overhanging balustrade panels and treadway shall not exceed **1/16 inch** (1.6 mm).
- J. Combs: [**Integrally colored structural plastic**] [**Cast aluminum**] [**Cast aluminum with powder-coated finish**].
1. Comb Color: [**Yellow**] [**Black**] [**Gray**] [**Red**] <Insert color>.
- K. Combplate Lights: Provide recessed light fixtures with flush lenses mounted in interior balustrade panels at each side of combplates, designed to illuminate treadway at combplate.
- L. Floor Plates: [**Cast or extruded aluminum**] [**Stainless steel**] with grooved or patterned surface[**and with abrasive material embedded in or metallically bonded to floor-plate surface**].

2.5 FEATURES

- A. Operational Control: Provide key-operated starter switches[**and key-operated switches for directional control**] located on exterior deck above newel base at both ends of moving walks.
- B. Fault Indicator: Provide moving walks with a microprocessor unit that monitors safety devices, motor temperature, and moving walk speed and records in nonvolatile memory date, time, and device identification if a safety device is activated or moving walk malfunctions.
1. Provide built-in[**or plug-in**] unit to display recorded information.
- C. Reduced-Current Starting: Provide moving walk motors with wye-delta or solid-state starting.
- D. Energy-Saving Feature: Provide moving walk motors and controls designed for motors running on partial windings (at reduced power) when not under full load.

- E. Brake-Saving Feature: Provide stopping mechanism that allows moving walks to coast to a stop before applying brakes, unless stopping is initiated by a safety device.
- F. Equip pallet drive mechanism with automatic pallet drive-chain lubricators.
- G. Oil Drip Pan: Provide metal pan under full width and length of moving walks to collect and hold oil and grease drippings from lubricated components. Design and fabricate drip pan to sustain a load of **250 lbf** (1.1 kN) on a **1.0-sq. ft.** (0.09-sq. m) area at any location without permanent deflection.
- H. Comb-Step Impact Device: Activated if a horizontal force in direction of travel is applied exceeding **400 lbf** (1780 N) at either side or exceeding **800 lbf** (3560 N) at center of front edge of combplate, or a resultant force in upward direction is applied exceeding **150 lbf** (688 N) at center of front edge of combplate.
- I. Comb-Step Impact Device: Activated if a horizontal force in direction of travel is applied exceeding **112 lbf** (500 N) at either side or exceeding **225 lbf** (1000 N) at center of front edge of combplate, or a resultant force in upward direction is applied exceeding **150 lbf** (688 N) at center of front edge of combplate.

2.6 EXTERIOR MOVING WALKS

- A. Fabricate exposed components from [**stainless steel**] [**bronze**] unless otherwise indicated.
- B. Hot-dip galvanize moving walk trusses and other structural components to comply with ASTM A 123/A 123M. Use only stainless-steel or zinc-plated fasteners for moving walk component assembly.
- C. Fabricate oil drip pan from galvanized steel sheet. Provide drain and oil/water separator in oil drip pan.
- D. Provide drains, weeps, and drips to prevent water accumulation on horizontal surfaces and to direct water away from electrical equipment and moving parts.
- E. Provide enclosures complying with NEMA 250, Type 4 for electrical connections, switches, and equipment.
- F. Provide totally enclosed fan-cooled motors complying with NEMA MG 1, Insulation Class B.
- G. Equip pallet drive mechanism with automatic pallet drive-chain lubricators.
- H. Provide electric heaters with integral thermostats in moving walk truss space to maintain temperature above **40 deg F** (4.4 deg C).
- I. Equip combplates with 400-W electric heaters to prevent ice and snow accumulation.

2.7 MATERIALS

- A. Stainless Steel: ASTM A 240/A 240M, **[Type 304] [Type 316] [Type 304, except use Type 316 for exterior moving walks]**.
1. Satin Finish: No. 4 directional satin.
 2. Polished Finish: No. 8 mirror polish.
 3. Gold-Colored Satin Finish: No. 4 directional satin with gold-colored oxide or titanium nitride finish.
 4. Gold-Colored Mirror Finish: No. 8 mirror polish with gold-colored oxide or titanium nitride finish.
- B. Satin Bronze Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal), fine satin finish, lacquered.
- C. Satin Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (architectural bronze), fine satin finish, lacquered.
- D. Steel Sheet: Cold-rolled steel sheet, ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
- E. Clear Tempered Glass: ASTM C 1048, Condition A (uncoated surfaces), Type 1 (transparent glass, flat), Class 1 (clear), Quality q3 (glazing, select), Kind FT (fully tempered), **[10.0] [12.0]** mm thick.
- F. Tinted Tempered Glass: ASTM C 1048, Condition A (uncoated surfaces), Type 1 (transparent glass, flat), Class 2 (tinted), Quality q3 (glazing, select), Kind FT (fully tempered), **[10.0] [12.0]** mm thick.
1. Color: **[Bronze] [Gray] [Green] <Insert color>**.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine moving walk areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Examine supporting structure, machine spaces, and pits; verify critical dimensions; and examine conditions under which moving walks are to be installed.
- B. Prepare a written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions.

- B. Set moving walks true to line and level[, **or to indicated slope**], properly supported, and anchored to building structure. Use established benchmarks, lines, and levels to ensure dimensional coordination of the Work.
- C. Adjust installed components for smooth, efficient operation, complying with required tolerances and free of hazardous conditions. Lubricate operating parts, including bearings, tracks, chains, guides, and hardware. Test operating devices, equipment, signals, controls, and safety devices. Install oil drip pans and verify that no oil drips outside of pans.
- D. Repair damaged finishes so no evidence remains of correction work. Return items to the shop that cannot be refinished in the field, make required repairs and refinish entire unit, or provide new units as required.

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of moving walk installation and before permitting moving walk use, perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by authorities having jurisdiction.
 - 1. For moving walks specified to comply with requirements more stringent than those of ASME A17.1/CSA B44, perform tests for compliance with specified requirements.
- B. Advise Owner, DEN Project Manager, and authorities having jurisdiction in advance of dates and times that tests are to be performed.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate[, **adjust, and maintain**] moving walks.
 - 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.
- B. Check operation of moving walks with Owner's personnel present before date of Substantial Completion[**and again not more than one month before end of warranty period**]. Determine that operation systems and devices are functioning properly.

3.5 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12<**Insert number**> months' full maintenance by skilled employees of moving walk Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper moving walk operation at rated speed and capacity. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Perform maintenance during normal working hours.
2. Perform emergency callback service during normal working hours with response time of **[two]** <Insert number> hours or less.
3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of **[two]** <Insert number> hours or less.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 143200

SECTION 147300 - OVER THE WING PASSENGER BOARDING BRIDGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies the furnishing and installing of new Passenger Boarding Bridges, including new bridges, new walkways, new pedestals and rotundas and new foundations
- B. Related Requirements:
 - 1. Provisions of the Contract, General and Special Conditions, Technical Specifications Division 01, and all other Technical Specification Sections, apply to this Section.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. General: Submit required items in accordance with General Contract Conditions and Division 01 Specification Sections.
 - 1. All drawings, sketches details, and material shall be submitted in the English language, in United States units, including dimensions, volumes, weights, and forces. The use of metric or SI units is not acceptable.
 - 2. No installation of any of the passenger loading bridge components shall begin until the drawings for such components have been reviewed and approved in writing by DEN. Fabrication and / or assembly begun prior to approval by DEN is done so solely at the risk of the Contractor / Manufacturer. Additional drawings shall be submitted as necessary to fully describe the bridge to be delivered.
- B. Minimum Required Submittal for Layout Approval:
 - 1. Complete finalized layout, including fuel pits, and PC Air unit.
- C. Minimum Required Submittals for 75% Review:
 - 1. Complete Issue for Construction set of drawings and technical specifications

including:

- a. Cover sheet with sheet index.
 - b. Vicinity plan of Airport and surrounding area.
 - c. Concourse key plan.
 - d. Gate layout plan including centerlines of rotundas in DEN coordinate system and with dimensions.
 - e. Phasing / Safety plan including trenching required for fuel pit work.
 - f. Foundation drawings.
 - g. Electrical drawings.
 - h. All other letters and calculations required for Building Permit.
 - i. Graphics / signage details.
 - j. Paint finishes.
 - k. Preconditioned air and 400 Hz brackets and connection details for tie-in to existing monitoring system.
 - l. Technical Specifications.
- D. Minimum Required Submittals for Building Permit.
1. See Memorandum of Understanding, Article V attached as 147300 Appendix A at the end of this Section.
 2. Elevations:
 - a. Side elevation of new bridges including Holdroom section.
 - b. Front elevation of new bridges including Holdroom elevation beyond.
- E. Minimum Required Submittals for Materials:
1. Reference Technical Specification Section 013300 "Submittal Procedures".
- F. Minimum Required Submittals for End of Project Report.
1. See Memorandum of Understanding, Article VI attached as 147300 Appendix A at the end of this Section.
- G. Welding: Refer to Technical Specification Section 059990 "Welding" for required welding submittals for field welding only. All shop welding shall be of good commercial quality.
- H. Spare parts:
1. Recommended spare parts list with current prices shall be furnished not less than 45 days prior to arrival of a bridge.
- I. All items required by Airlines / Denver International Airport agreement.
- J. LEED Submittals: <Insert requirements>
- 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Preinstallation Examination Report: Indicating dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.
- C. Product Certificates: For each type of boarding bridge. .
- D. Field quality-control reports.
- E. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. As Built-Plans: Contractor shall submit As-Built Plans in AutoCAD (Release 2000 minimum) format, Adobe Acrobat 6.0 (bookmarked and free of security), in hard copy and on Compact Disk. Two (2) sets of full size drawings (34x44 or 24x36) and (1) Compact Disk containing all drawing files shall be submitted to the DEN Project Manager as part of each submittal. Other file formats will not be accepted.
- B. Operation and Maintenance Data: For boarding bridges to include in operation and maintenance manuals.
- C. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[location and time as determined by DEN Project Manager][Project site] <Insert location>**.
- B. If needed, insert list of conference participants not mentioned in Section 013100 "Project Management and Coordination."

1.7 STANDARDS

- A. The standards listed below represent the minimum required standards. All editions shall be the most current issue. Safety to passengers, other personnel, aircraft, and equipment is of prime importance. Nothing in these specifications shall relieve the Contractor of the responsibility for providing a safe product.
- B. Design:
 - 1. Codes, Regulations, and References: The bridge shall be designed to conform to the most current editions all applicable Federal, State of Colorado, and City and County of Denver codes and regulations, including applicable Memoranda of Understanding between the City and County of Denver Building Department and

DEN.

- American Welding Society (AWS) Standards (Technical Specification Section 059990 "Welding" applies to field welding should the need for any arise).

C. Safety:

- All equipment shall be designed to be fail-safe and all controls, which regulate bridge motions (i.e., horizontal travel, vertical travel, and cab rotation), shall be of the dead-man type. Dead-man type shall mean controls, which require the operator to apply constant pressure to be engaged. Once the pressure is released, the control is disengaged.
- All operating mechanisms, i.e. horizontal and vertical drive, cab rotation, etc., shall be designed so the drive mechanism is locked when power fails or is shut off.
- Positive stops shall be provided to prevent dangerous overtravel where any component might become disengaged from its guiding or restraining component. The positive stop shall be in addition to all limit switches provided to restrict overtravel under normal operating conditions, including bogie steering motions. Documents highlighting the actual stops are a shop drawing requirement.
- The operator's position in the control cab shall be designed to permit the operator to position the loading bridge with the cab weather door closed. Suitable enclosures, guard rails, etc. shall be provided to protect the operator from being pitched out the open end of the cab (when operated from an open door) in case of sudden stops or inadvertent movements of the bridge. A handhold shall be attached to the wall on both sides of the cab weather door.
- The passenger loading bridges shall comply with all applicable local building codes and regulations at point of installation, which are in effect at the time of manufacture.
- All sheared or sharp metal edges shall be deburred or broken. All exposed metal corners shall have radii.

D. Materials:

Component:	ASTM Grade or Equivalent (Min. Properties):
Structural Plate	ASTM-A35-70A
Structural Steel and Shapes	ASTM-A36-69
Steel Tube	ASTM-A36-69
Steel Pipe	ASTM-A53-B
Steel Sheet	ASTM-A570-72 F or ASTM-A569
T-1 Pins	ASTM-A5-4-64 F or ASTM-A517-64 F
Hinge Pins	AISC-C1018
Bolts – Standard	ASTM-A307
Bolts – High Strength	ASTM-A325 or SAE Grade 8

E. Maintenance:

- Components shall be installed with adequate access and type of fasteners to permit them to be changed by one man. Where the weight of a component requires mechanical assistance, the component or assembly shall be provided with lift eyes, forklift guides, etc. Particular attention shall be given to keeping components simple, rugged, and easily accessible for routine maintenance,

- lubrication, component exchange, and adjustment.
2. Access panels, where required to gain access to equipment or maintenance areas, shall be suitably sized to permit accomplishment of the tasks required including tools and equipment. The panel shall be permanently attached to the structure by hinges, etc., and any fasteners required shall be a permanent part of the panel, etc., to prevent loss.
 3. If special tools are required for routine maintenance, one (1) set shall be furnished by the Contractor for each year of the Project.
 4. Modular components: Provide for rapid corrective maintenance of malfunctioning elements through use of standardized modular components, which are readily available in the continental U.S. Allowance must be made for convenient access to components critical to the operation of the passenger loading bridge.

1.8 INSTALLATION REQUIREMENTS

- A. The Contractor shall provide qualified technical and service personnel during the installation of the loading bridges to assure a proper installation. These representatives shall also be available to DEN at no charge on delivery of the first bridge and shall be on call for a timely response within eight (8) hours for a period of sixty (60) days after each loading bridge is officially opened for airline operations. This is to ensure adequate and reliable field service support to correct any and all equipment failures that normally occur during the initial operating period.
- B. Reference Technical Specification Section 011400 "Work Sequence and Constraints" for other Installation Requirements.
- C. Communications:
 1. Verification of existing communications at each existing bridge. Contractor shall also coordinate re-connection of communications with current communications contractor, Qwest.
 2. Contractor shall also coordinate reconnection of existing Pre Conditioned Air monitoring system with DEN HVAC department. Removal and reinstallation of existing Pre Conditioned Air units shall be done in such a way so that only the unit being removed and reinstalled shall not be connected and recognized by the monitoring system. Prior to removal, DEN and Contractor shall inspect and document condition of existing equipment.

1.9 ACCEPTANCE PROCEDURES

- A. In addition to the requirements described in the General Conditions and elsewhere in the Technical Specifications, the following also applies:
 1. Final Acceptance Inspection:
 - a. Final acceptance shall be done on an individual gate basis.
 - b. After full compliance by the Contractor of all outstanding Punch List items as determined from the Conditional Acceptance Inspection, DEN shall

- perform the final inspection of the bridge.
- c. The Contractor shall make certain that each bridge is complete in all respects and operating properly, all deficiencies noted in the Conditional Acceptance Inspection are corrected, and all training accomplished prior to the requesting the DEN Project Manager to witness and make the Final Acceptance Inspection. Upon satisfactory completion of that inspection, a Certificate of Customer Acceptance will be issued. The warranty for each individual bridge shall begin upon its Final Acceptance.
 - d. DEN reserves the right to employ an independent testing laboratory to inspect the bridges to verify the Contractor's compliance with the specified structural, welding, mechanical, electrical, and fireproofing requirements. Deficiencies and / or violations reported by the DEN laboratory shall be immediately corrected by the Contractor at no cost to DEN. The cost of re-inspection by the DEN Laboratory shall be borne by the Contractor and DEN will deduct such reinspection costs from monies due to the Contractor.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 FINAL CONFIGURATION

- A. This specification describes an Over-the-Wing (OTW) Passenger Boarding Bridge (PBB). This OTW Bridge, in conjunction with a standard Radial or Apron Drive PBB, is designed to extend from the terminal hold room doorway to both front and rear aircraft boarding doors so that passengers can enplane and deplane via both aircraft doors completely protected from inclement weather, aircraft engine blast and blown dust. The provision of both bridges is known as a Dual OTW system. The provision of the Rear Bridge only to an existing Forward Bridge is known as an OTW Bridge.
- B. The OTW Dual Bridge shall include a standard Radial or Apron Drive PBB (hereafter known as the Forward Bridge) to service the front aircraft door (L1 door) and an Over-The-Wing (OTW) PBB (also known as the Rear Bridge) that extends over the wing of the aircraft to service the rear door (L2 door). The two bridges shall typically be connected to one terminal building door via a section of fixed walkway, the location of which is determined by aircraft to be serviced and airport site considerations. Alternatively, each bridge may connect directly to the terminal building, each having its own door.
- C. The OTW Bridge shall service aircraft ranging in size between the **[Edit for appropriate fleet mix]** and shall clear winglets on these aircraft when traveling over the wing from a parked position. The OTW Bridge shall incorporate a pivot point along the bridge tunnel to provide sufficient lift such that a Boeing 777 wing shall clear the

underside of the bridge. The Forward Bridge may be specified to accommodate a larger mix of aircraft as it can still be used without engaging the OTW Bridge.

- D. The OTW Bridge Systems (Dual and singular) shall provide a rapid, simple, convenient, safe, and controlled method for passenger boarding. All elements of the system shall provide barrier free access with tunnel slopes not exceeding 1:12 when in the operating position. The walkway and bridge slopes are dependent on several factors including terminal building elevation, rotunda base heights, the aircraft being serviced and the allowable distance to aircraft, all of which shall be identified during layout planning prior to construction.
- E. The OTW System shall consist of the following components:
1. Fixed Walkway (Note: 1 & 2 are the same thing).
 2. Forward Bridge (provided only with Dual OTW Bridge System).
 3. OTW Bridge rotunda.
 4. OTW Bridge pivoting tunnels.
 5. OTW Bridge cab and telescoping tunnel.
 6. OTW canopy closure system.
 7. OTW Bridge vertical drive system.
 8. OTW Bridge horizontal drive system.
 9. OTW Bridge suspension drive system.
 10. Bridge Control Consoles (In OTW cab and remote in Forward cab).
 11. Electrical distribution system.
- F. The OTW Bridge shall employ a separate microprocessor controller so that it can be operated independently from the Forward Bridge. A remote control panel shall be provided in the cab bubble of the Forward Bridge to operate the OTW Bridge.
- G. NOTE: All references to direction are with the observer positioned with his or her back to the Terminal end and facing the aircraft end of the PBB when referring to left or right. The forward or front bridge refers to the bridge servicing the aircraft L1 or front door. The rear or rearward bridge (OTW) refers to the bridge servicing the rearmost aircraft door.

2.2 DESIGN CRITERIA

- A. The OTW Bridge Systems shall be built in accordance with good engineering practice and in accordance with legislative and industry standards applicable to aircraft passenger boarding bridges. The OTW Bridge shall include redundant safety features and factors of safety normal in the industry. Particular attention shall be given to keeping components simple, rugged, and easily accessible for routine maintenance, including lubrication, component exchange, and ease of adjustment. All access panels and openings shall be sized to accommodate the component being changed or adjusted, as well as the equipment and personnel necessary to accomplish the work.

2.3 CODE COMPLIANCE

- A. The OTW Bridge shall conform to all applicable Federal, Provincial/State, ADA, and Municipal codes and regulations that apply to the installation site. The bridge design and construction shall comply with the latest edition of the following codes: See also Paragraph 1.7 of this Section.

1. NEC - National Electric Code.
2. AISC - American Institute of Steel Construction.
3. ASME - American Society of Mechanical Engineers.
4. NEMA - National Electrical Manufacturers Association.
5. OSHA - Occupational Safety and Health Administration.
6. SAE - Society of Automotive Engineers.
7. NFPA - National Fire Protection Association.
8. SSPC - Steel Structures Painting Council.

2.4 OPERATION AND MAINTENANCE MANUALS AND TRAINING

- A. Reference the DEN / Airlines Lease Agreement.

2.5 DELIVERY AND STORAGE

- A. The transportation and installation of the OTW Bridge shall be included as part of the contract with DEN. The Dewbridge is shipped as soon as it is fabricated and installation begins immediately upon arrival at the job site. If necessary, special arrangements can be made with DEN for storage at site or at Dewbridge's facilities prior to the installation.

2.6 ACCEPTANCE CONDITIONS AND RESPONSIBILITY

- A. The PBB Contractor shall assume maintenance and repair responsibility for the OTW Bridge until such time as the Certificate of Customer Acceptance has been signed, and all training has been accomplished.
- B. DEN shall not operate the OTW Bridge until DEN has conditionally accepted it. DEN's Project Manager shall conduct a Conditional Acceptance Inspection for the purpose of certifying the OTW Bridge to be safe for training purposes. As part of the inspection, the DEN Project Manager shall issue a punch list to record the status of items checked and to record any remaining items, if applicable, to be corrected by the PBB Contractor. Upon completion of the inspection, DEN shall be granted use of the OTW Bridge under the supervision of the PBB Contractor for training purposes.
- C. The PBB Contractor shall ensure that the OTW Bridge is complete in all respects and operating properly, that all deficiencies noted in the Conditional Acceptance Inspection are corrected, and that all training is accomplished prior to requesting DEN's Project Manager to witness and perform the Final Acceptance Inspection. Upon satisfactory completion of this inspection, a Certificate of Customer Final Acceptance will be issued.

2.7 WARRANTY

- A. The OTW Bridge shall be warranted against defects in material and workmanship for twenty-four (24) months from the date of Final Acceptance by DEN in accordance with the PBB Contractor's standard product warranty. Warranty work shall be provided at no cost to DEN and shall include all labor and materials necessary to replace/repair defective material and workmanship during the period of the warranty. See Technical Specifications Sections Section 017835 "Warranties and Bonds" for requirements.

2.8 STRUCTURAL DESIGN

A. General Design

1. Structural Loads: The OTW Bridge shall support the following loads. The bridge shall accommodate the combination that imposes the most adverse loading condition. In addition to the dead loads and strain caused by movement, the entire passenger boarding bridge shall support:
 - a. A live load of 40 pounds per square foot. (195 kg/m²).
 - b. An operational wind load of 12.5 pounds per square foot (61 kg/m²) or an approximate wind velocity of 60.0 mph (97 km/h).
 - c. A retracted and stowed wind load of 25 pounds per square foot (122 kg/m²) or an approximate wind velocity of 90.0 mph (145 km/h).
 - d. A roof load (snow load) of 25 pounds per square foot. (122 kg/ m²).
2. The structure shall be sufficiently rigid to avoid excessive sway when the OTW Bridge is brought to a gradual stop.
3. All mechanisms for actuating, guiding, and restraining the OTW Bridge and its components shall be designed so that no excessive noise, sway, or sense of insecurity is apparent to passengers. No operating vibrations or loads shall be transmitted to the terminal building.
4. The Forward Bridge (if provided) shall be capable of accommodating the added loads of 400 Hz point of use ground power equipment, 28 Volt DC equipment, Gate Signage, Pre-Conditioned Air (PCA) equipment and potable water system. The purchase contract shall specify the location of this equipment when ordered with the OTW Bridge.

B. Environmental Considerations

1. The OTW Bridge shall operate satisfactorily under ambient temperatures from -40 deg F (-40 deg C) to 125 deg F (52 deg C). All of the OTW Bridge components and materials shall either individually or collectively be designed or selected for long service life under such conditions.
2. The OTW Bridge assembly shall provide a clean, structurally sound, comfortable, and functional transition between the aircraft and the terminal building.
3. The entire OTW Bridge shall be weatherproof and any equipment or controls that are exposed to the weather shall be weatherproof type or housed in weatherproof boxes. The PBB Contractor shall follow standard industrial practice regarding NEMA Enclosures for electrical equipment.

C. Interior Dimensions:

1. The OTW Bridge shall have the following minimum interior clear dimensions:
 - a. Tunnel width – 77 inches (1956 mm).
 - b. Tunnel width with handrails – 70 inches (1778 mm).
 - c. Tunnel height – 92 inches (2337 mm) from finished floor level.
 - d. Telescopic tunnel width – 62 inches (1574 mm).
 - e. Telescopic tunnel width with handrails – 55 inches (1397 mm).
 - f. Telescopic tunnel height – 79.5 inches (2019 mm) from finished floor level.

- D. Support: The OTW Bridge fixed walkway shall be supported from beneath at the terminal building end by a column to support the inboard end and additional support columns located along the walkway to support the walkway. The Forward Bridge and OTW Rear Bridge shall each be supported at one end by dual structural columns affixed to each of the drive wheel gantry systems and at the rotunda end by a structural support column located underneath the rotunda assemblies. Each of the fixed walkway, Forward Bridge and OTW Bridge shall be supported independently from one another. All fixed structural support columns shall rest on foundations supplied by others.

E. Building Connection

1. The OTW Bridge System shall be designated as equipment and as such shall receive no structural support from the air terminal building to which it is attached.
2. An aluminum diamond checker plate threshold shall be installed over the gap between the terminal building and the adjacent bridge interface. Interior metal and exterior flexible flashings shall provide a waterproof connection between the bridge and the terminal building.
3. At the terminal building, the bridge interface shall fit a door up to 48 inches (1219 mm) wide by 84 inches (2134 mm) high.

2.9 FOUNDATION SYSTEM

- A. Foundation Design: DEN shall provide an excavated and concrete filled foundation. The PBB Contractor shall provide DEN with all pertinent loads and design information to allow the Airport's Structural Engineer to design the foundations and structural attachments. This shall include the locations and orientations of all pedestals and columns.
- B. Bridge Operating Surface: DEN shall provide a concrete apron surface capable of supporting wheel loads up to 27,200 Lbs, with a maximum contact pressure of 530 PSI.

2.10 OTW BRIDGE SYSTEM MAIN COMPONENTS

- A. Rotunda:

1. The rotunda assembly for the OTW Bridge shall comprise a rotunda and support pedestal. The rotunda assembly shall abut the end of the fixed walkway at one end and be pivotally connected to the rear over-the-wing bridge tunnel at the opposite end and shall not transmit any live or dead loads or vibration to the fixed walkway.
2. The rotunda assembly shall be fixed to the pedestal and shall include pivot points for vertical and horizontal motion of the bridge. The bridge shall rotate about the rotunda. Slat type curtains and flexible panels attached to the rotunda shall be provided in order to maintain the seal as the bridge is rotated, raised, or lowered.
3. Over-travel and operational swing limits shall be located in the rotunda assembly. The operational limits shall be adjustable to meet local operating conditions and requirements.
4. A rotational encoder shall be installed in the Rotunda, for measuring the horizontal axis of rotation. The rotational encoder shall provide position data to the bridge control system. The encoder shall be of the absolute encoder type.
5. The rotunda floor shall remain stationary and level at all times to provide a smooth transition between the horizontal surface at the fixed walkway connection and the bridge tunnel. Flap type seals shall provide weather protection between the rotunda and the hinged rotating tunnel section. These seals shall be sufficient to prevent the accumulation of wind blown snow or rain in the interior of the bridge.
6. A support pedestal shall provide structural support for the rotunda. The pedestal shall mount to the foundation (provided by others). The PBB Contractor shall determine the length of the pedestal based on site information provided by DEN.

2.11 TUNNELS

- A. The pivoting tunnels, A (closest to rotunda) and B (pivotally attached to A) shall be rectangular in cross section. The tunnels shall be provided between the rotunda assembly and the over-the-wing telescoping bridge cab assembly. The A tunnel shall pivot in the vertical direction at the connection to the rotunda. The B Tunnel shall pivot in the vertical direction at the connection to the A Tunnel. The pivot point between the A and B Tunnels shall be located approximately above the leading edge of the aircraft wing when the bridge is connected to the aircraft. The tunnels shall not exceed a slope of 1:12 (8.33%) when the bridge is servicing the specified aircraft.
- B. The exterior walls of the tunnels shall be corrugated 14 gauge steel sheet. The roof shall be continuously welded flat 14 gauge steel sheet.
- C. Stainless steel handrails shall be provided on both sides of the A- tunnel and extend as far into the B tunnel as is possible without interference with the telescopic C tunnel.
- D. Roof drainage and seals shall be provided between tunnels B and C. The roof drains and seals shall be designed and constructed to prevent leakage of water run off into the interior of the bridge.
- E. A weather protective accordion type bellows shall be installed around the ends of the A and B Tunnels at the pivoting connection point. The bellows shall employ an outer material that shall not absorb water, be highly tear resistant, weather resistant, and

remain elastic and flexible in extreme hot or cold temperatures. The material and any supporting framework shall be designed with adequate strength to accept the load of water, snow, or debris that may accumulate in the folds of the bellows when the bridge is not in use. A flame retardant material compliant with NFPA 415 shall be assembled on the inside of the bellows.

- F. The bellows shall be split at the bottom (underside of tunnel connection) to permit installation or removal of the bellows without separating the A and B tunnels at the pivot point.
- G. Minimum interior clear dimensions shall be as follows:
 - 1. Tunnel width: **77 inches** (1956 mm).
 - 2. Tunnel width with handrails: **70 inches** (1778 mm).
 - 3. Tunnel height: **92 inches** (2337 mm) from finished floor level.
 - 4. Minimum inter-tunnel ramp width: **55 inches** (1397 mm).
- H. The tunnel materials and construction method shall ensure compliance with NFPA-415 specifications pertaining to emergency egress of passengers.

2.12 CAB AND TELESCOPING TUNNEL ASSEMBLY

- A. The cab and telescoping tunnel assembly shall include a telescoping tunnel or C Tunnel and adjustable cab. The cab shall be attached to the telescoping tunnel. The telescoping tunnel shall be mounted inside the B Tunnel on a roller system to provide telescopic movement. The telescopic action shall be provided by an electromechanical system.
- B. The face of the cab that interfaces with an aircraft shall have a minimum inside width of **128 inches** (3251 mm) and a minimum inside height of **102 inches** (2591 mm).
- C. A transition ramp shall accommodate the difference in elevation between the telescoping section (C Tunnel) and the B Tunnel. The transition ramp shall slope with respect to the tunnel centerline. The transition ramp shall provide a shallow slope in the transition area. Handrails shall be provided on both sides of the tunnel in the ramp area. The transition ramp shall be carpeted with a smooth yellow plastic edging.
- D. The telescoping tunnel shall be equipped with a dogleg style exterior electrical cable conveyance system mounted at the left hand side. The system shall be accessible to maintenance personnel for inspection of the cable bundle or addition of cable.
- E. The exterior walls of the telescoping tunnel shall be corrugated 14 gauge steel sheet covered by 22 gauge interlocking steel panels to provide a smooth surface. The roof shall be continuously welded flat 14 gauge steel sheet.
- F. Stainless steel handrails shall be provided on both sides of the telescoping tunnel section.
- G. A rectangular view port shall be located at the rearmost end of the telescoping tunnel on the right hand side. The view port shall provide the bridge operator a view of the

aircraft wing when operating the bridge in manual mode. The viewing area shall comprise of a wired safety glass panel with minimum dimensions of **29.38 inches** (746 mm) wide by **33 inches** (838 mm) high.

- H. Three view ports shall be provided in the cab area. Two view ports, each **29.38 inches high** (746 mm) by **33 inches wide** (838 mm) shall be located in the cab exterior walls, one on the rear wall and one on the right-hand sidewall. One view port **29.38 inches wide** (746 mm) by **33 inches high** (838 mm) shall be located in the front wall next to the weather door. The location of these view ports shall permit the operator an unobstructed view of the rear aircraft door contact area and aircraft rear stabilizer during manual docking operation when the bridge is being operated using the secondary control console. The view ports shall provide an unobstructed view of the auto-leveler without opening the weather door.
- I. Corrugated, black, ribbed-rubber, **¼ inch** (6 mm) thick, shall be installed on the floor of the cab. Aluminum carpet trim shall be provided on all edges of the flooring.
- J. A full width spacer (bumper) shall be installed along the front edge of the cab floor where the cab mates to an aircraft. The spacer material shall comply with NFPA-415 requirements. The spacer shall be of a material that remains flexible regardless of temperature and non-abrasive to prevent scratching or other damage to an aircraft fuselage.
- K. The cab shall be mounted at an adjustable angle to the telescoping tunnel. The cab rotational action shall be controlled by an electromechanical system (actuator type) that shall permit 6 degrees left or 6 degrees right from the neutral position. The cab exterior color shall be the same as the bridge pivoting tunnels.
- L. A weather door on the front of the cab shall seal and secure the interior when the bridge is not in use. The weather door shall be on the right side and shall be motorized. The door shall be a roll-up type, constructed in aluminum and minimum **42 inch** (1067 mm) wide by **81.5 inch** (2070 mm) high. The roll-up door shall be self locking with a manual release on the interior to permit manual operation of the door.
- M. An automatic door opener/closer shall be installed to operate the cab weather door. The weather door shall open upon confirmation from the bridge control system that the bridge is docked to the aircraft. The roll-up door shall close automatically upon a signal to un-dock the bridge from the aircraft.
- N. At the outermost end of the bridge, the leading edge of the cab floor shall be fixed at a generally level angle when the bridge is connected to the aircraft such that the floor nearest the aircraft is generally parallel with the floor of the aircraft. The floor shall slope slightly upwards toward the aircraft fuselage in order to permit unobstructed opening of a vertically hinged aircraft door. The transition floor shall provide a smooth platform sloped approximately in the direction of passenger flow. There shall be no raised surfaces, which may introduce a tripping hazard to passengers.

2.13 CANOPY ASSEMBLY

- A. The outermost end of the cab shall be equipped with an accordion type bellows aircraft closure (canopy). The closure shall be designed to provide a weather-tight seal against the specified aircraft contours. When fitted against the aircraft fuselage, the canopy shall enclose both the open aircraft door and doorway. In automated docking mode, the canopy shall be automatically positioned when the bridge is docked to the aircraft.
- B. The aircraft contact point of closure shall be made of gray colored soft material to prevent scratching or damage to the aircraft skin. The closure material shall be non-abrasive, highly tear resistant, and weather resistant, remain elastic and flexible in extreme hot or cold temperatures and shall not absorb water. The closure shall include segmented components for ease of removal or replacement.
- C. A flame retardant material compliant with NFPA 415 shall be assembled between the two exterior surfaces of the canopy. The closure, when in its retracted position shall be protected by a hood to prevent water and debris from laying in the folds of the closure material when the bridge is not in use.
- D. The canopy system shall be operated by two winches, one at each side. The winches shall unwind the closure bellows such that the canopy will rest against the aircraft fuselage. The gas cylinder assist canopy shall result in the canopy applying minimal pressure onto the aircraft skin.
- E. Canopy limit switches shall control canopy extension and retraction.

2.14 VERTICAL DRIVE SYSTEM

- A. The vertical drive system shall be electro-mechanical. The lifting mechanism shall consist of two (2) recirculating ball bearing screw assemblies. Ball screws shall be sized for the applicable loads. Each assembly shall be independent of the other, with individual motors and brakes and the two lift columns shall be interconnected with a drive shaft to prevent differential motion. The vertical drive system motors shall be AC and powered through an inverter system.
- B. Each assembly shall be capable of supporting the bridge under full design load. The vertical drive motors shall be equipped with spring applied brakes which release only when power is applied and vertical motion, up or down, is signaled from the control system.
- C. The ball nut of this assembly shall be equipped with wiper brushes to remove grit and dirt from screw threads. The ball nut shall incorporate a redundant load path to prevent the bridge from collapsing in the event of a failure of the ball nut.
- D. Each vertical lift column shall be equipped with an oiling system to provide lubrication of the ball-screw assembly during regular schedule maintenance.
- E. Limit switches shall be installed to prevent over travel of the vertical lift columns in both directions.

2.15 SUSPENSION DRIVE SYSTEM

- A. The suspension drive system shall be electro-mechanical. The system shall incorporate two (2) recirculating ball bearing screw assemblies mounted horizontally and connected in a manner to lift tunnel B in relation to tunnel A. Ball screws shall be sized for the applicable loads. Each assembly shall be independent of the other, with individual motors and brakes and the two ball screw assemblies shall be interconnected with a drive shaft to prevent differential motion. The suspension drive system motors shall be AC and powered through an inverter system.
- B. Each assembly shall be capable of supporting the bridge under full design load. The suspension drive motors shall be equipped with spring applied brakes which release only when power is applied and horizontal motion is signaled from the control system or the auto-leveler/shoe sensor system.
- C. The ball nut of this assembly shall be equipped with wiper brushes to remove grit and dirt from screw threads. The ball nut shall incorporate a redundant load path to prevent the bridge from collapsing in the event of a failure of the ball nut.
- D. Each ball screw assembly shall be equipped with an oiling system to provide lubrication during regular schedule maintenance.
- E. An accordion type bellows shall be installed on each ball screw assembly and enclose the area of telescopic extension/ retraction to provide protection from weather. The closure material shall not absorb water, be highly tear resistant, weather resistant and remain elastic and flexible in extreme hot or cold temperatures.
- F. Limit switches shall be installed to prevent over travel of the suspension lift columns in both directions. Two (2) external steel cables designed to support the load of the Tunnel B & C assemblies are provided as a positive mechanical stop in the unlikely event of on over travel of the suspension system.

2.16 MECHANICAL HARD-STOP SYSTEM

- A. The mechanical hard stop system shall provide a positive mechanical stop to prevent the tunnels from contacting a wing in the event of a lift system failure. Upon initial bridge movement the mechanical hard stop shall automatically position itself to provide a vertical clearance between the underside of the bridge tunnel and the top surface of the aircraft wing. The actuation system shall be electro-mechanical. The system shall incorporate acme self-locking thread assemblies. Each assembly shall incorporate individual AC motors and shall be interconnected through a horizontal drive shaft to prevent differential motion.
- B. Limit switches shall be installed to prevent over travel of the hard-stop lift system.
- C. Each acme screw assembly shall be equipped with a grease system to provide lubrication during regular schedule maintenance.
- D. The mechanical hard stop shall act as a maintenance stand while servicing the vertical lift system.

2.17 HORIZONTAL DRIVE SYSTEM

- A. The horizontal drive system shall be variable speed electro-mechanical. A four-wheeled gantry system shall provide horizontal drive of the bridge between parked position and the aircraft. The bridge shall travel in a radial arc pivoted about the rotunda. A link arm shall extend from the rotunda pivot point to the gantry frame at the center of wheel track such that tire scrub shall be minimized.
- B. The horizontal drive shall be powered by AC electric gear motors with integral brakes. Solid-state variable frequency motor controllers (inverters) shall drive the AC motors allowing the bridge to operate at variable speeds with smooth, controlled starts and stops. Removable covers shall be installed over the gear motor assemblies to provide environmental protection for the mechanisms.
- C. A dynamic braking system shall allow the bridge to come to a smooth controlled stop. Integral spring actuated brakes shall be located on the drive wheel motors and lock the bridge in place when electrical power is cut off. The horizontal drive motors shall be equipped with manual brake releases. These mechanisms shall allow the bridge to be towed in the event of a power failure. Towing lugs designed for the appropriate loads encountered during towing shall be located on either end of the gantry frame.
- D. Drive wheels and tires shall be rated for design loads. Tires shall be high wearing solid industrial type with a winter type tread pattern. OTW's shall not use treadless tires.

2.18 BRIDGE EMERGENCY LIFT MECHANISM

- A. An emergency lift mechanism, located on the horizontal drive system, shall be provided to lift the Over-The-Wing Bridge in the event of a power failure or malfunction in the vertical or suspension drive system. The lift mechanism shall be designed for the load encountered when lifting the entire bridge and shall provide sufficient lift travel to raise the cab end of the bridge a sufficient height to clear the wing to allow push back of an aircraft. The lift mechanism shall be separate from the vertical drive system.
- B. The emergency lift system shall consist of two (2) electric motors operated on a 20 amp, 120 VAC circuit. In the event of an electrical power interruption, an owner-supplied generator shall provide power to operate the emergency lift system.

2.19 TELESCOPING TUNNEL DRIVE SYSTEM

- A. The telescoping tunnel shall be driven by an electromechanical system mounted on the B tunnel structure. The drive system shall provide telescoping movement of the telescopic C Tunnel.
- B. An AC electric gear motor, complete with integral brake, shall power the telescoping tunnel drive. A solid-state variable frequency motor controller (inverter) shall drive the AC motor and shall provide smooth, controlled starts and stops.
- C. Integral spring actuated brakes shall be located on the telescopic tunnel drive motor and lock the tunnel in place when electrical power is cut off..

- D. A mechanical hard-stop device shall be installed at each end of the C Tunnel and shall prevent the telescopic unit from becoming separated from the bridge tunnel in the event of a failure of the telescopic drive system.

2.20 CONTROL CONSOLE

- A. Two control consoles shall be supplied with the rear bridge, a primary and secondary control console. The primary control console shall comprise a self-contained operator's control panel and shall be installed in the vicinity of the forward bridge control console. The primary control console shall be separate from the forward bridge control console and shall be installed on a movable pendant such that the operator's view of an approaching aircraft is not reduced. The secondary control console shall be located in the Over-The-Wing Bridge cab and shall consist of a movable pendant station mounted on the rear wall of the cab. Both control consoles shall be protected from the outside environment and from passenger interference. The control consoles shall include all controls, service utilities, and control interlocks required to accomplish bridge operation.
- B. Both the primary and secondary control consoles shall include all controls necessary for the operation and control of the rear bridge. All controls shall be labeled as to their function in a unilingual written format or in universal symbol format to meet customer specifications. The control circuits shall be designed and programmed so that it is impossible to select opposite motions simultaneously, e.g. extend and retract or raise and lower.
- C. The primary control console shall contain a Human Machine Interface (HMI) consisting of a 12 inch (305 mm) measured diagonally) graphical display to provide the operator with control interfaces and messages. The HMI display shall be LCD TFT type and incorporate a touch screen surface. The primary control console shall contain a 13-inch (330 mm) (measured diagonally) LCD STN view screen to display images from the CCTV camera located in the rear bridge cab. The camera shall be equipped with an auto focus lens system. PBB operational functions are to be microprocessor controlled. The programming language shall be English and all documentation for programming and troubleshooting shall be in English.
- D. The primary control console shall be interconnected to the forward bridge control console to provide the following functionality:
 - 1. The emergency stop button in the forward bridge control console shall be interconnected with the controls of the rear bridge such that the operator can stop movement of both the forward and rear bridge by pressing a single E-Stop button.
 - 2. The audible bell(s) located in the forward bridge shall be interconnected with the auto level fault system such that an auto level fault in the rear bridge shall cause the bell(s) in the forward bridge to sound.
- E. The HMI in the primary control console shall include as a minimum the following operator functions:

1. User authentication (password) screen.
 2. Aircraft type and model selection.
 3. Aircraft type and model selection confirmation.
 4. Begin automated bridge docking.
 5. Automated docking progress.
 6. Bridge docked screen/ Initiate automated bridge disengagement.
 7. Automated un-docking progress.
- F. The secondary control console shall contain an emergency stop button and HMI screen. The HMI screen shall be the same type and size as the HMI screen in the primary control console. The HMI in the secondary control console shall be in communication with the HMI screen in the primary control console.
- G. The HMI in the secondary control console shall include as a minimum the following operator controls:
1. Password or authentication method to control access to bridge operation or maintenance by only authorized personnel.
 2. Button to select maintenance mode.
- H. Both the primary and secondary control console shall include an auxiliary controls screen located on the HMI with the following operator controls:
1. Button to operate the cab floodlights.
 2. Button to sound the travel bell.
 3. Button to operate the ventilation fan (when so equipped).
 4. Button to operate the cab floor deicer (when so equipped).
 5. Button to switch on the cab exterior fluorescent lamp.
- I. Both the primary and secondary control consoles shall include information, warning, and maintenance screens located on the HMI. Additional password authentication shall be required to access screens available to maintenance personnel only. The screens shall display as a minimum the following messages and warnings to the operator/maintenance personnel:
1. Bridge parked indicator.
 2. Bridge docked indicator.
 3. Bridge in misparked indicator
 4. Auto level malfunction indicator. The screen shall display red to indicate a malfunction and an audible bell shall sound.
 5. Bridge Swing Limit error message shall indicate that the bridge has been rotated in manual mode beyond its set points causing the limit switches in the rotunda to be tripped, shutting down all bridge functions. The bridge must be operated in the opposite direction to enable the Operator to reset the shutdown function and reverse the direction of bridge movement that caused the shutdown.
 6. Cab floor deicer on indicator.
 7. Error message notification.
 8. Diagnostics (accessible by maintenance personnel only).
 9. Sensor status (accessible by maintenance personnel only).
 10. Calibration screens (accessible by maintenance personnel only).

2.21 POWER AND WIRING REQUIREMENTS

- A. The main power circuit shall be 480 volt, 3 phase, 4 wire, 60 Hz. The standard bridge requires 200A at 480V.
- B. DEN shall provide a fused disconnect with the required power at the terminal gate exterior wall. This disconnect should be sized for the bridge with all additional options required. If ancillary equipment is provided, separate disconnects should be provided for each.
- C. The main electrical panel for each bridge shall be accessible from the interior of the bridge.
- D. All standard lighting and duplex receptacles shall operate on 120 volt, single phase, 60 Hz power. The transformer and separate circuit breaker for lighting and control power shall be mounted in the main electrical panel.
- E. All electrical components, which are exposed to the weather, shall be of a weatherproof type or housed in weather-tight NEMA rated enclosures. The bridge main electrical panels and control consoles shall be equipped with heaters to control condensation.
- F. All electrical components utilized shall be recognized by the Underwriter's Laboratories (UL) in all cases where UL maintains a listing category for the devices installed.
- G. Wiring and installation shall be in accordance with National Electric Code (NEC) and applicable local electric codes. All wiring conductors shall be color coded or identified. Circuits of different voltages, emergency power, and telephone lines shall be separated.

2.22 DUPLEX RECEPTACLES

- A. Interior: Three (3) unswitched 120 volt, 1 phase, 60 Hz, 20 amp, three-conductor duplex receptacles shall be provided in the over-the-wing bridge. One receptacle shall be located in the cab section, one near the pivot point of the A and B tunnels and the last shall be at rotunda end of the A tunnel. An additional receptacle can be provided as an option in the fixed walkway.
- B. Exterior: Two (2) weatherproof, GFI protected, 120 volt, U ground, 20 amp, three-conductor duplex receptacles shall be provided. One shall be located on the gantry system and the other receptacle shall be mounted in the maintenance platform area on the roof.

2.23 TELEPHONE CIRCUIT

- A. A flush mounted J-Box containing 2 Cat 5 Ethernet cables shall be installed in the bridge cab near the control console to provide communications between the bridges control systems and the terminal building.

2.24 INTERIOR AND EXTERIOR LIGHTING

- A. Commercial double tube, flush-recessed, T-8 fluorescent lighting fixtures with prismatic lenses mounted perpendicular to the long dimension shall be installed in the ceilings of the fixed walkway and forward and rear over-the-wing bridge tunnels, spaced at 8'-0 inch centers and in the ceilings above the cab areas inside the weather doors. The double tube fixtures shall provide a minimum light intensity of 30-foot candles at the finished floor level with the cab weather doors closed. The lights shall be controlled by two 3-way switches. One switch shall be located at the rotunda assembly and one switch shall be located in cab.
- B. Two pairs of adjustable flood lamps shall be mounted on the exterior of the bridge. One pair shall be mounted under the cab area and the other pair just rear of the pivot point on the A tunnel to illuminate the ramp near the gantry wheels.
- C. One sealed exterior type two-tube fluorescent lighting fixtures shall be installed in the cab areas forward of the cab weather doors. The light switch shall be located on the HMI touch screens.
- D. Emergency lighting shall be provided in the bridge and fixed walkway. These shall be battery pack type with two spotlights per unit.

2.25 VISUAL AND AUDIBLE INDICATORS

- A. Two (2) amber rotating beacon lights are provided one mounted underneath the cab and the second near the gantry system, both shall be in a visually prominent location. The beacon lights shall be illuminated whenever power to the bridge is on to warn ramp personnel that movement of the bridge may occur.
- B. Two (2) audible hazard bells are provided one mounted underneath the cab and the second near the gantry system each shall sound to provide a warning that the bridge is moving. Each bell shall provide a sound level of 98 db at 10 feet (3048 mm).
- C. A visual indicator shall be located in the cab, forward of the weather door to provide a visual indication to the flight attendant inside an aircraft that the over-the-wing bridge is safely docked to the aircraft. This shall notify the Flight Attendant that the aircraft door can be safely opened. The indicator shall employ a green light to indicate when the bridge is properly docked to the aircraft and a red light to indicate that the bridge is not docked.
- D. A remote audible alarm shall be provided at the end of the fixed walkway nearest the terminal building. In the event of a power failure, an alarm shall sound to indicate that all bridge operational functions have become inoperable including the auto-level function for both the forward and rear over-the-wing bridges. Power for the alarm bell shall be drawn from the battery pack also providing power to the emergency lights inside the bridges.
- E. Four (4) E-stop buttons are provided for safety. Two are located on the gantry system on either end, one is located in the forward control console and another is located in

the rear control console.

- F. Rotating beacons are provided to warn the ground crew if the OTW bridge is not in it's fully parked position.

2.26 LIMIT SWITCHES

- A. Three (3) swing limit switches shall be located in the rotunda, two for each operational rotational direction limit and the third as a critical to prevent over rotation of the OTW Bridge. When the operational limit switches as triggered the direction of rotation shall be stopped and the bridge shall only rotate in the opposite direction. If the critical limit switch is triggered, a critical failure shall occur and all bridge motions shall cease to be operative and an indicator light shall illuminate in the respective control console of the bridge exhibiting the malfunction.
- B. Limit switches shall be provided to prevent travel beyond the maximum and minimum set point of travel of the vertical, suspension, adjustable hard stop and telescoping drive system. The location of the limit switches shall be factory set to meet local site conditions.
- C. Two safety limit switches shall stop the bridge horizontal movement should an obstacle be detected in the path of travel. One switch shall be mounted on the forward bumper and one switch shall be mounted on the rear bumper when viewed in the direction of wheel travel. The bumpers shall be designed to permit 6 inches of travel before striking the structure of the wheel gantry. Drive power to the gantry shall be cut off and the brakes shall be applied in a similar fashion to an E-stop.
- D. A limit switch is provided under the A tunnel to prevent unnecessary contact of the Mechanical Hard Stop system. When triggered all bridge functions are stopped and a warning is displayed on both HMI screens.
- E. Two (2) whisker type limit switches are provided underneath the cab area to prevent contact with the horizontal rear stabilizer of the aircraft. When triggered all bridge functions are stopped and a warning is displayed on both HMI screens.
- F. Four (4) whisker type limit switches are provided on the leading edge of the cab bumper with two on each end. When triggered all bridge functions are stopped however they are used in the final check that the OTW bridge has safely docked to the aircraft and therefore do not display any warnings.

2.27 SENSORS

- A. The bridge is equipped with three (3) encoder type sensors that provide information to the control system regarding the position of the Rotunda angle, Vertical height and the Suspension angle.
- B. A sensor shall provide information to the control system regarding the position of the telescoping tunnel section.

- C. Sensor(s) located in the outermost cab area shall determine the horizontal distance between the bridge and the aircraft. The sensor(s) shall provide data to the bridge control system to ensure that a safe distance is maintained between the bridge and the aircraft fuselage.
- D. Sensor(s) shall be provided to detect the leading edge of the selected aircraft to determine if the aircraft is in the correct parking position. When the sensor(s) are triggered all bridge movement will be prevented and a visible warning will be displayed on the forward HMI screen.
- E. Sensor(s) shall be provided under the cab area to prevent contact with the horizontal rear stabilizer of the aircraft. When the sensor(s) are triggered all bridge movement will be prevented and a visible warning will be displayed on the forward HMI screen.
- F. A bumper type sensor shall be provided on the outermost edge of the exterior cab wall to prevent the bridge from contacting the leading edge of the aircrafts horizontal rear stabilizer.
- G. A sensor(s) shall be provided at the underside of the B Tunnel to detect the clearance of the underside of the B Tunnel and the top surface of the aircraft wing. The sensor(s) shall provide data to the bridge control system to ensure that a save clearance is maintained between the bridge and the aircraft wing.
- H. When aircraft employing winglets are specified in the Aircraft Mix, a sensor(s) shall be located at both the right and left sides of the B Tunnel to provide data to the bridge control system to ensure that the bridge will not strike the winglet during horizontal travel.
- I. The bridge is equipped with sensor(s) that provide information to the control system allowing for automatically determining the height of the aircraft door.
- J. A safety shoe sensor shall be installed to serve as a back-up system to the auto level system. The safety shoe shall detect interference between the lower edge of the aircraft door and the cab floor and automatically lower the bridge to prevent the aircraft door from touching the cab floor. In the event that the safety shoe sensor is activated, the travel bell shall sound during the time that the bridge is moving vertically downwards. An alarm shall also sound in the HMI Panel in the forward bridge. A timer shall control the maximum amount of time that the bridge shall descend when triggered by the safety shoe sensor. After two activations of the shoe sensor, the bridge shall be shut down and an alarm buzzer shall sound continuously until the safety shoe sensor is reset by the operator. The alarm shall provide the same warning as an auto-level malfunction and the HMI Panel in the forward bridge cab shall display visible warning.

2.28 AUTO LEVELING SYSTEM

- A. The OTW Bridge shall be equipped with a wheel-type-auto-leveling sensor located in the cab to allow the floor of the cab to automatically follow small changes in the aircraft floor sill elevation as the aircraft loading varies. The auto level system shall be

engaged when the automated docking cycle is completed. The auto-level systems shall function for all designated aircraft, regardless of door location and fuselage contour. In this mode, the automatic leveling system shall regulate vertical travel.

- B. The auto-level system shall incorporate independent systems to monitor vertical movement in relation to time. In the event that over a pre-set period of time, the auto-level system causes vertical movement of either bridge beyond a pre-set displacement, the auto-level system shall shut down and prevent further vertical travel of the bridge exhibiting this condition. An audible alarm shall sound from a six-inch bell mounted beneath the bridge cab. The auto-level systems shall be able to be reset.

2.29 INTERLOCKS

- A. An interlock shall be installed on the OTW Bridge cab weather door to prevent movement of the bridge in the event the door is not closed.
- B. An interlock shall be provided to prevent auto movement of the bridge in the event the bridge is not in its preset parked position.
- C. The canopy is interlocked to prevent movement of the bridge unless the canopy is in the full retracted position.

2.30 EXTERIOR FINISH

- A. The OTW Bridge telescopic tunnel shall provide a smooth, flat-sided appearance. The exterior sides of the walls and roof shall be covered with 22 gauge interlocking steel panels with a baked enamel finish. The color shall be specified by DEN based on standard colors offered by the PBB Contractor. Other colors can be specified as a priced option.
- B. All exposed metal surfaces are dry abrasive blast cleaned in accordance with SSPC-SP6 (Commercial Blast Cleaning) prior to painting to remove all mill scale, rust, and dirt. Acceptable product is Sherwin Williams Polane paint system (or approved equal) consisting of a prime coat of lead and chromium free epoxy primer followed by a two-component polyurethane topcoat. Total dry film thickness is a minimum of four (4) mils when dry. This paint system is for all exposed parts excluding the interlocking panels that are pre-painted. Parts that are not exposed to passengers only have the prime coat applied. Exterior paint color is matched to the pre-painted interlocking steel panels.
- C. Anodized aluminum, galvanized or stainless steel trim items and cab curtains shall be supplied in their original unpainted bright finish. Machined surfaces shall not be painted unless they are exposed after assembly. Parts that are not exposed shall be prime coated only.

2.31 INTERIOR FINISH

- A. The bridge sub-floor shall be $\frac{3}{4}$ inches (19 mm) thick plywood. Adjoining plywood

sheets shall be supported and suitably fastened to common structural members to provide smooth, even joints. A painted galvanized steel skin shall be installed beneath the plywood.

- B. Floor covering, such as carpeting or carpet tiles shall be installed when specified by DEN.
- C. The wall treatment shall consist of floor to ceiling 7/16 inch fire-rated laminated particleboard. The plastic laminate (NEMA LD-3, Grade FR32, comply with UL 723) shall be adhered to an NFPA 415 approved backing-board (complying with UL 723). Colors to be selected by DEN. Wall panels shall be approximately 4 feet (1219 mm) on center and attached by clear anodized aluminum trim. The wall system shall be designed such that each panel can be removed individually for maintenance or replacement.
- D. The ceiling shall consist of interconnecting plank type panels with no gaps between adjacent slats. Ceiling panels shall be individually removable. Ceiling material shall be .020-inch (.51 mm) thick aluminum 4 inch linear plank-type panels with a white baked-on enamel finish. Ceiling panels shall be continuous slats from wall to wall and installed perpendicular to the tunnel centerline. A molding shall be provided along both sides down the length of the ceiling at the junction between the ceiling and walls.

2.32 AVAILABLE OPTIONS

- A. Cab Floor Deicer/Heater: An under floor heating system (floor de-icer) can be installed outside and forward of the cab weather door to prevent the build-up of snow and ice on the cab floor. The floor heating system shall be controlled by an exterior mounted ambient temperature sensor (summer/ winter selector), a temperature controller to cycle the heating element on and off and a manual control switch located on the HMI touch screen. This system does not guard against large accumulations of snow or ice. These must be removed separately.
- B. Bridge Heating, Forced Air: Multiple 5 or 10 KW forced air heaters can be located in the cab and/or rotunda roof as required. These are controlled by a central thermostat.
- C. Bridge Heating, Baseboard: Up to 10-2KW baseboard heaters can be provided along the bridge walls. These can be controlled by a central thermostat at an additional cost.
- D. Bridge Insulation: The walls and ceiling of the bridge can be insulated with pink fiberglass, type R12. This option is highly recommended if the Bridge Heating option is selected.
- E. Main Voltage System: The standard voltage system is 480 Volt. For other voltages, such as 600 Volt, a transformer can be supplied.
- F. Interior Additional Duplex: Extra interior and exterior wall outlets can be provided as required. These duplexes are 20 Amp. The additional quantity and location can be specified by the customer.

- G. 1500CFM Ventilator Fan: A ventilator fan can be installed in the cab and/or Rotunda roofs of the PBB to increase air circulation within the bridge.
- H. 12 Pair Communication Cable: Cat5E communication cable.
- I. Ballast Emergency Light: Selected interior fluorescent tunnel lights, one tube per fixture, can be provided with emergency power for improved safety in the event of a power outage. These are ballast type battery packs that are charged via an automatic recharging device on the same circuit as the interior lighting fixtures. This system would replace the spotlight battery pack type provided as standard.
- J. Brushed Aluminum Ceiling: The standard interior ceiling panel is a 4" horizontal plank type system with baked on white enamel finish. A brushed aluminum finish is available as an option.
- K. Marine Grade Flooring: This option is usually chosen for humid climate regions or for clients who want to provide a more durable sub-floor. Marine grade plywood is a type of plywood that has been treated to increase its resistance to moisture.
- L. Carpeting: The base bridge price does not include carpeting. Many purchasers prefer to provide their standard carpeting. If the purchaser chooses to provide the carpet, we can provide an option price for factory or field installation. We can also provide an option price for carpeting plus installation. Our standard commercial grade carpeting has a pile weight of 28oz/sq.yard and is available in many colors.
- M. Exterior Siding: The tunnel C is sided with 22 gauge interlocking panels. The A and B tunnels are painted 14 gauge corrugated steel. As an option, A and B tunnels can also be sided over with the interlocking panels.
- N. Gate Sign: A Gate sign can be installed on the cab roof, including 3-sided illuminated gate signs.
- O. Interior and Exterior Signage: Signs can be installed on the walls of the bridge such as welcome notes on the interior or airport logos on the exterior.
- P. Exit Signs: Exit signs can be installed within the bridge. One will be installed at the intersection point of the OTW Bridge and the fixed walkway to indicate the terminal direction. This sign shall be back lit.

PART 3 - EXECUTION (NOT USED)

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

PART 6 - APPENDIX 14730 A

6.1 Copy of Memorandum of Understanding between the City and County of Denver Building Department and Denver International Airport

MEMORANDUM

DATE: 5 August 2004

TO: John Brann

Chief Construction Inspector

THROUGH: Hana Rocek, PE

Assistant Deputy Manager

THROUGH: Reginald Norman, RA

Design Manager

FROM: Mark Percy,

Project Manager

SUBJECT: Memorandum of Understanding / Administrative Modification

Fixed and Moveable Aircraft Loading Walkways at Denver International Airport

CODES: 2004 Denver Amendments to the 2003 International Building Code
NFPA 415

REQUEST: Denver International Airport desires to clarify and strengthen requirements that govern constructing moveable and fixed Aircraft Loading Walkways. Therefore, we request approval of the Provisions I through VI as detailed below.

REFERENCE: Memorandum of Interpretation and Administrative Understanding (MAU) dated 25 August 1992 (attached)

Administrative Modification (AM) 2003 AM 0496 dated 28 October 2003 (attached)

PROVISIONS:

- A. Memorandum of Interpretation and Administrative Understanding dated 25 August 1992

1. This Memorandum remains in full effect, with the following exception:

- a. All references to "NAPA 417" shall be changed to "NFPA 415".

- B. Administrative Modification 2003 AM 0496 dated 28 October 2003

1. This Administrative Modification shall remain in full effect, with the following exception:

2. Item 1 shall be revised to read "The fixed bridges to be used shall be similar to those originally installed on Concourse B, and shall be in compliance with the Denver Amendments to the 2003 International Building Code and NFPA 415".

- C. 2004 Denver Amendments to the 2003 International Building Code, Appendix N, Paragraph N103.3
 - 1. This Paragraph remains in full effect, with the following exception:
 - 2. All references to "NAPA 417" shall be changed to "NFPA 415".
- D. Maximum Allowable Distances for Aircraft Loading Aircraft Loading Walkways at Denver International Airport
- E. Fixed and Moveable Aircraft Loading Walkways of a total combined length not to exceed 242'-0 inch from Concourse face to Aircraft threshold shall be constructed per the Memorandum of Interpretation and Administrative Understanding dated 25 August 1992 as modified herein.
- F. Fixed and Moveable Aircraft Loading Walkways of a total combined length greater than 242'-0 inch but not to exceed 400'-0 inch from Concourse face to Aircraft threshold shall be constructed per the Administrative Modification 2003 AM 0496 dated 28 October 2003 as modified herein.
- G. Fixed and Moveable Aircraft Loading Walkways of a total combined length greater than 400'-0 inch from Concourse face to Aircraft threshold shall be one-hour noncombustible construction from Concourse face to such a length that the remaining portion is 242'-0 inch or less. The remaining portion shall be constructed per the Administrative Modification 2003 AM 0496 dated 28 October 2003 as modified herein.
- H. Building Permit Application Requirements for Aircraft Loading Aircraft Loading Walkways at Denver International Airport
- I. Drawings (2 Sets)
 - 1. Airport Site Plan
 - 2. Concourse Orientation Plan
 - 3. Gate Plan
 - 4. Cross Section through Aircraft Loading Walkway
- J. Complete set of Technical Specifications (1 Set)
- K. Calculations (1 Set)
 - 1. Wind Load shall be 30 miles per hour (mph)
 - 2. Jet Blast Load shall not be applicable
 - 3. Applicable Live Loads shall be stated
 - 4. Load at Concourse face (if applicable) shall be stated
 - 5. Worst Case Loads at both ends of Aircraft Loading Walkway (full extension) shall be stated
 - 6. Wheel Load at Apron
 - 7. Caisson Load at Rotunda
 - 8. Worst Case Overturning Moment
 - 9. Electrical Loads, accompanied by Panel Schedules and One Line Diagrams

- L. Certifications (1 Set)
1. Manufacturer shall certify Aircraft Loading Walkways meet all applicable provisions of NFPA 415
 2. Manufacturer shall certify all electrical materials, components, etc. used to construct the Aircraft Loading Walkways meet NEMA 3R
 3. Manufacturer shall demonstrate compliance with the above standards by submission of a letter from a Nationally Recognized Testing Laboratory (NRTL). Inspection and verification by the independent laboratory of the manufacturer's facilities shall have taken place within six (6) months of the letter's date.
 4. A structural consultant, currently registered as a Professional Engineer in the State of Colorado, shall review calculations furnished by the Manufacturer and author a report on those calculations and submit report to Denver International Airport for subsequent review by Denver Building Inspection Division.
- M. Nothing in these Provisions shall be interpreted as lessening the requirements for Professionals currently licensed in the State of Colorado to stamp and sign submitted documents.
- N. Structural Analysis
- O. Denver International Airport assumes all responsibilities for inspection Manufacturer's in-plant welding.
- P. A structural consultant, currently registered as a Professional Engineer in the State of Colorado shall inspect the Aircraft Loading Walkways once erection in complete. The Engineer shall then author a report to Denver International Airport on their findings. This report shall be forwarded to Denver Building Inspection Division by Denver International Airport. The Engineer shall inspect where applicable:
1. Foundation connections to Apron
 2. Foundation connections to support columns
 3. Column connections to Aircraft Loading Walkways.
 4. Any other connections completed in the field.

END OF SECTION 147300

SECTION 147310 - APRON DRIVE PASSENGER BOARDING BRIDGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies the furnishing and installing of new Passenger Boarding Bridges, including new bridges, new walkways, new pedestals and rotundas, new foundations, removal and re-installation of the existing Pre-conditioned Air Units, and removal and re-installation of the 400 Hz aircraft power units.
- B. Related Requirements:
 - 1. Provisions of the Contract, General and Special Conditions, Technical Specifications Division 01, and all other Technical Specification Sections, apply to this Section.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. General: Submit required items in accordance with General Contract Conditions and Division 01 Specification Sections.
 - 1. All drawings, sketches details, and material shall be submitted in the English language, in United States units, including dimensions, volumes, weights, and forces. The use of metric or SI units is not acceptable.
 - 2. No installation of any of the passenger loading bridge components shall begin until the drawings for such components have been reviewed and approved in writing by DEN. Fabrication and/or assembly begun prior to approval by DEN is done so solely at the risk of the Contractor / Manufacturer. Additional drawings shall be submitted as necessary to fully describe the bridge to be delivered.
- B. Minimum Required Submittal for Layout Approval:
 - 1. Complete finalized layout, including fuel pits, and PC Air units.
- C. Minimum Required Submittals for 75% Review:

1. Complete Issue for Construction set of drawings and technical specifications including:
 - a. Cover sheet with sheet index.
 - b. Vicinity plan of Airport and surrounding area.
 - c. Concourse key plan.
 - d. Gate layout plan including centerlines of rotundas in DEN coordinate system and with dimensions.
 - e. Phasing / Safety plan including trenching required for fuel pit work.
 - f. Foundation drawings.
 - g. Electrical drawings.
 - h. All other letters and calculations required for Building Permit.
 - i. Graphics / signage details.
 - j. Paint finishes.
 - k. Preconditioned air and 400 Hz brackets and connection details for tie-in to existing monitoring system.
 - l. Technical Specifications.
- D. Minimum Required Submittals for Building Permit.
 1. See Memorandum of Understanding, Article V attached as 147310 Appendix A at the end of this Section
 2. Elevations:
 - a. Side elevation of new bridges including Holdroom section.
 - b. Front elevation of new bridges including Holdroom elevation beyond.
- E. Minimum Required Submittals for Materials:
 1. Reference Technical Specification Section 013300 "Submittal Procedures" for the Master List of Submittals
- F. Minimum Required Submittals for End of Project Report:
 1. See Memorandum of Understanding, Article VI attached as 147310 Appendix A at the end of this Section
- G. Welding: Refer to Technical Specification Section 059990 "Welding" for required welding submittals for field welding only. All shop welding shall be of good commercial quality.
- H. Spare parts:
 1. Recommended spare parts list with current prices shall be furnished not less than 45 days prior to arrival of a bridge.
- I. All items required by Airlines / Denver International Airport agreement.
- J. LEED Submittals: **<Insert requirements>**

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Preinstallation Examination Report: Indicating dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.
- C. Product Certificates: For each type of boarding bridge.
- D. Field quality-control reports.
- E. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For boarding bridges to include in operation and maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[location and time as determined by DEN Project Manager][Project site] <Insert location>**.

1.7 STANDARDS

- A. The standards listed below represent the minimum required standards. All editions shall be the most current issue. Safety to passengers, other personnel, aircraft, and equipment is of prime importance. Nothing in these specifications shall relieve the Contractor of the responsibility for providing a safe product.
- B. Design:
 - 1. Codes, Regulations, and References: The bridge shall be designed to conform to all applicable Federal, State of Colorado, and City and County of Denver codes and regulations, including applicable Memoranda of Understanding between the City and County of Denver Building Department and DEN.
 - 2. American Welding Society (AWS) Standards (Technical Specification Section 059990 "Welding" applies to field welding should the need for any arise).
- C. Safety:
 - 1. All equipment shall be designed to be fail-safe and all controls, which regulate bridge motions (i.e., horizontal travel, vertical travel, and cab rotation), shall be of

- the dead-man type. Dead-man type shall mean controls, which require the operator to apply constant pressure to be engaged. Once the pressure is released, the control is disengaged.
2. All operating mechanisms, i.e. horizontal and vertical drive, cab rotation, etc. shall be designed so the drive mechanism is locked when power fails or is shut off.
 3. Positive stops shall be provided to prevent dangerous overtravel where any component might become disengaged from its guiding or restraining component. The positive stop shall be in addition to all limit switches provided to restrict overtravel under normal operating conditions, including bogie steering motions. Documents highlighting the actual stops are a shop drawing requirement.
 4. The operator's position in the control cab shall be designed to permit the operator to position the loading bridge with the cab weather door closed. Suitable enclosures, guard rails, etc., shall be provided to protect the operator from being pitched out the open end of the cab (when operated from an open door) in case of sudden stops or inadvertent movements of the bridge. A handhold shall be attached to the wall on both sides of the cab weather door.
 5. The passenger loading bridges shall comply with all applicable local building codes and regulations at point of installation, which are in effect at the time of manufacture.
 6. All sheared or sharp metal edges shall be deburred or broken. All exposed metal corners shall have radii.

D. Materials:

Component:	ASTM Grade or Equivalent (Min. Properties):
Structural Plate	ASTM-A35-70A
Structural Steel and Shapes	ASTM-A36-69
Steel Tube	ASTM-A36-69
Steel Pipe	ASTM-A53-B
Steel Sheet	ASTM-A570-72 F or ASTM-A569
T-1 Pins	ASTM-A5-4-64 F or ASTM-A517-64 F
Hinge Pins	AISC-C1018
Bolts – Standard	ASTM-A307
Bolts – High Strength	ASTM-A325 or SAE Grade 8

E. Maintenance:

1. Components shall be installed with adequate access and type of fasteners to permit them to be changed by one man. Where the weight of a component requires mechanical assistance, the component or assembly shall be provided with lift eyes, forklift guides, etc. Particular attention shall be given to keeping components simple, rugged, and easily accessible for routine maintenance, lubrication, component exchange, and adjustment.
2. Access panels, where required to gain access to equipment or maintenance areas, shall be suitably sized to permit accomplishment of the tasks required including tools and equipment. The panel shall be permanently attached to the structure by hinges, etc., and any fasteners required shall be a permanent part of the panel, etc., to prevent loss.
3. If special tools are required for routine maintenance, one (1) set shall be furnished by the Contractor for each year of the Project.

4. Modular components: Provide for rapid corrective maintenance of malfunctioning elements through use of standardized modular components, which are readily available in the continental U.S. Allowance must be made for convenient access to components critical to the operation of the passenger loading bridge.

1.8 INSTALLATION REQUIREMENTS

- A. The Contractor shall provide qualified technical and service personnel during the installation of the loading bridges to assure a proper installation. These representatives shall also be available to DEN at no charge on delivery of the first bridge and shall be on call for a timely response within twenty-four (24) hours for a period of sixty (60) days after each loading bridge is officially opened for airline operations. This is to ensure adequate and reliable field service support to correct any and all equipment failures that normally occur during the initial operating period.
- B. Reference Technical Specification Section 011400 "Work Sequence and Constraints" for other Installation Requirements.
- C. Communications:
 1. Verification of existing communications at each existing bridge. Contractor shall also coordinate re-connection of communications with current communications contractor, Qwest.
 2. Contractor shall also coordinate reconnection of existing Pre Conditioned Air monitoring system with DEN HVAC department. Removal and reinstallation of existing Pre Conditioned Air units shall be done in such a way so that only the unit being removed and reinstalled shall not be connected and recognized by the monitoring system. Prior to removal, DEN and Contractor shall inspect and document condition of existing equipment.

1.9 ACCEPTANCE PROCEDURES

- A. In addition to the requirements described in the General Conditions and elsewhere in the Technical Specifications, the following also applies:
- B. Final Acceptance Inspection:
 1. Final acceptance shall be done on an individual gate basis.
 2. After full compliance by the Contractor of all outstanding Punch List items as determined from the Conditional Acceptance Inspection, DEN shall perform the final inspection of the bridge.
 3. The Contractor shall make certain that each bridge is complete in all respects and operating properly, all deficiencies noted in the Conditional Acceptance Inspection are corrected, and all training accomplished prior to the requesting the DEN Project Manager to witness and make the Final Acceptance Inspection. Upon satisfactory completion of that inspection, a Certificate of Customer Acceptance will be issued. The warranty for each individual bridge shall begin upon its Final Acceptance.

4. DEN reserves the right to employ an independent testing laboratory to inspect the bridges to verify the Contractor's compliance with the specified structural, welding, mechanical, electrical, and fireproofing requirements. Deficiencies and / or violations reported by DEN's laboratory shall be immediately corrected by the Contractor at no cost to DEN. The cost of re-inspection by DEN's Laboratory shall be borne by the Contractor and DEN will deduct such reinspection costs from monies due to the Contractor.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 APRON DRIVE PASSENGER LOADING BRIDGE TYPE

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide one of the following:
 1. Dew Bridge Airport Systems.
 2. FMC Technologies.
 3. <Insert manufacturer's name>
 4. Or approved equal.
- B. Apron drive units are those that have "major" degrees of motion, lateral, horizontal, and vertical, of a portion of the loading bridge tunnel and the bridge head/cab about a fixed point.
- C. The apron drive units shall be capable of having simultaneous omnidirectional (extension, lateral and horizontal) movements in a fashion similar to a motor vehicle. These invariably include vertical elevation and significant rotation in a horizontal plane and include extension retraction capability.
- D. General In Service Requirements:
 1. The passenger loading bridge array indicated shall permit aircraft to be taxied in frontward, with all engines running, to final parking positions.
 2. The passenger loading bridges shall operate satisfactorily under ambient temperature conditions of **25 degrees to +125 degrees F** (-32 to +52 degrees C), with or without wind and windblown precipitation up to **60 miles per hour** (96.6 km/h). All components and materials must, individually and collectively, be designed and/or selected for long service life under such climatic conditions.
 3. All electrical systems shall be guarded and protected from damage that might be caused by falling objects or collision with aircraft service equipment and other moving ground vehicles.
 4. Electrical control panels, disconnect switches shall be so located that they are at

all times accessible to the maintenance personnel standing at ground level without the use of a ladder, regardless of the vertical position of the bridge.

E. In Service, Shutdown:

1. The Contractor shall provide a manual override to release wheel bogey brakes to permit towing the passenger loading bridge into or out of position on the apron in case of power failure.
2. The override system shall be mechanically interlocked to preclude normal operation with the brakes locked out.
3. The wheel bogey shall include tow lugs on the front and rear to permit attachment of a suitable tow bar.

F. In Service, Maneuvering:

1. The bridge head/cab shall be equipped with canopies, side curtains, and floor bumpers and shall be capable of docking with aircraft without scratching or damaging the aircraft fuselage when contact is made, with aircraft parked within plus or minus 1 foot (0.3 m) in any direction from the position marked on the apron.
2. The bridge shall have the capability of simultaneous vertical, horizontal, cab rotate and cab floor motion in order to minimize bridge pre positioning time.

G. In Service, Docked to Aircraft:

1. Contractor shall submit, with his Bid, certificate(s) of compliance with NFPA 415, latest edition, from a certified testing company located in the continental United States. The Contractor shall also provide affidavits attesting to the passenger loading bridge's compliance with NFPA 415 (in effect at the date of bid submittal).
 - a. Concourse floor height elevation: Contractor to verify the exact elevation at each gate.
 - b. Unless otherwise directed by DEN, the passenger loading bridges shall be capable of accommodating the first forward door of all aircraft.
 - c. The Contractor shall verify apron elevations at each bridge location and coordinate these elevations with the bridge operation, layout, and maximum slope.
 - d. The Contractor shall be responsible to check the above requirements to assure that the selected passenger loading bridges shall meet the requirements of the application within the Contractor's installation guidelines and constraints of the models selected. Permissible slope of telescoping tunnel: (8.33% or 1:12) maximum measured, for each aircraft type serviced, from the hinge point at the concourse rotunda to the hinge point in the adjustable cab floor.
 - e. The cab shall be designed to rotate a total of 125 degrees (90-95 degrees CCW and 30 35 degrees CW). The cab shall rotate at a maximum peripheral speed of 19.0 feet per minute (5.8 m/min.) in either direction.
 - f. The rotunda shall be such that it permits the entire unit to rotate 175 degrees.
 - g. The bogey wheels shall be capable of rotating a minimum of 90 degrees left

and 90 degrees right.

- 1) A warning light shall be installed on the control panel to indicate when the steer limit switch is activated.
 - 2) It shall not be possible for the wheel bogey to rotate beyond its positive stop.
 - 3) Provide positive identification for both the front and back sides of the bogey, such identification shall be clearly readable by the operator through the mirrors specified by this Section.
 - 4) The wheel's position shall also be identified by a wheel position indicator on the control panel. Install a protective cover or screen over the indicator.
- h. The vertical lift speed as measured at the cab bumper shall be **2.5 fpm to 3.5 fpm** (0.76 to 1.07 m/min).
- i. The drive system shall permit the unit to be extended/retracted and rotated to any point within its operating envelope and shall permit these movements at variable speed between **10 and 90 fpm** (3.0 to 27.4 m/min). The drive mechanism shall be such as to permit the extension/retraction movement be accomplished simultaneously with the rotation movement. Maximum speed shall be limited to **85 90 fpm** (25.9 to 27.4 m/min).
- j. The horizontal drive system shall include a decelerator device to reduce or eliminate shocks when approaching maximum extension, or when horizontal travel is stopped or reversed suddenly, for protection of the equipment and passenger loading bridge operator.

2.2 STRUCTURAL DESIGN AND SUPPORT ELEMENTS

A. General Design:

1. Structural Loads: The Bridge shall support the following loads. The bridge shall accommodate the combination that imposes the most adverse loading condition. In addition to the dead loads and strain caused by movement, the entire passenger boarding bridge shall support:
 - a. A live load of **40 pounds per square foot** (195 kg/m²).
 - b. An operational wind load of **12.5 pounds per square foot** (61 kg/m²) or an approximate wind velocity of **60.0 mph** (97 km/h).
 - c. A retracted and stowed wind load of **25 pounds per square foot** (122 kg/ m²) or an approximate wind velocity of **90.0 mph** (145 km/h).
 - d. A roof load (snow load) of **25 pounds per square foot** (122 kg/ m²).
2. The structure shall be sufficiently rigid to avoid excessive sway when the Bridge is brought to a gradual stop.
3. All mechanisms for actuating, guiding, and restraining the Bridge and its components shall be designed so that no excessive noise, sway or sense of insecurity is apparent to passengers. No operating vibrations or loads shall be transmitted to the concourse building.

B. Environmental Considerations:

1. The Bridge shall operate satisfactorily under ambient temperatures from **-40 degrees F (-40 degrees C)** to **125 degrees F (52 degrees C)**. All of the Bridge components and materials shall either individually or collectively be designed or selected for long service life under such conditions.
2. The Bridge assembly shall provide a clean, structurally sound, comfortable, and functional transition between the aircraft and the concourse building.
3. The entire Bridge shall be weatherproof and any equipment or controls that are exposed to the weather shall be weatherproof type or housed in weatherproof boxes. The PBB Contractor shall follow standard industrial practice regarding NEMA Enclosures for electrical equipment.

C. Interior Dimensions:

1. The Bridge shall have the following minimum interior clear dimensions:
 - a. Tunnel width: **77 inches (1956 mm)**.
 - b. Tunnel width with handrails: **70 inches (1778 mm)**.
 - c. Tunnel height: **92 inches (2337 mm)** from finished floor level.
 - d. Telescopic tunnel width: **62 inches (1574 mm)**.
 - e. Telescopic tunnel width with handrails: **55 inches (1397 mm)**.
 - f. Telescopic tunnel height: **79.5 inches (2019 mm)** from finished floor level.

- D. Support: The Bridge fixed walkway shall be supported from beneath at the concourse building end by a column to support the inboard end and additional support columns located along the walkway to support the walkway. All fixed structural support columns shall rest on foundations supplied by others.

E. Building Connection:

1. The Bridge System shall be designated as equipment and as such shall receive no structural support from the air concourse building to which it is attached.
2. An aluminum diamond checker plate threshold shall be installed over the gap between the concourse building and the adjacent bridge interface. Interior metal and exterior flexible flashings shall provide a waterproof connection between the bridge and the concourse building.
3. At the concourse building, the bridge interface shall fit a door up to **48 inches (1219 mm)** wide by **84 inches (2134 mm)** high.

F. In Service, Maneuvering:

1. Passenger loading bridge wheels shall be of sufficient width and surface quality to preclude damage to apron pavement. The Contractor shall ascertain the bearing strength and pavement hardness from the DEN for specific passenger loading bridge locations.
 - a. The wheels shall be designed to operate on Portland cement and asphaltic concrete pavement in Denver, Colorado climatic conditions.

2. The tires shall be new solid tires manufactured of a rubber compound that will not chip or fray at the edges and not be affected or damaged due to contact with oil, lubricating and hydraulic fluids, and/or fuels from aircraft and servicing equipment, including hydraulic fluid.
 - a. The tire treads shall be suitable for use by passenger loading bridges.
 - b. The tire rim, wheel and hub design shall be such that only the wheel to axle hub bolts/nuts are available for removal while the wheel is mounted on the bogey. This is to preclude accidentally loosening the tire from the rim while still mounted on the wheel bogey assembly.
 - c. The wheel and tire changing procedures shall be specified in the Maintenance Manual.

2.3 BRIDGE ASSEMBLY ELEMENTS

- A. The apron drive bridge is capable of moving to any point on the concourse apron within its design operation range to accommodate the required aircraft type. The proposed apron drive bridge requirements for the following components are as follows:
 1. Optional Fixed Walkways, Rotunda Entry Corridor and Rotunda:
 - a. Handrails with returned ends shall be installed the full length of the fixed walkway, both sides.
 - b. The fixed walkway shall be supported at the concourse building by a column or columns such that it is not anchored or secured to the concourse building in any way.
 - c. Minimum inside dimensions of the fixed walkway shall be:
 - 1) 7'-0" at Concourse B.
 - d. Depending upon length, structural loads, or other considerations, the fixed walkway may be supported by the rotunda column or by independent column supports at the end adjacent to rotunda entry corridor.
 - e. The rotunda entry corridor shall be a fixed rectangular tunnel at a constant height that connects the concourse building or fixed walkway with the rotunda.
 - f. The rotunda entry corridor shall be cantilevered from the rotunda column to the concourse building face or the mating frame of the fixed walkway.
 - g. The rotunda is a cylindrical structure supported on a tubular column. It shall permit the telescoping tunnels to swing through a minimum arc of **175 degrees** (87-1/2 degrees CW and 87-1/2 degrees CCW of centerline). The rotunda floor shall remain level at all positions.
 - h. The rotunda column shall not be anchored or secured to the concourse building, nor shall it transmit any live or dead loads or vibrations to the concourse building. An industry standard 8 bolt foundations pattern shall be used.
 - i. The flashing between the concourse building and the rotunda hall, corridor or fixed walkway shall be provided to effect a weathertight connection between the concourse building and the rotunda entry corridor or fixed

walkway. Similar seals shall be used between the rotunda entry corridor and the fixed walkway, if specified. Interior flashing shall be installed.

- j. The flashing shall be such that it does not damage the existing building or void the warranty. If the Contractor modifies the existing building the Contractor will be responsible for any weather damage to the building in the general area of the building modification regardless of source.
- k. Concourse Door Thresholds: The Contractor shall install a threshold at the concourse door loading bridge interface. The threshold shall have an anti-slip surface.
- l. The rotunda shall be equipped with adjustable limit switches to control the traversable area of the bridge. If the limit switch is activated by the bridge, all power shall be disconnected, stopping the bridge.
- m. Flap type seals (dual) shall be provided for complete weather tightness between the rotunda and the hinged telescoping tunnels.
- n. Rotunda side curtain shall be galvanized steel unless otherwise noted.

2. Telescoping Tunnels:

- a. The telescoping tunnel shall permit servicing of all commercial jet aircraft as specified by the tenant, **[United]** **[Frontier]** **[insert other]** Airlines
- b. Where telescoping sections overlap, low angle transition ramps shall be provided to accommodate the difference in elevation. The hinged inner tunnel transition ramps shall be designed to minimize the transition slope. The additional slope shall be less than 3 degrees in relation to the overall tunnel slope. Manufacturer shall submit actual data for transition slopes.
 - 1) Ramps shall have yellow chamfered edges 1/4" (6 mm) black ribbed rubber matting.
 - 2) The inner tunnel transition ramp shall be hinged and slope shall be less than (3) degrees relative to female tunnel section.
 - 3) Handrails shall be provided at all transition ramp areas (both sides of the tunnel).
 - a) Where folding handrails are utilized to accommodate telescoping sections, the design shall be such that the handrail is self erecting and automatically folded by tunnel action.
 - b) The handrail, when erected, shall be rigid and promote the confidence of the user and shall be turned at the ends in an approved manner to prevent injury and prevent grabbing coats and purse straps of passengers passing through the tunnel. Handrails in the A Tunnel with returned ends shall be provided on both sides and run the full length of the tunnel. The handrail shall extend over the transition ramps and shall be sloped at a uniform dimension above the ramp.
 - c) The telescoping tunnels and all other elements of the structure shall be so designed as to resist the accumulation of water at low points and pockets in the structure. Drain holes shall be provided where necessary so as to drain collection points in any operating attitude. Drains from internal gutters shall be carried clear of the structure and shall be sized to prevent

- blockage by accumulated debris.
- d) Flat roof shall be provided at all telescoping tunnels, fixed extensions, and fixed walkways typically.
 - e) The telescoping tunnels shall be equipped with two stage limit switches, slow and stop, to control extended and retracted lengths. Mechanical stops with elastomeric bumpers to prevent overtravel in the event of limit switch failure shall be provided.
 - f) Clearance between the telescoping tunnels shall be maintained such that no soiling or wear of the interior surfaces occurs as the result of movement.
 - g) Flap type seals (dual) shall be utilized between the individual tunnel assemblies to provide a weathertight seal and to prevent the entrance of fire and/or smoke in the event of an apron fire.
 - h) The extended length of the telescoping tunnels shall be determined such that the slope of telescoping tunnels does not exceed 8.33 percent (except at the tunnel transition ramps) unless otherwise specified by the user.

	2-Tunnel Bridge and Fixed Walkways:	3-Tunnel Bridge:
Min. Interior Width:	4'-10" (1473 mm)	4'-10" (1473 mm)
Min. Interior Height:	7'-0" (2134 mm)	7'-0" (2134 mm)
Min. Transition Ramp Width:	4'-8" (1422 mm)	4'-8" (1422 mm)

- i) The telescoping tunnels shall allow for mounting transport system to accommodate conductors for transmission of 400 Hz aircraft ground power to the gate box mounted adjacent to, or under, the aircraft cab, or 60 Hz power, or 400 Hz static converters, and/or Preconditioned Air handler units.
- j) Tunnel ice scrapers shall be provided.

3. Operator Cab:

- a. The cab shall be equipped with a forward facing operator control station located behind a wire glass window to permit the operator full view of the aircraft contact area. Additional visibility shall be provided through windows to the left side of the control station.
- b. The cab slat curtains shall have view panels installed so the operator will have maximum visibility of the aircraft and ramp when positioning bridge to and from an aircraft or stowed position.
- c. A manually operated, insulated, weather roll-up door with vision panels shall be provided at the cab front to seal the bridge when not in use. The weather door shall be capable of being locked to ensure securing. Minimum clear width of the weather door shall be **3 feet 8 inches** (1118 mm).
- d. A full width aircraft spacer shall be provided at the aircraft end of the cab floor. The bumper material shall meet the latest issue of the fire protection requirements of NFPA 415 and shall be sufficiently flexible and nonabrasive to prevent scratching of or other damage to the aircraft fuselage.
- e. The cab shall be rotated by a gear motor and chain drive operating on the

circumference of the fixed circular floor section of the aircraft cab.
Adjustable limit switches and fixed physical stops control the extreme of rotation.

- f. Aircraft bumper to be furnished with B737 left doorjamb reference strip. Stripe to be located approximately **71 inches (1800 mm)** from right end of bumper. Manufacturer to assure coordination with aircraft closure.
- g. A cab floor deicer, thermostatically controlled, and a manual control switch, with indicator light, located in control console, shall be provided.
- h. Cab side curtains shall be galvanized steel with wire glass windows on every other panel minimum.
- i. The operator's control console shall include, in addition to other specified requirements, the following components:
 - 1) Controls.
 - 2) Indicators.
 - 3) Control features.
 - 4) Interlocks.
 - 5) Warning devices.
 - 6) Aircraft Cab Interim Illumination
 - 7) Exterior Apron and Aircraft Interface Illumination.
 - 8) Interior Illumination Controls.
 - 9) Operator cab shall be equipped with infrared slow-down sensors that restrict the cab's forward and rotational movements when the cab is within two (2) feet of the aircraft.
 - 10) Console work light.
 - 11) Console heater.
 - 12) Video display of wheel bogie taken from Rotunda looking toward cab. Screen shall be within console and not within control screen. Provide screen sunshields.

4. Aircraft Closure (Canopy):

- a. The outermost end of the cab shall be equipped with an adjustable closure with folded accordion bellows to make a weather tight seal against the aircraft. The closure shall enclose both the open aircraft door and its doorway.
- b. Pressure sensitive limit switches or tension switches shall be incorporated into each side of the closure mechanism to prevent excessive pressure on the aircraft.
 - 1) The contacting edge or seal shall be a soft material to prevent scratching or damage to the aircraft skin.
 - 2) The entire closure shall be designed to withstand weathering, be non water absorbent, and remain elastic and flexible between **-31 degrees F (-35.0 degrees C)** and **127 degrees F (52.8 degrees C)** and be highly tear resistance and shall meet the fire resistance requirements of NFPA 415.
 - 3) Aircraft closures must be capable of accommodating the doors of the A320 and F100 aircraft, as applicable.
 - 4) Provide A300 closure modifications where applicable.

- c. The canopy shall be designed in such a manner that it will be possible to lower the canopy over the aircraft door and have sufficient clearance to open the door.
- 1) It shall be able to service both L1 and L2 doors on wide body aircraft as specified on the Plans and shall conform to the approximate top fuselage contour at the forward loading door.
 - 2) Cushion pad(s) shall be provided at the point of contact between the canopy and aircraft fuselage to prevent denting and or scratching of the aircraft skin or cabin and cockpit windows. This includes damage to rain diverters or troughs that may be located over the doors.
 - 3) Any canopy supports or stiffening rods of the canopy shall be thoroughly padded to prevent contact with the aircraft and protect canopy material when in its retracted position. This padding will be firmly attached in such a manner that it will not slip, turn, twist, or distort from repeated usage. It shall be possible to replace the padding sides and top, and any inserts in sections without replacing the entire canopy.
 - 4) The actuating mechanism shall be designed to preclude excessive pressure on the aircraft fuselage.
 - 5) Changes in the position of the aircraft and/or passenger loading bridge while the canopy is in contact with the fuselage shall not cause excessive loads to be exerted on the fuselage skin. Pressure exerted by the closure against the aircraft fuselage shall not exceed **2 psig (13.8 kPa)**.
 - 6) The mechanism shall be rugged and be able to withstand wind gusts and jetblasts.
 - 7) The entire Aircraft Closure shall be designed to withstand weathering, shall be non water absorbent, shall remain elastic and flexible between 32 degrees C and 52 degrees C, shall be tear resistant, and shall meet the fire resistance requirements of the current issue of NFPA 415.
 - 8) An electrical interlock shall be provided preventing forward motion and cab rotation with the Aircraft Closure extended. The interlock shall not prevent the bridge from being withdrawn from the aircraft with the canopy extended.
 - 9) Any chains, cables, or electrical wire that penetrate the floor or wall structure shall have adequate clearance, be protected, and securely fastened.
 - 10) Dependence upon the automatic leveling device to prevent such an occurrence as in 6 (first above) is unacceptable.
 - 11) Cab seal shall be resilient bellows type; tarpaulin types are not acceptable.
 - 12) The canopy, when in its retracted position, shall be protected by a hood or other device to prevent water from lying in the folds of the canopy material when the bridge is not in use.
5. Bumper: An aircraft bumper, the full outside width of the passenger loading bridge cab opening, shall be provided along the front edge of the floor at the point of contact with the aircraft.

- a. Bumper installation and material shall be such that it will not mark and will prevent any damage or abrasion of the aircraft skin when the bridge is in contact with the aircraft.
 - b. The bumper shall provide bodily support when stepped upon, and shall have a Shore A Durometer hardness of 50 - 70 when measured in accordance with ASTM D2240.
 - c. The bumper material shall be an E.P.D.M. or other suitable polymer compounded to meet the fireproofing requirements of NFPA 415, current edition.
 - d. Passenger loading bridge motion control or limit devices mounted on the bumper shall be located at the extreme outboard ends of the bumper and along its centerline or shall be mounted continuously along the face of the bumper.
 - e. There shall not be any metal trim or structural element capable of contacting the aircraft fuselage outside the canopy padding and/or bumper.
 - f. Provide for clearance for B737 pitot tubes on all bridges. The vertical front-edge of of the bracket shall be no closer to the front vertical edge than three (3) inches.
6. Lighting:
- a. Interior Lighting: Interior fluorescent lighting fixtures shall be divided among several different circuits, at least two, in such a way that failure of one circuit will not preclude the distribution of light sufficient for the safe use of the passenger loading bridge.
 - 1) Fluorescent fixtures shall be standard type suitable for use with 48 inch (1219 mm) long cool white 34 Watt fluorescent lamps.
 - 2) Ballast shall be provided for 20 degrees F (-28.9 degrees C) cold weather applications. Interior lighting shall be actuated by a manual switch located next to the concourse door. Lighting calculations shall be submitted under provisions of Article titled "Submittals".
 - 3) Fluorescent fixtures (interior) shall have painted steel housings and acrylic prismatic lens.
 - 4) Not less than one (1) fixture per tunnel/walkway segment shall remain illuminated at all times.
 - b. Exterior Lighting: Exterior lights shall have aluminum housing, weatherproof (gasketed) with high impact lens.
 - c. Tunnel Lighting: 20 to 25 average maintained footcandles (215 to 270 Lux).
 - d. Cab Lighting: 20 footcandles (215 Lux). Control panel area shall have 60 footcandles (645 Lux). It shall be possible for the operator to turn off cab lights at the control console to eliminate glare when positioning the bridge to the aircraft during hours of darkness.
 - e. Intensity of illumination will be measured at the floor.
 - f. Emergency Fluorescent Lamp Power Supply: Provide self-contained battery powered inverter unit for direct mounting in designated fluorescent fixtures. Provide unit with dual 120 or 277 VAC input, fully automatic two rate charger, nickel cadmium battery, automatic low voltage battery disconnect, AC "ON" pilot light, and test switch. Design unit to automatically

transfer to battery supply on loss of normal AC power and shall operate one F40 fluorescent lamp with a minimum output of 1100 lumens for 1 1/2 hours. Not less than one fixture per bridge section and two per fixed walkway over 30 feet (9.15 m) shall be provided.

- g. All lighting fixtures shall be designed for easy access for lamp replacement and for cleaning of fixtures.
- h. The service stairs and landing shall be illuminated by a 100-watt weatherproof incandescent lamp with a control switch inside and adjacent to the service door.
- i. For night operations, exterior sealed beam type floodlights shall be provided to illuminate the apron area ahead of the bridge. A sealed fluorescent fixture shall be provided just beyond the roll up weather door to illuminate the cab aircraft interface area.
- j. Existing Gate ID sign shall be carefully removed from existing bridge, temporarily stored and maintained in good condition and re-installed on the new bridge.

7. Electronically Operated 400 Hz Cable Hoist:

- a. The existing hoist system consisting of either one or two cable hoists (for dual output 400 Hz converters) shall be carefully removed from existing bridge, temporarily stored and maintained in good condition and re-installed on the new bridge.

8. Insulation:

- a. An R4.5 average value is required to be integrated into metal structures at ceilings and sidewalls at the time of manufacture.
- b. In no instance shall insulation materials be exposed to the weather or applied with glues or tape but shall be covered with appropriate weather resistant finish material.
- c. The ceilings shall incorporate acoustical insulation of an inert non combustible type (1 inch (25 mm) minimum).
- d. Particular attention shall be given in the design to eliminate the possibility of condensation in the insulation that might cause unsightly water stains appearing on the interior finished surfaces and rust at the interface of the insulation and outer shell.
- e. The use of asbestos or asbestos products as an insulation material or for any other use will not be permitted.

9. Service Assembly:

- a. A service door, served by a stair and landing, shall provide apron access to and from the bridge for authorized personnel. The service door shall be located on the right side of the cab.
- b. The service door shall be hollow core, steel door heavy 1/2 hour fire rating and an automatic door closure. It shall be of a standard size with nominal dimensions of 2 feet 6 inches by 6 feet 8 inches (762 mm x 2032 mm).
- c. The service door shall be provided with a double-sided keyless push button simplex combination lock as manufactured by Kaba Ilco or approved equal.

- d. It shall be equipped with a 1/2 inch (12 mm) wire mesh glass upper window a minimum size of 12 inches x 18 inches (305 x 457 mm).
- e. A 30 inch (762 mm) high stainless steel kickplate shall be provided for the full width of the inside of the door.
- f. The door shall open outward using heavy duty industrial type hardware (using standard U.S. hinges and finish hardware), and it shall be provided with an automatic heavy duty door closer installed on inside of the door.
- g. A doorstop and hook assembly shall be provided on the stair handrail or platform to prevent damage to the passage set and/or door.
- h. The door shall be so constructed that the door and all its components can be easily removed and reset or replaced for maintenance purposes.
- i. The service access landing shall be constructed of open mesh (grip strut) galvanized steel grating equipped on the outside perimeter with tubular steel handrails in accordance with applicable safety codes.
- j. The service stair shall be equipped with self adjusting risers with open mesh galvanized steel treads (grip strut) and is supported at the apron on castering rollers.
 - 1) The caster type rollers shall have solid rubber tires that are designed to operate on asphalt pavement in elevated temperature conditions.
 - 2) All steps shall have an equal rise with a tread width of 27 1/2 inches (700 mm) and a depth of 9 1/2 inches (240 mm).
 - 3) Both sides of the stair shall be equipped with tubular steel handrails of proper height to comply with applicable codes and regulations.
 - 4) Clear width between handrails shall be a minimum of 28 inches (813 mm).
 - 5) The service stair shall be fully usable at all heights and positions.
- k. A roof access ladder shall be provided on the service landing. The frame of the ladder shall be of galvanized steel channel and the rungs shall be galvanized steel bars with cast abrasive.
- l. A system to allow workers on the bridge roof to attach safety harnesses shall be provided.
- m. A handrail on the roof to protect workers maintaining the vertical life motors.
 - 1) Structural Performance of Handrails and Railing Systems: Design, engineer, fabricate, and install handrails and railing systems to comply with requirements of ASTM E 985 for structural performance based on testing performed in accordance with ASTM E 894 and E 985.
 - 2) Structural Performance: Design, engineer, fabricate and install the following metal fabrications to withstand the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections. Apply each load to produce the maximum stress in each respective component of each metal fabrication.
 - 3) Top Rail of Guardrail/Handrail Systems: Capable of withstanding the following loads applied as indicated: Concentrated load of 300 pounds applied at any point non-concurrently, vertically downward, or horizontally.

- 4) Handrails Not Serving as Top Rails: Capable of withstanding the following loads applied as indicated: Concentrated load of 200 pounds applied at any point non-concurrently, vertically downward or horizontally.
- 5) Infill Area of Guardrail Systems: Capable of withstanding a horizontal concentrated load of 200 pounds applied to one square foot at any point in the system, including panels, intermediate rails balusters or other elements composing the infill area.

10. Pre-Conditioned Air Unit (PC Air):

- a. Bridge mounted in accordance with Division 23 sections.
- b. Stand mounted in accordance with Division 23 sections.

2.4 CONTROL ELEMENTS

A. General In Service Requirements:

1. Controls shall be PC based.
2. Electrical Components:
 - a. General: Electrical equipment, components, and installation shall be manufactured in U.S. standard units and shall conform to the recommendations and requirements of the American Insurance Association (AIA), the National Electrical Manufacturers Association (NEMA), the National Electrical Code (NEC), and the Denver Building Code.
 - b. The means of accomplishing all motions shall be contained at the operator's control panel.
 - c. Electrical Junctions: All electrical junction points and connections within the loading bridge shall be made directly to concourse strips, or by means of plug type connections.
 - 1) Power lines shall likewise be hard wired from the passenger loading bridge directly to concourse building feeder panels.
 - 2) Unless otherwise shown on the plans, no standard electrical and/or communication service conduit will be permitted on the exterior sides of the passenger loading bridge.
 - 3) All cables and wiring shall be installed in cable carrying devices approved by the Construction Supervisor.
 - d. All operating electrical circuitry shall be checked before the unit leaves the manufacturer's plant.
 - e. Anti Chafing Devices: Whenever electrical cables are required to slide or move, anti chafing devices shall be provided. Acceptable anti chafing devices include grommets, flexible sleeves and jackets, and other approved similar protection.
 - f. Electrical panels mounted on the rotunda at apron-level shall be equipped with a locking mechanism containing a Best cylinder.
 - g. Not more than one (1) wire may be terminated under any terminal..

3. Mechanical Design and Components:
 - a. Only standard components of highest commercial or industrial quality, readily available in the continental United States, manufactured in U.S. standard units and conforming to recommendations and standards established by the Society of Automotive Engineers (SAE) and American Society of Mechanical engineers (ASME) shall be used.
 - b. All operating mechanical components must be assembled and checked out before the unit(s) leaves the manufacturer's plant.

4. Horizontal and Vertical Drive System: The drive systems shall be electrical mechanical.
 - a. Vertical Drive - Electro Mechanical:
 - 1) The bridge shall be moved vertically by means of two recirculating ball bearing screw assemblies. Each assembly shall be independent of the other, with individual motors. The ball nut of this assembly shall be equipped with wiper brushes to remove grit or dirt from screw threads and a self locking acme type thread which will prevent unit collapse in the vent of ball nut failure.
 - 2) The vertical drive motors shall be fitted with spring applied brakes which release only when electric power is applied and vertical motion, up or down, is signaled from the operator's console or the auto level system.
 - 3) The brakes shall hold securely at all elevations, without creeping whether the bridge is in operation or not.
 - 4) The fault detector circuit shall shut down the electrical power to the vertical drive motors and sets the brakes independently of the operator. This shall occur if the bridge is in the vertical operate mode and there is differential motion at the ball screws.
 - 5) Attached into the ball screw's lower end shall be a tapered collar that prevents the screw from disengaging the ball nut. Vertical rate of travel shall be a constant speed.
 - 6) Reference stripes shall be painted or mechanically fastened on the inner tube (s) to indicate maximum travel of column, both up and down.
 - 7) Back up emergency magnetic type limit switch(s) shall be provided in the vertical circuit, for both up and down limits.
 - 8) Each screw shall be capable of supporting a full loaded bridge.
 - 9) Inspection holes in each column tube shall be provided to allow baroscope inspection of the ball screw surface. All holes shall be aligned in inner and outer column tubes. Covered plates shall be provided in outer tube.

 - b. Horizontal Drive:
 - 1) An electro mechanical drive system shall provide extend, retract, swing and steer capabilities at variable speeds up to 90 ft. (27 m) per minute. This two wheeled system shall operate on solid tires. Both

- wheels shall be independently driven by DC gear motors with solid state SCR controls.
 - 2) The entire system shall be contained within the bridge and require only AC power.
 - 3) A dynamic braking system shall allow the bridge to come to smooth, controlled stops. Spring actuated brakes shall be located on each drive motor and lock the bridge in place whenever electrical power is cut off by moving the control lever to the neutral position or if power fails. The horizontal drive motors shall be equipped with brake releases.
 - 4) Connection lugs shall be provided to allow the bridges to be towed in the event of power failures.
- c. The control logic shall be such that if any one (1) horizontal or vertical drive motor is shut-down by current overload, all drive motors shall be shut down, necessitating a re-start from the operator's control panel.
5. Certifications: The Contractor shall furnish notarized certifications that all electrical, mechanical, and hydraulic designs, components, and installations meet the requirements specified in this Section.

B. In Service, Maneuvering:

1. Control Console and Station:

a. General:

- 1) All passenger loading bridge operator controls shall be located on the control console in the bridge cab section in such a position as to afford the operator maximum visibility as the bridge is positioned to the aircraft with the cab weather door closed.
- 2) The operator's control station shall be so located so as to provide adequate space for the operator and his required movements and sufficient space for maintenance of the electrical control components as required by voltage classification in the National Electrical Code (NEC).
- 3) In addition, each passenger loading bridge shall be provided with **18 inch (457 mm)** circular convex mirrors and 2 undercarriage floodlights to enable the operator to have full unobstructed view of the apron and bogey wheels at any time before setting the bridge into motion and when the bridge is in motion.
- 4) A wheel position indicator shall also be provided on the control panel to enable the operator to determine the bogey's position at any given time the bridge is idle or in motion.
- 5) The control console shall be of such design and installation to be tamper and theft proof.
- 6) Control console shall have painted steel enclosure, heavy duty oil tight push buttons, selection switches, and indicating lights. "Push to Test" push buttons shall be provided for indicating lamps. All legend plates shall colored graphic labels mounted on the surface.

b. Controls:

- 1) A key switch with positions marked "Auto", "Manual", and "Autolevel". The key can be removed only in the "Auto" and "Autolevel" positions.
- 2) A lever arm that controls all forward and reverse motions. The speed of travel (forward/reverse) shall be proportional to the movement of the lever arm. Push button controls shall provide for steering motion. Legend plates marked "Left", "Steer" and "Right".
- 3) Push button switches to extend or retract the Aircraft Canopy independently. Legend plates marked "Extend" and "Retract" and "Left" and "Right". .
- 4) A red, mushroom head, maintained contact emergency stop switch for turning power off to all controls, except lights.
- 5) A push button switch to bypass the Rotunda travel limit switches, located inside of the console and to bypass the wheel rotation travel limit.
- 6) A push button switch to operate the cab rotation, left and right. Legend plates marked "Left" and "Right".
- 7) A switch for floodlights that illuminate the apron area under the aircraft, drive column undercarriage. A switch for the overhead lights in the cab.
- 8) All switches and/or push buttons shall be labeled. Each function shall be spelled out, i.e. "Canopy" "Extend"-"Retract".
- 9) Primary Switch: A standard switch on the control panel shall be used to energize and de-energize the other panel controls.
- 10) A disconnect switch inside the bridge main control power cabinet shall be provided. When this disconnect switch is depressed, all power to the bridge shall be interrupted.

c. Labeling: The control panel shall include all passenger loading bridge motion controls, cab weather door controls, canopy controls, emergency stop control, cab and control panel lights, ramp floodlights, and associated indicator lights, meters and gages, if any. These shall be permanently labeled as to function.

- 1) Telephone Service: A 6 wire telephone outlet, complete with all conduit and fittings for installation of telephone or intercommunication system and a standard modular jack, shall be provided in the vicinity of the Control Station. The telephone set will be provided by DEN.
- 2) Convenience Outlets: 4 unswitched 120 volt, 1 phase, 60 Hz, 20 A, 3 conductor duplex receptacles shall be provided, one located near the operator's console, one in the rotunda, one weatherproof outlet at the wheel bogey, and one weatherproof outlet on roof near lifting column.
- 3) A minimum of 6 spare conductors shall be included in the bridge control circuitry for possible future additions or changes to the control system.
- 4) All electrical switch and receptacle device plate covers shall be stainless steel and shall match the device configurations, and on

- exposed wiring shall exactly fit the outlet box dimensions.
- 5) Indicators: The operator's control station shall include indicators for the following:
- d. An aircraft cab floor height indicator mounted in the Control Console.
 - e. A drive/steer position indicator mounted in the Control Console that shows wheel orientation, regardless of the cabs rotational position.
 - f. An amber light (console) that indicates the auto leveling function is energized and operating.
 - g. A red light (console) that indicates an auto level travel timer has tripped. This light shall be coupled with an audible alarm. In the event of the interruption of primary power at the main contractor, both visual and audible warnings shall be activated when in the auto level mode.
 - h. An amber light (console) that indicates when the bridge is approaching its maximum rotational points (Rotunda Limit). This light shall be coupled with an audible alarm.
 - i. A red light (console) that indicates when the bridge has reached its maximum rotational points (Rotunda Limit), both left and right. This light shall be coupled with an audible alarm.
 - j. Amber light associated with control switch mounted in the operator control console indicating cab floor deicing "on" status.
 - k. A red light that indicates when the aircraft closure curtain is not in the full stowed position.
 - l. Green status light for pre conditioned air, including light and terminal points within the console for field connection to the light.

C. Control System:

- 1. Motion Control System:
 - a. The motion control switches shall be of a "dead man" type which must be manually held "on" during entire period of operation and shall be fully protected at all times against the outside environment and passenger interference.
 - b. In most cases, visual observation of the ramp area through viewing windows shall be adequate for monitoring the passenger loading bridge position.
 - c. The Contractor shall also provide an amber rotating light and a bell warning system on the exterior base of the bridge head/cab.
 - d. These warning systems shall be automatically activated by any movement of the loading bridge, except when in the Autolevel mode.
- 2. Canopy Control: The canopy shall be operated by switch from the operator's control panel.
- 3. Emergency Stop Control: An emergency stop button shall be provided on the control panel to stop all motion of the passenger loading bridge.
- 4. Movement Prevention Interlocks:
 - a. General: The control system logic shall be such as to preclude damage to circuits or mechanical systems because of simultaneous contrary control

- signals or an otherwise unsafe combination of control signals.
- b. Deployed Canopy Interlock: All passenger loading bridge motion, except auto leveling, shall be possible only when the canopy is in a fully retracted position. Provide for a mechanical override (of the dead man type) to permit the retraction (only in case of mechanical emergency or mechanical failure) of the bridge with the canopy not in the fully retracted position.
 - c. Contrary Control Signal Interlock: All loading bridge motion shall be precluded whenever contrary control signals (e.g., extend and retract) are activated.
5. Actuator Systems:
- a. General: All actuator systems shall be protected from motion overrun near the design limits of motion. All equipment shall be designed to be fail safe both in terms of the components themselves and in terms of the passenger loading bridge as a whole.
 - b. Limit Switches for Electrical Mechanical Designs: Electrical limit switches shall be provided on all passenger loading bridge movement actuator systems, car bumper, canopy system, and include fail safe limit switches near the end of horizontal travel and vertical travel. These switches, when contacted, shall de-energize their respective actuator systems. The tunnel rotation limit switch shall be located per manufacturer's recommendations and reset locally.
 - c. Mechanical Stops: Mechanical stops shall be provided on all movement actual systems except for tunnel rotation, which shall have a dual limit switch. Mechanical stops shall be shown and detailed on shop drawings.
6. In Service, Docked to Aircraft:
- a. Auto leveling: All passenger loading bridges shall be equipped with an automatic leveling device which permits the bridge to automatically respond to small changes in aircraft door sill height thus maintaining a constant relationship between the floor of the aircraft and the floor of the loading bridge.
 - 1) It shall not exert any stresses on the loading bridge. The leveling device actuating mechanism or sensor which contacts the aircraft shall be located on the right side of the cab in full view of the operator at all times.
 - 2) If the actuating mechanism or sensor is located in the cab interior or other area normally exposed to passenger traffic, it shall be adequately protected or shrouded to preclude passenger interference.
 - 3) It shall function reliably on all specified aircraft regardless of door location, fuselage contour, and aircraft doorsill height.
 - 4) Since the aircraft and passenger loading bridge are exposed to various wind conditions and jet blast during the servicing period, the auto level actuating mechanism and sensor shall be capable of activating within the full range of its horizontal or lateral clearance.
 - 5) The control circuitry shall include an adjustable solid state timer

- which will limit the automatic leveler's continuous response in either direction.
- 6) The timer shall have a maximum rotation of one revolution and allow a range of adjustment of at least six inches (150 mm) up or down from a neutral position.
 - 7) The circuitry shall include an audible alarm and warning light at the control station, and a bell or horn in the general ramp area, which shall produce a distinctively different sound than any other on the unit, when the timer interrupts the response to the system.
 - 8) When the timer circuit is interrupted, the vertical lift system shall automatically be locked in position and de-energized, a vertical travel brake automatically engaged and a red warning light and audible alarm will be energized on the control panel, a red warning light and an audible warning horn will be activated in the ramp area, and an audible alarm sounded in the adjacent holdroom.
- b. Adjustable Cab Floor: The cab (aircraft vestibule) shall be provided with a synchronized up and down control to assure a level horizontal attitude at the various extension lengths, vertical heights, and tunnel and cab rotations of the passenger loading bridge. The Contractor shall submit details of his design for review by the Construction Supervisor.
- c. Aircraft Height Indicator: An aircraft height indicator to enable the operator to pre position the cab to the approximate aircraft sill height prior to the arrival shall be prominently displayed on the control console. This indicator can either be digital or have lights which shall indicate the sill height of each aircraft type.
- 1) The indicator shall be permanently calibrated for each aircraft prior to the initial inspection of the passenger loading bridges.
 - 2) All electrical connections to the height indicator stops shall be securely fastened and enclosed in a box for waterproofing and to prevent tampering.
- d. The lifting mechanism shall hold securely at any elevation within the travel range with or without power supplied and in the event of power failure.

2.5 POWER AND COMMUNICATION CHARACTERISTICS

- A. The boarding bridge shall operate on 480 volts, 3 phase, 60 Hz, and "Y" configuration with neutral and ground power for motion. The 480V AC shall be transformed to 120/240V AC for lighting and controls by an onboard transformer provided with the loading bridge. The transformer shall be mounted according to manufacturer standards.
- B. Power requirements for boarding bridges that are equipped with bridge mounted, 400 Hz solid state aircraft power units must have a dedicated input circuit of the 480V, 3 phase, 60 Hz "Y" configuration with neutral and ground power as follows:
1. 1.90 kVA 400 Hz unit = 150 amps.

2. 10120 kVA 400 Hz unit = 225 amps.
- C. All exterior electrical components shall be housed in weathertight and corrosion resistant enclosures; aluminum, stainless steel, etc.
- D. Provisions for a restricted telephone service next to the control panel. The Contractor shall furnish and install a $3/4$ inch (20 mm) (min.) diameter galvanized steel conduit, with 8 conductor communications cable from a junction box at the rotunda end to a junction box installed in the cab wall adjacent to the operator's console located approximately 54 inches (1372 mm) above the floor.

2.6 INTERIOR SURFACES

A. Walls:

1. Interior wall treatment shall consist (unless noted otherwise) laminated flame resistant phenolic plastic panels (Wilson Art or equivalent) four (4) feet wide with aluminum trim and recessed black accept strips. The decorative facing shall consist of a high-pressure laminate, of approximate thickness of 0.030". Subject to compliance with requirements, provide one of the following:
 - a. Wilson Art # 264.
 - b. **<Insert manufacturer's name>**
 - c. or approved equal.
2. The finished product shall carry a UL label and meet the flame spread test as listed in ASTM E-84.

B. Floors:

1. Passenger loading bridge, rotunda, tunnels, and cab floors shall be constructed of $3/4$ " high-density fire retardant plywood subfloor.
2. Loading bridge floor finish shall be factory-installed carpet.
3. Cab floor finish shall be black ribbed, non-skid, neoprene floor finish. Subject to compliance with requirements, provide one of the following:
 - a. Musson Rubber Company Epoxy Glue, #775.
 - b. **<Insert manufacturer's name>**
 - c. or approved equal.
4. Anodized aluminum and other galvanized, aluminum, or stainless steel shall have a satin finish.

PART 3 - EXECUTION (NOT USED)

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

PART 6 - APPENDIX 147310 A

6.1 Copy of Memorandum of Understanding between the City and County of Denver Building Department and Denver International Airport

MEMORANDUM

DATE: 5 August 2004
TO: John Brann
Chief Construction Inspector
THROUGH: Hana Rocek, PE
Assistant Deputy Manager
THROUGH: Reginald Norman, RA
Design Manager
FROM: Mark Percy,
Project Manager

- A. SUBJECT: Memorandum of Understanding / Administrative Modification
1. Fixed and Moveable Aircraft Loading Walkways at Denver International Airport
- B. CODES:
1. 2004 Denver Amendments to the 2003 International Building Code
 2. NFPA 415
- C. REQUEST:
1. Denver International Airport desires to clarify and strengthen requirements that govern constructing moveable and fixed Aircraft Loading Walkways. Therefore, we request approval of the Provisions I through VI as detailed below.
- D. REFERENCE:
1. Memorandum of Interpretation and Administrative Understanding (MAU) dated 25 August 1992 (attached)
 2. Administrative Modification (AM) 2003 AM 0496 dated 28 October 2003

(attached)

E. PROVISIONS:

1. Memorandum of Interpretation and Administrative Understanding dated 25 August 1992
 - a. This Memorandum remains in full effect, with the following exception:
 - 1) All references to "NAPA 417" shall be changed to "NFPA 415".
2. Administrative Modification 2003 AM 0496 dated 28 October 2003
 - a. This Administrative Modification shall remain in full effect, with the following exception:
 - 1) Item 1 shall be revised to read "The fixed bridges to be used shall be similar to those originally installed on Concourse B, and shall be in compliance with the Denver Amendments to the 2003 International Building Code and NFPA 415".
3. 2004 Denver Amendments to the 2003 International Building Code, Appendix N, Paragraph N103.3
 - a. This Paragraph remains in full effect, with the following exception:
 - 1) All references to "NAPA 417" shall be changed to "NFPA 415".
4. Maximum Allowable Distances for Aircraft Loading Aircraft Loading Walkways at Denver International Airport
 - a. Fixed and Moveable Aircraft Loading Walkways of a total combined length not to exceed 242'-0" from Concourse face to Aircraft threshold shall be constructed per the Memorandum of Interpretation and Administrative Understanding dated 25 August 1992 as modified herein.
 - b. Fixed and Moveable Aircraft Loading Walkways of a total combined length greater than 242'-0" but not to exceed 400'-0" from Concourse face to Aircraft threshold shall be constructed per the Administrative Modification 2003 AM 0496 dated 28 October 2003 as modified herein.
 - c. Fixed and Moveable Aircraft Loading Walkways of a total combined length greater than 400'-0" from Concourse face to Aircraft threshold shall be one-hour noncombustible construction from Concourse face to such a length that the remaining portion is 242'-0" or less. The remaining portion shall be constructed per the Administrative Modification 2003 AM 0496 dated 28 October 2003 as modified herein.
5. Building Permit Application Requirements for Aircraft Loading Aircraft Loading Walkways at Denver International Airport
 - a. Drawings (2 Sets)

- 1) Airport Site Plan
 - 2) Concourse Orientation Plan
 - 3) Gate Plan
 - 4) Cross Section through Aircraft Loading Walkway
- b. Complete set of Technical Specifications (1 Set)
- c. Calculations (1 Set)
- 1) Wind Load shall be 30 miles per hour (mph)
 - 2) Jet Blast Load shall not be applicable
 - 3) Applicable Live Loads shall be stated
 - 4) Load at Concourse face (if applicable) shall be stated
 - 5) Worst Case Loads at both ends of Aircraft Loading Walkway (full extension) shall be stated
 - 6) Wheel Load at Apron
 - 7) Caisson Load at Rotunda
 - 8) Worst Case Overturning Moment
 - 9) Electrical Loads, accompanied by Panel Schedules and One Line Diagrams
- d. Certifications (1 Set)
- 1) Manufacturer shall certify Aircraft Loading Walkways meet all applicable provisions of NFPA 415
 - 2) Manufacturer shall certify all electrical materials, components, etc. used to construct the Aircraft Loading Walkways meet NEMA 3R
 - 3) Manufacturer shall demonstrate compliance with the above standards by submission of a letter from a Nationally Recognized Testing Laboratory (NRTL). Inspection and verification by the independent laboratory of the manufacturer's facilities shall have taken place within six (6) months of the letter's date.
 - 4) A structural consultant, currently registered as a Professional Engineer in the State of Colorado, shall review calculations furnished by the Manufacturer and author a report on those calculations and submit report to Denver International Airport for subsequent review by Denver Building Inspection Division.
- e. Nothing in these Provisions shall be interpreted as lessening the requirements for Professionals currently licensed in the State of Colorado to stamp and sign submitted documents.
6. Structural Analysis
- a. Denver International Airport assumes all responsibilities for inspection Manufacturer's in-plant welding.
 - b. A structural consultant, currently registered as a Professional Engineer in the State of Colorado shall inspect the Aircraft Loading Walkways once erection in complete. The Engineer shall then author a report to Denver International Airport on their findings. This report shall be forwarded to Denver Building Inspection Division by Denver International Airport. The

Engineer shall inspect where applicable:

- 1) Foundation connections to Apron
- 2) Foundation connections to support columns
- 3) Column connections to Aircraft Loading Walkways.
- 4) Any other connections completed in the field.

END OF SECTION 147310

SECTION 147320 - RADIAL DRIVE PASSENGER BOARDING BRIDGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Refer to specification sections for furnishing and installing new foundations, Pre-conditioned Air Units, and Ground Power Units.

1.2 SUMMARY

- A. This Section specifies the design, fabrication, testing, transporting, installing, and commissioning of new Radial Drive Passenger Boarding Bridges ("PBB" or "bridge"), including new bridges, new walkways, new pedestals, and rotundas as shown on the Contract Documents.
 - 1. Related Requirements:
 - a. Provisions of the Contract, General and Special Conditions, Technical Specifications Division 01, and all other Technical Specification Sections, apply to this Section.
 - B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. Definitions in ASME A18.1 apply to Work of this Section.

1.4 ACTION SUBMITTALS

- A. General: Submit required items in accordance with General Contract Conditions and Division 01 Specification Sections.
 - 1. All drawings, sketches details, and material shall be submitted in the English language, in United States units, including dimensions, volumes, weights, and forces. The use of metric or SI units is not acceptable.
 - 2. No installation of any of the passenger loading bridge components shall begin until the drawings for such components have been reviewed and approved in writing by DEN. Fabrication and / or assembly begun prior to approval by DEN is done so solely at the risk of the Contractor / Manufacturer. Additional drawings

shall be submitted as necessary to fully describe the bridge to be delivered.

B. Minimum Required Submittal for Layout Approval:

1. Complete finalized layout, including fuel pits and PC Air units.

C. Minimum Required Submittals for Shop Drawing:

1. Complete Issue for Construction set of drawings and technical specifications including:
 - a. Cover sheet with sheet index.
 - b. Vicinity plan of Airport and surrounding area.
 - c. Concourse key plan.
 - d. Gate layout plan including centerlines of rotundas in DEN coordinate system and with dimensions.
 - e. Phasing / Safety plan including trenching required for fuel pit work.
 - f. Foundation drawings.
 - g. Electrical drawings.
 - h. All other letters and calculations required for Building Permit.
 - i. Graphics / signage details.
 - j. Paint finishes.
 - k. Preconditioned air and 400 Hz brackets and connection details for tie-in to existing monitoring system.
 - l. Technical Specifications.

D. Minimum Required Submittals for Building Permit.

1. See Memorandum of Understanding, Article V attached as 147320 Appendix A at the end of this Section
2. Elevations:
 - a. Side elevation of new bridges including Holdroom section.
 - b. Front elevation of new bridges including Holdroom elevation beyond.

E. Minimum Required Submittals for Materials:

1. Reference Technical Specification Section 013300 "Submittal Procedures" for the Master List of Submittals

F. Minimum Required Submittals for End of Project Report.

1. See Memorandum of Understanding, Article VI attached as 147310 Appendix A at the end of this section

G. Welding: Refer to Technical Specification Section 059990 "Welding" for required welding submittals for field welding only. All shop welding shall be of good commercial quality.

H. Spare parts:

1. Recommended spare parts list with current prices shall be furnished not less than 45 days prior to arrival of a bridge.

I. All items required by Airlines / Denver International Airport agreement.

J. LEED Submittals:

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Preinstallation Examination Report: Indicating dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.

C. Product Certificates: For each type of lift.

D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lift to include in operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

- a. Parts list with sources indicated.
- b. Recommended parts inventory list.

B. Verify requirements for as-built plans with DEN Project Manager.

C. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at **[location and time as determined by DEN Project Manager][Project site] <Insert location>**.

1.8 STANDARDS

A. The standards listed below represent the minimum required standards. All editions shall be the most current issue. Safety to passengers, other personnel, aircraft, and equipment is of prime importance. Nothing in these specifications shall relieve the Contractor of the responsibility for providing a safe product.

B. Design:

1. Codes, Regulations, and References: The bridge shall be designed to conform to all applicable Federal, State of Colorado, and City and County of Denver codes and regulations, including applicable Memoranda of Understanding between the City and County of Denver Building Department and DEN.
2. American Welding Society (AWS) Standards (Technical Specification Section 059990 "Welding" applies to field welding should the need for any arise).
3. National Electrical Code (NEC) and National Electrical Manufacturers Association (NEMA).
4. National Fire Prevention Association (NFPA): New bridges shall meet all provisions of NFPA 415.
5. Mechanical Specifications and Standards.
 - a. All Mechanical components and designs shall conform to the recommendations and standards of the Society of Automotive Engineers (SAE), Joint Industrial Conference (JIC) and the American Society of Mechanical Engineers (ASME).
 - b. All threaded fasteners shall incorporate suitable locking devices.
 - c. All components shall be U.S. or Canadian manufactured or be directly interchangeable.
6. Occupational Safety and Health Administration (OSHA).
7. The Society for Protective Coatings (SSPC).

C. Safety:

1. All equipment shall be designed to be fail-safe and all controls, which regulate bridge motions (i.e., horizontal travel, vertical travel, and cab rotation), shall be of the dead-man type. Dead-man type shall mean controls, which require the operator to apply constant pressure to be engaged. Once the pressure is released, the control is disengaged.
2. All operating mechanisms, i.e. horizontal and vertical drive, cab rotation, etc., shall be designed so the drive mechanism is locked when power fails or is shut off.
3. Positive stops shall be provided to prevent dangerous overtravel where any component might become disengaged from its guiding or restraining component. The positive stop shall be in addition to all limit switches provided to restrict overtravel under normal operating conditions, including bogie steering motions. Documents highlighting the actual stops are a shop drawing requirement.
4. The operator's position in the control cab shall be designed to permit the operator to position the loading bridge with the cab weather door closed. Suitable enclosures, guard rails, etc., shall be provided to protect the operator from being pitched out the open end of the cab (when operated from an open door) in case of sudden stops or inadvertent movements of the bridge. A handhold shall be attached to the wall on both sides of the cab weather door.
5. The passenger loading bridges shall comply with all applicable local building codes and regulations at point of installation, which are in effect at the time of manufacture.
6. All sheared or sharp metal edges shall be deburred or broken. All exposed metal

corners shall have radii.

D. Materials:

Component:	ASTM Grade or Equivalent (Min. Properties)
Structural Plate	ASTM-A#%-70A
Structural Steel and Shapes	ASTM-A36-69
Steel Tube	ASTM-A36-69
Steel Pipe	ASTM-A53-B
Steel Sheet	ASTM-A570-72 F or ASTM-A569
T-1 Pins	ASTM-A5-4-64 F or ASTM-A517-64 F
Hinge Pins	AISC-C1018
Bolts - Standard	ASTM-A307
Bolts - High Strength	ASTM-A325 or SAE Grade 8
Welding: All shop welding shall be good commercial quality per all applicable provisions of American Welding Society or Canadian Welding Bureau. Field welding shall also be governed by Technical Specification Section 059990 "Welding"..	

E. Maintenance:

1. Components shall be installed with adequate access and type of fasteners to permit them to be changed by one man. Where the weight of a component requires mechanical assistance, the component or assembly shall be provided with lift eyes, forklift guides, etc. Particular attention shall be given to keeping components simple, rugged, and easily accessible for routine maintenance, lubrication, component exchange and adjustment.
2. Access panels, where required to gain access to equipment or maintenance areas, shall be suitably sized to permit accomplishment of the tasks required including tools and equipment. The panel shall be permanently attached to the structure by hinges, etc., and any fasteners required shall be a permanent part of the panel, etc., to prevent loss.
3. If special tools are required for routine maintenance, one (1) set shall be furnished by the Contractor for each year of the project.
4. Modular components: Provide for rapid corrective maintenance of malfunctioning elements through use of standardized modular components, which are readily available in the continental U.S. Allowance must be made for convenient access to components critical to the operation of the passenger loading bridge.
5. Manuals and Training: The Bridge Contractor shall furnish to DEN two (2) copies of its maintenance manual for Radial Drive Bridges and 1 copy of the manual in Microsoft Word format on disk. The manual shall clearly identify all required periodic maintenance. Two (2) eight hour sessions shall be provided to train DEN's Maintenance personnel. One session shall be late afternoon or evening.
6. If special tools are required the Contractor shall identify them and supply 2 sets to DEN.
7. A recommended spare parts list with current prices shall be submitted as an

attachment to Appendix 147320 A. A price for each individual part shall be given.

F. Structural Design:

1. Structural Loads: The bridge shall support the following loads. The bridge shall accommodate the combination that imposes the most adverse loading condition. In addition to the dead loads and strain caused by movement, the entire passenger boarding bridge shall support:
 - a. A live load of 40 pounds per square foot (195 kg/m²).
 - b. An operational wind load of 12.5 pounds per square foot (61 kg/m²) or an approximate wind velocity of 60.0 mph (97 km/h).
 - c. A retracted and stowed wind load of 25 pounds per square foot (122 kg/m²) or an approximate wind velocity of 90.0 mph (145 km/h).
 - d. A roof load (snow load) of 25 pounds per square foot. (122 kg/ m²).
 - e. 200 pound maintenance personnel on roof.
2. The bridge shall be sufficiently rigid to avoid excessive sway when the bridge is brought to a gradual stop.
3. All mechanisms for actuating, guiding, and restraining the bridge and its components shall be designed so that no excessive noise, sway, or sense of insecurity is apparent to passengers. No operating vibrations or loads shall be transmitted to the concourse building.
4. The bridge shall be capable of accommodating the added loads of 400 Hz point of use Ground Power Unit (GPU), 28 Volt DC equipment, Gate Signage, Pre-Conditioned Air (PCA) equipment and potable water system. Reference Contract Documents for equipment loads and locations.
5. The bridge shall receive no structural support from the building. Reference the Contract Documents for foundations.

G. Electrical Design:

1. Bridge power shall be 480 volt AC, 60 Hz, 3 phase, 4 wire. Power shall be transformed to 120 / 240 volt for lighting and as required for controls.
2. All unsupported power cabling shall have strain relief.
3. Power cabling shall be capable of accommodating full range of bridge motion.
4. 120 volt weatherproof GFI duplex outlet on separate circuits shall be provided at the drive column and near the rotunda
5. A minimum of two 120 volt, 15 amp duplex outlets shall be provided at the bridge interior. One shall be located in the cab, near the control console, and the other shall be located in or immediately adjacent to the rotunda.
6. Coordinate with Ground Power Unit (GPU) supplier and provide lifting cable and hoist adequate to allow the power cable to service every aircraft in the fleet mix.

H. Communication Design

1. A telephone outlet shall be provided on the wall adjacent to the control console supplied by a minimum of six pairs.

I. Pre Conditioned Air (PCA): Reference Contract Documents for PCAir requirements.

1. Coordinate with the PCA supplier to allow a hose basket for the PCA hose to be mounted at drive assembly.

J. Environmental Considerations:

1. The bridge shall operate satisfactorily, consistently, and reliably under ambient temperatures from **-40 deg F (-40 deg C)** to **125 deg F (52 deg C)**. All bridge components and materials shall be individually and collectively be designed and / or selected for reliable long service life under these conditions.
2. The entire bridge shall be weatherproof and any equipment or controls that are exposed to the weather shall be weatherproof type or housed in weatherproof boxes (NEMA 3R or 4 rating).

- K. Slope: The maximum slope of the bridge shall be 1:12 or 8.33% when reaching the threshold of any aircraft in the designated aircraft fleet mix.

1.9 INSTALLATION REQUIREMENTS

- A. The Contractor shall provide qualified technical and service personnel during the installation of the loading bridges to assure a proper installation. These representatives shall also be available to DEN at no charge on delivery of the first bridge and shall be on call for a timely response within eight (8) hours for a period of sixty (60) days after each loading bridge is officially opened for airline operations. This is to ensure adequate and reliable field service support to correct any and all equipment failures that normally occur during the initial operating period.
- B. Reference Technical Specification Section 011400 "Work Sequence and Constraints" for other Installation Requirements.
- C. Communications:
1. Verification of existing communications at each existing bridge. Contractor shall also coordinate re-connection of communications with current communications contractor, Qwest.
 2. Contractor shall also coordinate reconnection of existing Pre Conditioned Air monitoring system with DEN HVAC department.

1.10 ACCEPTANCE PROCEDURES

- A. In addition to the requirements described in the General Conditions and elsewhere in the Technical Specifications, the following also applies:
1. Final Acceptance Inspection:
 - a. Final acceptance shall be done on an individual gate basis.
 - b. After full compliance by the Contractor of all outstanding Punch List items as determined from the Conditional Acceptance Inspection, DEN shall perform the final inspection of the bridge.
 - c. The Contractor shall make certain that each bridge is complete in all

respects and operating properly, all deficiencies noted in the Conditional Acceptance Inspection are corrected, and all training accomplished prior to the requesting the Project Manager to witness and make the Final Acceptance Inspection. Upon satisfactory completion of that inspection, a Certificate of Customer Acceptance will be issued. The warranty for each individual bridge shall begin upon its Final Acceptance.

- d. DEN reserves the right to employ an independent testing laboratory to inspect the bridges to verify the Contractor's compliance with the specified structural, welding, mechanical, electrical, and fireproofing requirements. Deficiencies and / or violations reported by DEN's laboratory shall be immediately corrected by the Contractor at no cost to DEN. The cost of re-inspection by DEN's Laboratory shall be borne by the Contractor and DEN will deduct such reinspection costs from monies due to the Contractor.

1.11 WARRANTY

- A. The bridge shall be warranted against defects in material and workmanship for twenty-four (24) months from the date of Final Acceptance by DEN in accordance with the PBB Contractor's standard product warranty. Warranty work shall be provided at no cost to DEN and shall include all labor and materials necessary to replace/repair defective material and workmanship during the period of the warranty. See Technical Specifications Sections Section 017835 "Warranties and Bonds" for requirements.

1.12 AIRCRAFT FLEET MIX

- A. All CRJ types.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Acceptable Manufacturers:
 1. Dew Bridge Airport Systems.
 2. FMC Technologies.
 3. **<Insert manufacturer>**
 4. or approved equal per Division 01.
- B. Contractor shall furnish and install only radial drive bridges, in which the drive wheels travel in a fixed arc across the apron, and the tunnel section nearest the aircraft shall be capable of an extend / retract motion. The cab of the bridge shall be capable of rotating about a fixed point. The bridge shall be capable of a range of motion in its arc travel, extend / retract plane, and cab rotation that will allow it to safely dock to every aircraft specified in the Aircraft fleet mix.
- C. Contractor shall demonstrate that every aircraft contained in the aircraft fleet mix will be adequately serviced. Also, the slope for each bridge at each aircraft type shall be

given.

- D. All interior and exterior colors and finishes shall be selected by DEN.

2.2 WALKWAY

- A. The walkway is the connection between the Commuter Building and rotunda, and shall be constructed to match the Tunnels
- B. The Contractor shall furnish and install an aluminum diamond plate threshold at the floor gap between the Commuter Building and the walkway.
- C. The Contractor shall furnish and install weatherproof and watertight flashing at the wall and ceiling junctures between the Commuter Building and the walkway. The flashing shall be flexible enough to maintain its integrity independently of all bridge and / or rotunda motion or walkway motion due to ambient temperature changes.
- D. During installation of the bridges, walkways, and / or rotundas, the Contractor shall maintain temporary watertight and weatherproof seals as required to protect the Commuter Building interior.

2.3 ROTUNDA ASSEMBLY

- A. The rotunda shall be the stationary pivot point for the bridge to rotate about horizontally and vertically. It shall be self supporting; not imparting any loads to the Commuter Building (reference Contract Documents for foundations). The Contractor shall be responsible for coordinating with the bridge manufacturer as to the bolt pattern required to anchor the rotunda. The rotunda shall be capable of a total range of horizontal rotation of 175 degrees. This range shall be equally distributed in clockwise and counterclockwise directions.
- B. The walls of the rotunda shall be constructed of a slat type sheet metal curtain assembly. The rotunda shall also have flexible panels capable of maintaining a weather tight seal as the rotunda rotates. The rotunda shall also have dual rubber seals at its juncture with the tunnel to maintain weatherproof and watertight protection.
- C. The floor of the rotunda shall be flat and stationary, being level with the floor of the Commuter Building.
- D. Limit Switches: The rotunda shall have limit switches that protect it against damage by the bridge over-traveling its range of motion in any and all directions. These limit switches shall be adjustable and disable all motion except that opposite the direction of over-travel. The limit switch shall activate a warning buzzer and light on the operator's console when a limit is reached.

2.4 TUNNELS

- A. The tunnel spans between the rotunda assembly and the cab assembly. It may be

constructed of corrugated steel wall panels of 14 gauge minimum thickness, or alternatively as a steel tube truss with walls and roof constructed of 24 gauge minimum thickness. The tunnels shall be rectangular in its cross section. The exterior walls and roof shall be painted. Paint colors and interior wall finishes shall be selected by DEN. The interior wall finish shall be plastic laminate of a color selected by DEN. The interior wall panels shall be individually removable and trimmed by clear anodized aluminum strips. Exterior finishes shall be cleaned per SPPC SP-1, dry abrasive blast prepared per SPPC SP-6, primed to a minimum of 2-10 mils dry film thickness with Sherwin Williams Hi Build Epoxy or approved equal, and finish coated to a minimum of 2-3 mils dry film thickness with Sherwin Williams Polane H Polyurethane or approved equal.

- B. The floor shall be of steel construction and meet NFPA 415. Floor covering shall be carpet to match that in the Commuter Facility supplied by the General Contractor and installed by the bridge manufacturer after the bridge is in place.
- C. A transition ramp shall be provided over any changes in elevation between tunnel segments. Handrails shall run on both sides of the transition ramp and a one inch minimum OSHA compliant yellow alert strip shall be placed on the transition strip nosing. The transition ramps shall be covered in the same flooring material as the remainder of the bridge.
- D. The tunnel segments shall be provided with seals capable of maintaining weatherproof and waterproof integrity throughout the tunnel's extension / retraction range
- E. The tunnel ceiling shall be constructed of removable interlocking metal panels, painted a color selected by DEN. The panels shall span transversely across the tunnels. A continuous trim piece shall be provided at the juncture between the ceiling and each wall.
- F. The tunnels shall have mounted within the ceiling, fluorescent lighting providing a minimum of 18 footcandles at the floor. The lights shall be circuited such that one light remains on at all times, or the lights shall be provided with emergency ballasts. The lights shall be switched both from the cab and immediately adjacent to the Commuter Building.
- G. Limit Switches: The tunnels shall have limit switches that protect it against damage by the bridge over-traveling its extend / retract range of motion. These limit switches shall be adjustable and disable all motion except that opposite the direction of over-travel. The limit switch shall activate a warning buzzer and light on the operator's console when a limit is reached.
- H. Provide OSHA approved painted steel guardrails at the roof or provisions for attaching fall protection cable per OSHA requirements.

2.5 CAB ASSEMBLY

- A. The cab shall be located at the aircraft end of the tunnels. It shall be capable of a range of motion that renders it capable of safely docking to all aircraft in the fleet mix.

- B. The cab shall have an operator's control console located on its right side. The control console shall be afforded the largest view windows possible to its right side and front. Reference Article 2.6 for control console.
- C. The cab shall have a weather door with a minimum clear width of 30 inches at its front (immediately adjacent to the aircraft). This door shall afford weatherproof and waterproof protection when closed and have the largest possible view window. The door shall have a mechanism capable of holding it opened and closed.
- D. The cab shall have a bumper at its leading edge sufficiently flexible and non-abrasive enough that it will not damage or mar aircraft while the bridge is docked to it. The bumper shall also meet all NFPA 415 requirements. It shall accommodate all aspects of every aircraft in the fleet mix such as doors, steps, stairs, handrails, pitot tubes, etc.
- E. The walls of the cab shall be constructed of a slat type sheet metal curtain assembly that allows it to rotate a minimum of 90 degrees. The maximum cab rotation speed shall be 3.5 deg/sec. Limit switches shall be provided that prevent the over rotation of the cab. These limit switches shall be adjustable and disable all motion except that opposite the direction of over-rotation. The limit switch shall activate a warning buzzer and light on the operator's console when a limit is reached.
- F. The remaining walls and ceiling shall be constructed to match those of the tunnels. All interior and exterior finishes shall match those of the tunnels.
- G. The cab floor shall be self leveling regardless of bridge slope or orientation relative to the aircraft. The floor shall be heated and finished with 3/16 inch ribbed black rubber. The cab floor shall be extendable / retractable on its left side and provided with handrail slots to meet its designated aircraft fleet mix. Limit switches and pressure sensitive switches shall disable all bridge motion and trigger visible and audible warnings at the control console if contact is made with any part of the aircraft, including handrails.
- H. A moveable handrail system shall be provided at the left side of the cab to assist passengers as they exit the aircraft.
- I. The cab shall be equipped with fluorescent lights at its interior ceiling and weatherproof fluorescent lights at its exterior aircraft side entrance. Minimum lighting level shall be 18 footcandles measured at the floor.
- J. Exterior floodlights controlled from the control console shall be provided to illuminate the apron area.
- K. An amber flashing light shall be provided underneath the cab that activate when the bridge power is turned on. A 90 db minimum audible alarm shall also be located underneath the cab and sound whenever the bridge moves.
- L. Manufacturer's standard Baggage Lift to be added to the bridge.
- M. Manufacturer to include a Powered Bagslide System as manufactured by Advanced Bridge Systems to the bridge.

- N. Provide OSHA approved painted steel guardrails at the roof or provisions for attaching fall protection cable

2.6 CONTROL CONSOLE

- A. The control console shall be located per Part 2. If the console is configured with sides, they shall be constructed of steel panels painted to match the walls and its faceplate shall be of brushed stainless steel.

- B. Bridge Controls: All bridge controls shall be of the momentary contact (“deadman”) type and the following controls shall be provided at a minimum:

1. A 3 position master switch shall be used to select “OFF”, “ON”, or “AUTO” (auto level). The key shall only be removable when in the “OFF” or “AUTO” position. Two keys shall be provided for each bridge.
 - a. In the “OFF” position all controls and power to actuating motors shall be disabled.
 - b. In the “ON” position, all controls shall be active (except when overridden by limit switches or interlocks) and power shall be supplied to all actuating motors.
 - c. In the “AUTO” position all controls shall be disabled except for Auto Level and power supplied only to the vertical drive actuating motors.
2. Lever arms or push buttons shall control:
 - a. Bridge drive right / left.
 - b. Bridge raise / lower.
 - c. Tunnel extend / retract.
 - d. Cab rotate right / left.
3. An emergency stop switch that immediately disables all bridge motion.
4. Exterior floodlight control buttons.
5. Floor and platform control buttons.
6. Canopy control buttons.
7. Auto level control buttons.
8. Pre Conditioned Air and Ground Power Unit control buttons, including cable hoists.

- C. Bridge Status Indicators: All warnings shall be visible and audible. The following status indicators shall be provided at a minimum:

1. Diagnostic indicators.
2. Auto Level:
 - a. Activation indicator.
 - b. Fault warning.
3. Limit warning for all travel / rotation limits.
4. Proximity warning.

5. Cab height indicator.
6. Pre Conditioned Air and Ground Power Unit indicators, including cable hoists.
7. Cab floor heater indicator.

D. Optional Status Controls and Indicators: If the options are selected for inclusion by DEN, provide the following status indicators:

1. Baggage Valet in controls / indicators.
2. Powered Bagslide controls / indicators.

E. Maintenance Access: Maintenance access shall be provided by means of lockable access panels. All controls shall be de-energized and all bridge motion disabled when maintenance access panels are opened. Provide two (2) keys per panel per bridge.

F. Each control shall be clearly labeled in English.

2.7 SERVICE ACCESS

A. Service access shall be provided, allowing personnel access from the Apron to the bridge cab.

B. Service Stairs: Stairs shall lead from the Apron to the Service Landing.

1. The stairs shall be constructed of galvanized steel.
2. Stair treads shall be constructed of serrated expanded metal, Gripstrut or equal approved by DEN.
3. The stairs shall be capable of adjusting to the changing bridge height, throughout its entire range of vertical motion.
4. The stairs shall be equipped with rollers at its lowest tread such that it may smoothly travel across the apron with the bridge, throughout its entire range of motion.
5. The stairs shall have OSHA approved handrails on each side constructed of galvanized steel.
6. All treads shall be at an equal rise.

C. A Service Landing shall be furnished and installed on right side of the cab and shall be at the same level as the cab floor.

1. The landing shall be constructed of galvanized steel, with galvanized serrated expanded metal landing surface, Gripstrut or approved equal.
2. The landing shall be surrounded by an OSHA approved guardrail constructed of galvanized steel.

D. A Service Door shall lead from the service landing to the interior of the cab.

1. The door shall be hollow metal steel, painted to match the bridge exterior, and a minimum of 2 feet 6 inches wide and 6 feet 7 inches high.
2. The door shall have weather stripping and threshold to maintain weather proof and water proof integrity.
3. The door shall have heavy duty commercial hardware and closer. The door's

lockset shall be a double sided simplex cipher lock, Kaba Ilco 1000-1 or approved equal.

4. The door shall have a wire glass window.
5. Provide a gutter over the door.

E. A 100 watt minimum light shall be provided at the exterior of the cab, adjacent to the service door. The light shall be switched immediately adjacent to the service door at the cab interior.

F. A painted steel ladder with safety cage shall lead from the landing to the cab roof. The ladder and safety cage shall meet all applicable OSHA standards.

2.8 CANOPY

A. The aircraft end of the cab shall be equipped with a flexible canopy of an adjustable contour capable of sealing against the fuselage of every aircraft listed in the fleet mix. The canopy shall enclose both the aircraft exit door and the cab weather door, affording a weather / moisture screen for passengers.

B. The canopy shall be power actuated such that it deploys against a stationary aircraft and retracts to allow an aircraft to arrive / depart.

C. The canopy shall be constructed of a material that will not mar or scratch the surface of an aircraft. The material shall also meet the provisions of NFPA 415. The material shall also be durable, tear resistant, not absorb water and remain flexible from 40 deg F (-40 deg C) to 125 deg F (52 deg C).

D. The canopy shall have an interlock that prevents horizontal bridge movement while it is deployed.

2.9 DRIVE SYSTEMS

A. Vertical Drive:

1. The vertical drive system shall be a recirculating ball bearing screw assembly on each lift column, with an individual electric motor for each column. Each ball bearing assembly shall be self oiling and have a mechanism(s) to remove dirt from the screw threads. The ball bearing assembly shall be actuated by electrical motors.

2. The lift columns shall either be connected with a synchronized shaft, or have a detector to sense differential movement between the columns and disconnect power from the electrical drive motors in the event of a fault.

3. Each assembly shall be fully capable of independently supporting the full bridge weight at all times.

4. Each vertical lift assembly shall have a brake capable of holding the column securely in place in the absence of electrical power being applied or component failure.

5. The minimum vertical travel speed shall be 3.5 feet per minute.

B. Horizontal Drive

1. The horizontal drive shall be actuated by electrical motors, capable of variable speeds and smooth stop / starts.
2. The horizontal drive system shall be equipped with a manual brake release that will permit the bridge to be towed in the event of a power failure. Provide means to attach a tow bar to the wheel assembly.
3. The bridge shall have solid tires or foam filled tires capable of providing sufficient traction in all weather conditions inherent to Denver.

2.10 CONTROL FEATURES

A. Automatic Leveling Device ("Auto Level"): The bridge shall be equipped with a device, when deployed, capable of sensing elevational changes in a parked aircraft and automatically adjusting the height of the bridge to maintain its vertical relationship to the aircraft.

1. The Auto Level shall perform reliably in conjunction with each aircraft list in the fleet mix.
2. The Auto Level shall be a wheel type device, visible at all time from the control console. The wheel shall freely turn, and constructed of such materials and in such a manner as to not mar or damage the aircraft fuselage.
3. The Auto Level system shall include provisions to trigger a fault and thus stop vertical travel in the event:
 - a. Vertical travel does not cease in an adjustable dimension of 1 inch – 6 inches.
 - b. The Auto Level arm does not cease travel in the adjustable duration of 1 second – 6 seconds.

B. Interlocks: The bridge shall have the following interlocks:

1. Prevention of simultaneous opposite motion.
2. Prevention of motion while Pre Conditioned Air, Ground Power Unit, 28v system, Baggage Valet, and / or Powered Bagslide are operating.

C. Bridge controls shall be PLC based.

D. PRE-CONDITIONED AIR UNIT (PC AIR)

1. Bridge mounted in accordance with Division 23 sections.
2. Stand mounted in accordance with Division 23 sections.

PART 3 - EXECUTION (NOT USED)

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 PAYMENT

- A. No separate payment will be made for work under this section. The cost of the work described in this Section shall be included in the applicable unit price item, work order or lump sum bid item.

PART 6 - APPENDIX 14732 A

- 6.1 Copy of Memorandum of Understanding between the City and County of Denver Building Department and Denver International Airport

MEMORANDUM

DATE: 5 August 2004
TO: John Brann
Chief Construction Inspector
THROUGH: Hana Rocek, PE
Assistant Deputy Manager
THROUGH: Reginald Norman, RA
Design Manager
FROM: Mark Percy,
Project Manager

- A. SUBJECT:
1. Memorandum of Understanding / Administrative Modification
 2. Fixed and Moveable Aircraft Loading Walkways at Denver International Airport
- B. CODES:
1. 2004 Denver Amendments to the 2003 International Building Code
 2. NFPA 415
- C. REQUEST:
1. Denver International Airport desires to clarify and strengthen requirements that govern constructing moveable and fixed Aircraft Loading Walkways. Therefore,

we request approval of the Provisions I through VI as detailed below.

D. REFERENCE:

1. Memorandum of Interpretation and Administrative Understanding (MAU) dated 25 August 1992 (attached)
2. Administrative Modification (AM) 2003 AM 0496 dated 28 October 2003 (attached)

E. PROVISIONS:

1. Memorandum of Interpretation and Administrative Understanding dated 25 August 1992
 - a. This Memorandum remains in full effect, with the following exception:
 - 1) All references to "NAPA 417" shall be changed to "NFPA 415".
2. Administrative Modification 2003 AM 0496 dated 28 October 2003
 - a. This Administrative Modification shall remain in full effect, with the following exception:
 - 1) Item 1 shall be revised to read "The fixed bridges to be used shall be similar to those originally installed on Concourse B, and shall be in compliance with the Denver Amendments to the 2003 International Building Code and NFPA 415".
3. 2004 Denver Amendments to the 2003 International Building Code, Appendix N, Paragraph N103.3
 - a. This Paragraph remains in full effect, with the following exception:
 - 1) All references to "NAPA 417" shall be changed to "NFPA 415".
4. Maximum Allowable Distances for Aircraft Loading Aircraft Loading Walkways at Denver International Airport
 - a. Fixed and Moveable Aircraft Loading Walkways of a total combined length not to exceed 242'-0" from Concourse face to Aircraft threshold shall be constructed per the Memorandum of Interpretation and Administrative Understanding dated 25 August 1992 as modified herein.
 - b. Fixed and Moveable Aircraft Loading Walkways of a total combined length greater than 242'-0" but not to exceed 400'-0" from Concourse face to Aircraft threshold shall be constructed per the Administrative Modification 2003 AM 0496 dated 28 October 2003 as modified herein.
 - c. Fixed and Moveable Aircraft Loading Walkways of a total combined length greater than 400'-0" from Concourse face to Aircraft threshold shall be one-hour noncombustible construction from Concourse face to such a length that the remaining portion is 242'-0" or less. The remaining portion shall be constructed per the Administrative Modification 2003 AM 0496

dated 28 October 2003 as modified herein.

5. Building Permit Application Requirements for Aircraft Loading Aircraft Loading Walkways at Denver International Airport
 - a. Drawings (2 Sets)
 - 1) Airport Site Plan
 - 2) Concourse Orientation Plan
 - 3) Gate Plan
 - 4) Cross Section through Aircraft Loading Walkway
 - b. Complete set of Technical Specifications (1 Set)
 - c. Calculations (1 Set)
 - 1) Wind Load shall be 30 miles per hour (mph)
 - 2) Jet Blast Load shall not be applicable
 - 3) Applicable Live Loads shall be stated
 - 4) Load at Concourse face (if applicable) shall be stated
 - 5) Worst Case Loads at both ends of Aircraft Loading Walkway (full extension) shall be stated
 - 6) Wheel Load at Apron
 - 7) Caisson Load at Rotunda
 - 8) Worst Case Overturning Moment
 - 9) Electrical Loads, accompanied by Panel Schedules and One Line Diagrams
 - d. Certifications (1 Set)
 - 1) Manufacturer shall certify Aircraft Loading Walkways meet all applicable provisions of NFPA 415
 - 2) Manufacturer shall certify all electrical materials, components, etc. used to construct the Aircraft Loading Walkways meet NEMA 3R
 - 3) Manufacturer shall demonstrate compliance with the above standards by submission of a letter from a Nationally Recognized Testing Laboratory (NRTL). Inspection and verification by the independent laboratory of the manufacturer's facilities shall have taken place within six (6) months of the letter's date.
 - 4) A structural consultant, currently registered as a Professional Engineer in the State of Colorado, shall review calculations furnished by the Manufacturer and author a report on those calculations and submit report to Denver International Airport for subsequent review by Denver Building Inspection Division.
 - e. Nothing in these Provisions shall be interpreted as lessening the requirements for Professionals currently licensed in the State of Colorado to stamp and sign submitted documents.
6. Structural Analysis

- a. Denver International Airport assumes all responsibilities for inspection Manufacturer's in-plant welding.
- b. A structural consultant, currently registered as a Professional Engineer in the State of Colorado shall inspect the Aircraft Loading Walkways once erection is complete. The Engineer shall then author a report to Denver International Airport on their findings. This report shall be forwarded to Denver Building Inspection Division by Denver International Airport. The Engineer shall inspect where applicable:
 - 1) Foundation connections to Apron
 - 2) Foundation connections to support columns
 - 3) Column connections to Aircraft Loading Walkways.
 - 4) Any other connections completed in the field.

END OF SECTION 147320

SECTION 149100 - FACILITY CHUTES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes [**waste**] [**and**] [**laundry**] chutes.
- B. Related Sections:
 - 1. Section 055000 "Metal Fabrications" for metal supporting framework at floor penetrations.
 - 2. Section 076200 "Sheet Metal Flashing and Trim" for roof-vent flashing and counterflashing.
 - 3. Section 077200 "Roof Accessories" for roof curbs.
 - 4. Section 078413 "Penetration Firestopping" for annular spaces at doors, floors, or roofs.
 - 5. Section 211313 "Wet-Pipe Sprinkler Systems" for building fire sprinklers and piping.
 - 6. Section 221116 "Domestic Water Piping" for water-service connections.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chutes.
 - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For chutes. Include plans, elevations, sections, details, weights, operational clearances, and attachments to other work. Indicate method of field assembly.
 - 1. Wiring Diagrams: Power, signal and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of chute, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For chutes to include in operation and maintenance manuals.

- 1. Include manufacturer's recycling plan guidelines.

- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated.

- 1. Test Pressure: Test at atmospheric (neutral) pressure according to NFPA 252 or UL 10B.
 - 2. Intake Door: Class B labeled; [1] [1-1/2]-hour fire rated[**with 30-minute temperature rise of 250 deg F** (140 deg C)].
 - 3. Discharge Door: Class B labeled; 1-hour fire rated[**with 30-minute temperature rise of 250 deg F** (140 deg C)].
 - 4. Access Door: Class B labeled; [1] [1-1/2]-hour fire rated[**with 30-minute temperature rise of 250 deg F** (140 deg C)].

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- C. Standard: Provide chutes complying with NFPA 82.

1.7 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Chute Systems, Inc.
 2. Chutes International.
 3. Midland Chutes.
 4. U.S. Chutes.
 5. Valiant Products, Inc.
 6. Western Chutes; Div. of Buchanan Company, Inc.
 7. Wilkinson Hi-Rise, LLC.
 8. **<Insert manufacturer's name>**.
 9. or approved equal.

2.2 CHUTES

- A. Chute Metal: **[Aluminum-coated, cold-rolled, commercial steel sheet; ASTM A 463/A 463M, Type 1 with not less than T1-40 (T1M-120) coating] [Type 430 stainless steel, ASTM A 240/A 240M] [Type 304 stainless steel, ASTM A 240/A 240M]**.
1. Thickness: **[0.060 inch (1.6 mm)] [0.075 inch (1.9 mm)]**.
- B. Size: **[24-inch (610-mm) diameter] [As indicated on Drawings] <Insert dimension>**.

2.3 DOORS

- A. Intake Door Assemblies: ASTM A 240/A 240M, Type 304 stainless-steel, self-closing units with positive latch and latch handle; as required to provide fire-protection[**and temperature-rise**] ratings indicated; and with frame suitable for enclosing chase construction.
1. Door Type: **[Hopper] [Hopper, limited access] [Side hinged, limited access, 180-degree swing, square] [Type as indicated on Drawings] <Insert description>**.
 2. Size: Manufacturer's standard size for door type, chute type, and diameter indicated.
 3. Finish: Manufacturer's standard satin or No. 3 directional polish.
 4. Locks: Cylinder locks with keys that are removable only when cylinder is locked. For each chute, key locks **[keyed alike] [to master key system]**. For each door, furnish **[four] <Insert number>** keys.
 5. Baffles: Rubber-back draft baffles at each intake.
 6. Foot Operators: Hopper-type door operators that unlatch and open door when foot pedal is depressed.

7. Accessible Automatic Door Operating System: Manufacturer's standard system complying with applicable provisions in **[the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines] [and] [ICC/ANSI A117.1]**.
 8. Mechanical Interlocks: Interlock system operated from discharge door to automatically lock intake doors.
 9. Electrical Interlocks: Interlock system that is energized by opening one intake door; remaining doors automatically lock when system is energized.
- B. Discharge-Door Assemblies: Aluminum-coated-steel doors as required to provide fire-protection[**and temperature-rise**] ratings indicated; equipped with fusible links that cause doors to close in the event of fire.
1. Direct Vertical Discharge: Provide inclined, horizontally rolling, shutter-type unit.
 2. Horizontal Discharge: Provide top-hinged, self-closing, hopper door with self-latching hardware; floor-mounted leg brace designed to absorb impact of material dropping against chute; and minimum **NPS 2 (DN 50)** drainpipe connection.
- C. Heat-[**and Smoke-**]Detector System: Interlock system with temperature-rise elements that locks chute doors when temperature in chute reaches a predetermined, adjustable temperature.
1. Locate smoke detector outside discharge door with solenoid to close discharge door.
- D. Access Door Assemblies: Manufacturer's standard ASTM A 240/A 240M, Type 302/304 stainless-steel doors; as required to provide fire-protection[**and temperature-rise**] ratings indicated; with frame suitable for enclosing chase construction; and in satin or No. 3 directional polish finish.
- E. Manual Control System: Control system with manual switches that lock doors of chute during shutdown hours and service operations.
- 2.4 ACCESSORIES
- A. Fire Sprinklers: Manufacturer's standard **NPS 1/2 (DN 13)** fire sprinklers ready for piping connections.
 - B. Flushing Spray Unit: **NPS 3/4 (DN 19)** spray head unit located in chute above highest intake door, ready for hot-water piping connection, and with access for head and piping maintenance.
 - C. Sanitizing Unit: **NPS 3/4 (DN 19)** disinfecting and sanitizing spray head unit located in chute above highest intake door, including **1-gal. (3.8-L)** tank and adjustable proportioning valve with bypass for manual control of sanitizing and flushing operation, ready for hot-water piping connection, and with access for head and piping maintenance.

- D. Intake Door Baffles: Rubber baffles, 1/8 inch (3 mm) thick.
- E. Sound Dampening: Manufacturer's standard **[sound deadening coating on exterior of chute] [and] [sound and vibration isolator pads at floor supporting frames]**.

2.5 FABRICATION

- A. General: Factory assemble chutes to greatest extent practical with continuously welded or lock-seamed joints without bolts, rivets, or clips projecting on chute interior. Include intake door assemblies and metal supporting framing at each floor, and chute expansion joints between each support point.
- B. Roof Vent: Fabricate vent unit to extend [36 inches (910 mm)] [48 inches (1200 mm)] **<Insert dimension>** above roof with full-diameter, screened vent and metal safety cap or glass explosion-release cap. Fabricate with roof-deck flange, counterflashing, and clamping ring of nonferrous metal compatible with chute metal.
- C. Fire Sprinklers: Comply with NFPA 13. Locate fire sprinklers at or above the top service opening of chutes, within the chute at alternate floor levels in buildings more than two stories tall, and at the lowest service level.
- D. Equipment Access: Fabricate chutes with access for maintaining equipment located within the chute, such as flushing and sanitizing units, fire sprinklers, and plumbing and electrical connections.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with NFPA 82 requirements and with chute manufacturer's written instructions. Assemble components with tight, nonleaking joints. Anchor securely to supporting structure to withstand impact and stresses on vent units. Install chute and components to maintain fire-resistive construction of chute and enclosing chase.
- B. Install chutes plumb, without offsets or obstructions that might prevent materials from free falling within chutes.
- C. Anchor roof flanges of chute vents before installing roofing and flashing. Install chute-vent counterflashing after roofing and roof-penetration flashing are installed.
- D. Intake and Discharge Doors: Interface door units with throat sections of chutes for safe, snag-resistant, sanitary depositing of materials in chutes by users.
 - 1. Coordinate installation of foot-pedal door operator with installation of door and enclosing chase.
 - 2. Interconnect sanitizer control with door interlock system.
- E. Electrical Interlock System: Comply with applicable NECA 1 recommendations.

- F. Test chute components after installation. Operate doors, locks, and interlock systems to demonstrate that hardware is adjusted and electrical wiring is connected correctly. Complete test operations before installing chase enclosures.
- G. Test heat- [**and smoke-**]sensing devices for proper operation.
- H. Operate sanitizing unit through one complete cycle of chute use and cleanup, and replenish chemicals or cleaning fluids in unit containers.

3.2 CLEANING

- A. After completing chase enclosure, clean exposed surfaces of chute system's components. Do not remove labels of independent testing and inspecting agencies.

3.3 DEMONSTRATION

- A. Demonstrate use of chute and equipment to Owner's personnel.
 - 1. Schedule demonstration with Owner, through DEN Project Manager, with at least seven (7) days advance notice.
- B. Demonstrate replenishment of sanitizing-unit chemicals or cleaning fluids.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

A. METHOD OF PAYMENT

- B. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 149100

SECTION 210400 - BASIC FIRE-SUPPRESSION REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and DEN BIM models and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
1. Basic requirements common to the Work in general of Division 21 and other Divisions and Sections of the Specification where referenced.
 2. Provide, unless specified otherwise, all labor, materials, and equipment necessary for completely finished and operational fire protection systems described and specified under other Sections of this Division 21.
 3. Provide all minor incidental items such as offsets, fittings, and accessories required as part of the Work even though not specified or indicated.
 4. Inspection: Inspect Work preceding or interfacing with work of Division 21 and report any known or observed defects that affect the Work to the General Contractor. Do not proceed with the Work until defects are corrected.

1.3 REFERENCES

- A. General:
1. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable Codes.
 2. The date of the standard is that in effect as the date of the Contract Documents, except when a specific date is specified.
 3. When required by individual Specifications Section by means of reference for cleaning or installation requirements, etc., obtain a copy of the standard. Maintain the copy at job site during Work until substantial completion. Copy shall be in electronic format.
 4. Schedule of Referenced Organizations: The following is a list of the acronyms of organizations referenced in these Specifications:

- a. ABMA–American Bearing Manufacturers Association
- b. ACI–American Concrete Institute
- c. ASA–American National Standards on Acoustics and Vibrations
- d. ASME–American Society of Mechanical Engineers
- e. ASTM–American Society for Testing of Materials
- f. AGA–American Gas Association
- g. ANSI–American National Standards Institute
- h. API–American Petroleum Institute
- i. ASME–American Society of Mechanical Engineers
- j. ATA–Air Transport Association of America
- k. AWS–American Welding Society
- l. EPA–Environmental Protection Agency
- m. CISPI–Cast Iron Soil Pipe Institute
- n. FM–Factory Mutual Insurance Association
- o. HI–Hydronics Institute
- p. IFC–International Fire Code
- q. MSS–Manufacturers Standardization Society of the Valve and Fittings Industry
- r. NACE–National Association of Corrosion Engineers
- s. NAPCA–National Association of Pipe Coating Applicators
- t. NFPA–National Fire Protection Association
- u. NIST–National Institute of Science and Technology
- v. ABMA–American Bearing Manufacturers Association
- w. SSPC–The Society for Protective Coatings
- x. STI–Steel Tank Institute
- y. UL–Underwriters' Laboratories

1.4 DEFINITIONS

- A. Conform to Division 01: These Specifications are of abbreviated, simplified, or streamlined type and include incomplete sentences. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of the Contract Documents so indicates.
- B. The following words are re-defined and/or elaborated on for the context of Division 21 work:
 - 1. Furnish: Except as otherwise defined in greater detail, term "furnish" is used to mean supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.
 - 2. Install: Except as otherwise defined in greater detail, term "install" is used to describe operations at Project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations, as applicable in each instance.
 - 3. Provide: Except as otherwise defined in greater detail, term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.
 - 4. General Contractor: The term "General Contractor" used in Division 21 and elsewhere in the Contract Documents means the party with whom the Owner has

executed the Owner-Contractor Agreement.

1.5 QUALITY CONTROL

- A. Conform to Division 01. Materials and apparatus required for the Work to be new and of first-class quality; to be furnished, delivered, erected, connected and finished in every detail; and to be so selected and arranged so as to fit properly into the building spaces. Where no specific kind or quality of material is given, a first-class standard article shall be furnished.
- B. Unless otherwise specifically indicated, equipment and materials to be installed in accordance with the recommendations of the Manufacturer. This includes the performance of tests as recommended by the Manufacturer.

1.6 REGULATORY REQUIREMENTS

- A. Comply with latest editions of all applicable Codes, Standards, Ordinances and Regulations in effect as of the date of the Contract Documents adopted by CCD, BD, and FD, including but not necessarily limited to the following:
 - 1. National Electrical Code NFPA-70.
 - 2. NFPA.
 - 3. Underwriters Laboratories.
- B. If discrepancies occur between the Contract Documents and any applicable Codes, Guidelines, Ordinances, Acts, or Standards, the most stringent requirements shall apply.
- C. Where hourly fire ratings are indicated or required, provide components and assemblies meeting requirements of the American Insurance Association, Factory Mutual Insurance Association and listed by Underwriters Laboratories, Inc.

1.7 PRODUCT OPTIONS AND SUBSTITUTIONS

- A. Substitutions: Refer to Division 01, General Requirements.
- B. Some materials and equipment are specified by Manufacturer and catalog numbers. The Manufacturer and catalog numbers are used to establish a degree of quality and style for such equipment and material.
- C. When alternate or substitute materials and equipment are used, Contractor shall be responsible for space requirements, configurations, performance, changes in bases, supports, structural members and openings in structure, electrical changes and other apparatus and trades that may be affected by their use.
- D. When providing a product and/or service under the qualification of "acceptable equal,"

Contractor shall be entirely responsible for additional costs incurred due to modifications to the civil, architectural, structural, mechanical, electrical, or any other system design that may be required to accommodate the "acceptable equal."

- E. Substitute materials and equipment are only allowed to be provided from the manufacturers listed as approved.

1.8 SHOP DRAWINGS AND PRODUCT DATA

- A. General: Comply with the General Conditions of the Contract and with Division 01 General Requirements.

- 1. All documents shall be submitted in electronic format. Each submittal shall be in a single security free PDF document. PDF documents shall be compatible with the latest version of Adobe Acrobat. All as-built documents shall be submitted in the latest version of Revit format.

1.9 CONTRACT RECORD DOCUMENTS

- A. General: Comply with the General Conditions of the Contract and with Division 01 General Requirements,

1.10 OPERATING AND MAINTENANCE DATA

- A. Division 21 Contractor shall submit electronic record, in accordance with Division 1 requirements, a single PDF file of the entire maintenance manual to the DEN Project Manager and General Contractor for their approval.

- B. The manual shall have as a minimum the following:

- 1. Alphabetical list of all system components including the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year's operation.
- 2. Operating instructions for complete system, including emergency procedures for fire or failure of major equipment and procedures for normal starting/operating/shutdown and long-term shutdown.
- 3. Maintenance instructions, including valves, valve tag, and other identified equipment lists, proper lubricants and lubricating instructions for each piece of equipment and necessary cleaning/replacing/adjusting schedules.
 - a. Manufacturer's data on each piece of equipment, including:
 - 1) Installation instructions.
 - 2) Drawings, specifications, and approved shop drawings.
 - 3) Complete parts lists.

4. Complete wiring and temperature control diagrams (approved shop drawings).
 5. Each piece identified on any schedule shall be bookmarked in the electronic file by its scheduled tag ID.
- C. In addition to the maintenance manual, and keyed to it, the equipment shall be identified and tagged as specified elsewhere. Insert a copy.
1. Identify all starters, disconnect switches, and manually operated controls, except integral equipment switches with permanently applied, legible markers corresponding to operating instructions in the "Maintenance Manual".
 2. Tag all manual operating valves with 1-1/2" diameter brass tags attached with chains. Tags are to be sequence numbered with legible metal stamps. Obtain latest tag identification schedule from the DEN Project Manager.
 3. Provide a typed tag list or schedule mounted under glass in the room designated by DEN Project Manager stating number, location, and function of each tagged item. Insert a copy of tag list in each "Maintenance Manual".
- D. Division 21 Contractor shall be responsible for scheduling instructional meetings for maintenance personnel on the proper operation and maintenance of all fire suppression systems, using the maintenance manual as a guide. These meetings must be scheduled through the DEN Project Manager, and General Contractor far enough in advance so that all personnel can be notified.
- E. Division 21 Contractor shall provide proof of performance certification of all fire suppression systems to demonstrate that all fire suppression systems are operating to the intent of the design.

1.11 FINAL OBSERVATION

- A. Comply with the requirements of Division 01 and the following.
- B. Prior to the request for final observation, all Work under the contract shall be completed, all systems shall be in proper working order and placed in operation (System Startup of 48 hours).
- C. All equipment shall be cleaned, including but not limited to, plumbing fixtures. All debris and construction materials shall be removed from the DEN property to a suitable landfill off-airport.
- D. The temperature control system shall be complete and in proper working order. All instruments shall be properly and accurately field calibrated.
- E. At the request of the DEN Project Manager, a representative of the Contractor who is thoroughly familiar with the Project and operation of the various systems shall be present during the final observation to demonstrate proper operation of the equipment and controls. If requested by the DEN Project Manager, the Contractor shall have representatives from the Contractor's subcontractors present to assist during final observation.

1.12 PROJECT CONDITIONS

A. Accessibility:

1. Division 21 Contractor shall be responsible for the sufficiency of the size of shafts and chases and the adequate clearance in double partitions and hung ceilings for proper installation of the Contractor's Work. The Contractor shall cooperate with Contractors of other Divisions of the Work whose work is in the same space and shall advise the General Contractor of the Contractor's requirements. Such spaces and clearances shall, however, be kept to the minimum size required.
2. Division 21 Contractor shall locate all equipment, which must be serviced, operated, or maintained in fully accessible positions. Such equipment shall include (but not be limited to) valves, shock absorbers, traps, cleanouts, motors, controllers, switchgear, and drain points. If required for better accessibility, furnish access doors for this purpose, minor deviations from Drawings may be allowed to provide for better accessibility. Any changes shall be approved by the DEN Project Manager prior to making the change.
3. Division 21 Contractor shall provide the General Contractor with the exact locations of access doors for each concealed valve, shock absorber control, damper, or other device requiring service. Locations of these doors shall be submitted in sufficient time to be installed in the normal course of work.
4. Provide carpentry, masonry, concrete and metal work required for Work of this Division where not specifically called for under other Sections.

B. Fabrication:

1. Before any ductwork is fabricated and before running and/or fabricating any lines of piping or ductwork, the Contractor shall assure himself that they can be run as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of existing conditions and new structural and architectural Work.

C. Freeze Protection:

1. Do not run lines in outside walls, or locations where freezing may occur. Piping next to outside walls shall be in furred spaces with insulation between the piping and the outside wall. Insulation of piping shall not be considered freeze protection.

D. Scaffolding, Rigging and Hoisting:

1. Provide all scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises of any equipment and apparatus furnished; remove same from premises when no longer required. Conform to OSHA requirements and standards.

1.13 COORDINATION

- A. General: Coordinate and order the progress of fire protection Work to conform to the progress of the Work of the other trades. Complete the entire installation as soon as the condition of the building will permit.
- B. Coordination with Electrical Work: Section 210500 "Common Work Results for Fire Suppression".
- C. Existing System Interruptions: Comply with Division 01.
- D. Cutting and Patching: Section 210500 "Common Work Results for Fire Suppression", Division 01 requirements, and Section 017330 "Cutting and Patching".
- E. Drawings and Specifications: The Fire Protection Drawings indicate the general design and arrangement of lines, equipment, systems, etc. Information shown may be diagrammatic in character and does not necessarily indicate every required offset, fitting, etc. Do not scale the Drawings for dimensions. Review dimensions, measurements, locations, levels, etc., on the architectural drawings and equipment to be furnished, and field verify all dimensions.
- F. Discrepancies: Examine Drawings and Specifications for other parts of the Work, and if any discrepancies occur between the plans for the Work of this Division and the plans for the work of others, report such discrepancies to the DEN Project Manager and obtain written instructions for any changes necessary.
- G. Order of Precedence: The precedence of construction documents are as Specified in the General Conditions.

1.14 START-UP PROCEDURES

- A. Before start-up, each piece of equipment comprising a part of the system shall be checked for proper lubrication, drive rotation, belt tension, proper control sequence, and any other condition, which may cause damage to equipment or endanger personnel.
- B. Ensure that all control systems are fully operational in automatic mode.
- C. If systems are not to continue in use following the start-up procedures, steps should be taken to ensure against accidental operation or operation by unauthorized personnel.
- D. Factory personnel shall be notified as appropriate to start systems requiring their services.
- E. Notify the DEN Project Manager in writing a minimum of 72 hours prior to start-up of all major fire protection equipment and systems.
- F. Should there be any equipment found which had not been properly started up, it will be the responsibility of this Contractor to arrange for the appropriate personnel to start up the equipment at the Contractor's expense and at a time as scheduled by the DEN

Project Manager.

1.15 SCHEDULE OF TESTING

- A. Provide testing in accordance with the General Conditions of the Contract.
- B. A schedule of testing shall be drawn up by the Division 21 Contractor in such a manner that it will show areas tested, test pressure, length of test, date, time and signature of testing personnel.
- C. Notify the DEN Project Manager, DEN Inspector, and DEN Mechanical Engineer in writing a minimum of 72 hours prior to testing of any fire protection equipment and systems.
- D. All testing must be performed in the presence of the DEN Project Manager and or the DEN Project Manager's designated representative; DEN Project Manager's signature for verification of the test must appear on the schedule.
- E. All testing must be performed in accord with the procedures set forth in Division 21 and other Sections of the Specifications where referenced. At completion of testing, the schedule shall then be submitted in triplicate to the DEN Project Manager.
- F. Make all specified tests on piping, ductwork, and related systems as necessary.
- G. Make sure operational and performance tests are made on seasonal equipment.
- H. Complete all tests required by Code Authorities, such as health codes, building codes, and safety codes.
- I. After test runs have been completed and systems have been demonstrated to be satisfactory and ready for permanent operation, all permanent pipeline strainers and filters shall be cleaned, air filters cleaned or replaced, valve and pump packing properly adjusted, belt tensions adjusted, drive guards secured in place, lubrication checked and replenished if required.

1.16 CLEANING AND FINISHING

- A. Provide cleaning in accordance with the General Requirements of the Contract.
- B. Cleaning shall include but not be limited to removing grease, dirt, dust, stains, labels, fingerprints, and other foreign materials from sight-exposed piping, ductwork, equipment, fixtures and other such items installed under Division 21 of the Work. If finishes have been damaged, refinish to original condition and leave everything in proper working order and of intended appearance.

1.17 WARRANTIES

- A. Conform to Division 01: Provide a written warranty covering the entire fire protection

Work to be free from defective materials, equipment, and workmanship for a minimum period of two (2) years after date of acceptance. During this period, provide labor and materials as required to repair or provide labor and materials required to repair or replace defects. Provide certificates for such items of equipment, which have or are specified to have warranties in excess of one (1) year.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the applicable unit price item, work order or lump sum bid item.

END OF SECTION 210400

SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following basic fire protection materials and methods to complement other Division 21 Sections.
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Sleeves.
 - 5. Escutcheons.
 - 6. Nonshrink grout for equipment installations.
 - 7. Flowable backfill for underground piping.
 - 8. Field-fabricated metal equipment supports.
 - 9. Concrete bases
 - 10. Installation requirements common to equipment specification Sections.
 - 11. Fire protection demolition.
 - 12. Cutting and patching.
 - 13. Touch up painting and finishing.
 - 14. Pipe and pipe fitting materials are specified in piping system Sections.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 RELATED SECTIONS

- A. Drawings and general provisions of Contract, including General and the Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 31 Earthwork Sections.
- C. Section 050510 "Welding"
- D. Section 210553 "Identification for Fire-Suppression Piping and Equipment" for labeling and identifying plumbing systems and equipment.

1.4 DEFINITIONS

- A. Pipe, pipe fittings, and piping include tube, tube fittings, and tubing.
- B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below the roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- C. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- D. Exposed Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- E. Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- F. Concealed Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.5 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections:
 - 1. Shop drawings detailing fabrication and installation for metal supports and anchorage for fire protection materials and equipment.
 - 2. Prepare coordination drawings according to Division 01 Section "Submittals" to a 1/4 inch equals 1 foot scale or larger. Detail major elements, components, and systems of fire protection equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Show where sequence and coordination of installations are important to the efficient flow of the Work. Include the following:
 - a. Clearances for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.
 - b. Pump metal support details.
 - 3. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the Quality Assurance Article.
 - 4. Floor x-rays and/or ground penetrating radar reports.
 - 5. "As Built" Plans shall be provided in the same format and manner as described above.
 - 6. Contractor shall submit fully dimensioned spool drawings for all welded piping work. Drawings shall indicate all weld types, sizes, and materials to be used. The spool drawing size shall match the full size contract documents of either 24 x 36 or 34 x 44. Spool drawings shall be submitted in either the latest version of Revit or the latest version of Adobe Acrobat (pdf). Adobe Acrobat files shall not contain

- security. Other file formats will not be accepted.
7. Field Test Reports: Written reports of each pressure tests specified in Division 21 Sections. Include the following:
- a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Failed test results and corrective action taken to achieve requirements.

1.6 QUALITY CONTROL

- A. Equipment Selection: Equipment of greater or larger power, dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing by the DEN Project Manager and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.
- B. Unless specified otherwise, all materials and equipment shall be of domestic (USA) manufacture and shall be of the best quality used for the purpose in commercial practice.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.
- C. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.
- D. Protect flanges, fittings, and piping specialties from moisture and dirt.
- E. Deliver ductwork and fittings with plastic sheeting to protect it from elements. Inspect duct liner for exposure to dirt and tears.

1.8 SEQUENCING AND SCHEDULING

- A. Coordinate fire protection equipment installation with other building components.
- B. Coordinate the installation of required supporting devices.
- C. Sequence, coordinate, and integrate installations of fire protection materials and equipment for efficient flow of the Work.

- D. Coordinate connection of electrical services.
- E. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

- A. Refer to individual piping system specification Sections for pipe and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual piping system specification Sections in Division 21 for special joining materials not listed below.
- B. Grooved Mechanical Couplings: Acceptable only for fire protection piping; not acceptable for any other applications.
- C. Pipe Flange Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, except where thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125 cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250 cast-iron and steel flanges.
- D. Solder Filler Metal: ASTM B 32.
 - 1. Alloy Sn95 or Alloy Sn94: Tin (approximately 95 percent) and silver (approximately 5 percent) – Not industry standard, usually 5% antimony.
- E. Brazing Filler Metals: AWS A5.8.
 - 1. BCuP Series: Copper-phosphorus alloys.
 - 2. BAg1: Silver alloy.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded. All welding rod is to be kept in an operable rod oven at all times.

2.3 PIPING SPECIALTIES

- A. Dielectric Fittings: Assembly or fitting having insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.
1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.
 2. Insulating Material: Suitable for system fluid, pressure, and temperature.
 3. Dielectric Waterway Fittings: Dielectric fittings designed to effectively separate dissimilar metals exposed to water or other electrolytes, conforming to NSF and ASTM F492 standards for continuous use at temperatures up to 225 degrees F and pressures up to 300 psi. Fittings to have electro-zinc-plated steel casings providing for maintained exterior electrical continuity, threaded or flanged ends as applicable, and inert linings.
 4. Dielectric Flanges: Factory-fabricated, companion-flange assembly for 150- or 300-psig minimum pressure to suit system pressures.
 5. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - a. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure to suit system pressures.

2.4 MECHANICAL SLEEVE SEALS

- A. Reference Section 210517 "Sleeves and Sleeve Seals for Fire Suppression Piping" for sleeve seals.

2.5 SLEEVES

- A. Reference Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping" for sleeves.

2.6 ESCUTCHEONS

- A. Reference Section 210518 "Escutcheons for Fire-Suppression Piping" for escutcheons.

2.7 GROUT

- A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psi, 28-day compressive strength.
 3. Packaging: Premixed and factory-packaged.

2.8 BACKFILL

- A. Flowable Backfill: Designed in accordance with ASTM C 94 and ASTM D 4832.
 - 1. Refer to Section 033350 "Flowable Backfill Low-Strength Concrete" for material and installation requirements.
 - 2. Minimum Requirements:
 - a. Compressive Strength: 50-100 psi
 - b. Slump: 6-8 inches.
 - 3. Required for all piping and ductwork installed below concrete slabs, apron paving and roadways.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General: Install piping as described below, except where system Sections specify otherwise. Individual piping system specification Sections in Division 21 specify piping installation requirements unique to the piping system.
- B. General Locations and Arrangements: Drawings indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, except where deviations to layout are approved on coordination drawings.
- C. Install piping at indicated slope.
- D. Install piping free of sags and bends.
- E. Install piping plumb and at right angles and plumb or parallel to building walls. Diagonal runs are prohibited, except where indicated.
- F. Install piping tight to slabs, beams, joists, columns, walls, and other building elements.
- G. Install fittings for changes in direction and branch connections.
- H. Install couplings according to manufacturer's printed instructions.
- I. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping system Sections.
 - 1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 - 2. Remove scale, slag, dirt, rust, and debris from inside and outside of pipe and fittings before assembly.
 - 3. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends

to remove burrs and restore full inside diameter. Join pipe fittings and valves as follows:

- a. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - b. Apply appropriate tape or thread compound to external pipe threads (except where dry seal threading is specified).
 - c. Align threads at point of assembly.
 - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
 - e. Damaged Threads: Do not use pipe or pipe fittings having threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- J. Piping Connections: Except as otherwise indicated, make piping connections as specified below.
1. Install unions in piping 2 inches and smaller adjacent to each valve and at final connection to each piece of equipment having a 2-inch or smaller threaded pipe connection.
 2. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.
- K. Piping below apron, concrete slabs or paving shall be encased in flowable backfill. Refer to Section 033350 "Flowable Backfill Low-Strength Concrete" and Division 31 Sections for material and installation requirements.

3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to provide the maximum possible headroom where mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work may be shown only in diagrammatic form. Refer conflicts to the DEN Project Manager for review.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.
- D. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
- E. Install fire protection equipment giving right-of-way to piping systems installed at a required slope.

3.3 PAINTING AND FINISHING

- A. Refer to Division 09 Sections for field painting requirements. Paint color schedule shall conform to ASME A13.1-1996, "Scheme for the Identification of Piping Systems."
- B. Damage and Touch Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- C. All rooftop equipment exposed to public or aircraft view shall be painted flat white or grey in accordance with Division 09.

3.4 CONCRETE PENETRATIONS

- A. Reference Section 017329 "Cutting and Patching" for core drilling and saw cutting requirements.
- B. Reference Section 017329 "Selective Demolition" for demolition and removal of selected portions of a building or structure, and repair procedures for selective demolition operations.
- C. All penetrations required through completed concrete construction shall be core drilled or saw cut at minimum size required. All penetrations in concrete require an x-ray or ground penetrating radar to determine if the location is clear of reinforcing steel and embedded systems. Precautions shall be taken when drilling to prevent damage to structural concrete.
 - 1. The Contractor shall provide an interpretation of the x-rays or radar shot and obtain written acceptance from the DEN Project Manager before proceeding with drilling.

3.5 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use [**3000-psi**] <Insert other>, 28-day compressive-strength concrete and

reinforcement as specified in Division 03.

3.6 WELDING

- A. Qualify welding processes and operators for structural steel according to AWS D1.1 Structural Welding Code - Steel. See Division 05 for additional requirements.
- B. All welding shall be inspected in process by a contractor provided, Certified, Independent Testing Agency by an AWS certified welding inspector.
- C. Qualify welding processes and operators for piping according to ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.
 - 1. Comply with provisions of ASME B31 Series "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Refer to Division 05 for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire protection materials and equipment.
- C. Field Welding: Comply with AWS D1.1 Structural Welding Code - Steel, as referenced in Part1.
- D. Double nut all suspended assemblies.

3.8 DEMOLITION

- A. Refer to Division 01 for general demolition requirements and procedures.
- B. Where pipe, ductwork, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.
- C. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.
- D. Disconnect, demolish, and remove fire protection systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping and associated supports indicated to be removed, provide a shutoff valve with plug or cap in pressurized systems and cap or plug remaining piping with same or compatible piping material. No piping shall be abandoned in place. Repair insulation.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.

3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to DEN Project Manager.
6. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
7. Repair structure [**floor, ceilings, roof, slabs**] from removed supports in accordance with [**Division 03**], [**Division 05**], [**and Division 09**]

3.9 GROUTING

- A. Mix and install grout for fire protection equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the applicable unit price item, work order or lump sum bid item.

END OF SECTION 210500

SECTION 210513 - COMMON MOTOR REQUIREMENTS FOR FIRE SUPPRESSION EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

1.4 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.

- B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: **[Class F] <Insert class>**.
- J. Code Letter Designation:
 - 1. Motors **[15] <Insert number>** HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than **[15] <Insert number>** HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes **[324T] <Insert number>** and larger; rolled steel for motor frame sizes smaller than **[324T] <Insert number>**.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: **[Ratings, characteristics, and features coordinated with and approved by controller manufacturer.]**
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 210513

SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Include all sleeves, sleeve seals, fittings, and accessories to provide a complete seal system. If conflicts occur in this specification or between this specification and other contract documents, the most stringent requirement shall apply.
- B. Section Includes:
 - 1. Sleeves.
 - 2. Stack-sleeve fittings.
 - 3. Sleeve-seal systems.
 - 4. Sleeve-seal fittings.
 - 5. Grout.
- C. Related Sections
 - 1. Section 210500 "Common Work Results for Fire Suppression" for work results.
 - 2. Section 211200 "Fire Suppression Standpipes" for standpipe work.
 - 3. Section 211313 "Wet Pipe Sprinkler Systems" for wet pipe sprinkler system work.
 - 4. Section 211316 "Dry Pipe Sprinkler Systems" for dry pipe sprinkler system work.
 - 5. Section 211319 "Preaction Sprinkler Systems" for preaction sprinkler system work.
 - 6. Section 211326 "Deluge Fire Suppression Sprinkler Systems" for deluge sprinkler system work.
 - 7. Section 211339 "Foam-Water Systems" for foam water systems work.
 - 8. Section 212200 "Clean Agent Fire Extinguishing Systems" for clean agent systems work.
 - 9. Division 7 Sections for fire stopping, fire sealants, fire proofing for materials and methods for sealing pipe penetrations through walls and fire/smoke barriers.
 - 10. Division 099123 "Interior Painting" for preparation and painting of fire protection piping systems.
- D. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

- A. Furnish pipe sleeves, complete with drawing(s) locating all sleeves and indicating sleeve size to Division 3, 4 or 9, contractors, or other contractors as required, for placement.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include data substantiating that materials comply with requirements.
- B. Shop drawing(s) locating all sleeves and indicating sleeve size and type to Division 3, 4 or 9 contractors as required, or other contractors, for placement.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Protect sleeves and sleeve seals from moisture and dirt.

1.6 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: B. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, galvanized, plain ends
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, , with plain ends.
- D. Galvanized-Steel Sheet: 0.0478-inch (18 gage) minimum thickness; round tube closed with welded longitudinal joint.
- E. Molded-PE or -PP Sleeves: Reusable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40

- G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Smith, Jay R. Mfg. Co.
2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
3. **<Insert manufacturer's name>**.
4. or approved equal.

- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Metraflex Co.
2. Pipeline Seal and Insulator, Inc.
3. PSI-Thunderline/Link-Seal.
4. **<Insert manufacturer's name>**.
5. or approved equal.

- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: **[EPDM-rubber] [NBR]** interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: **[Carbon steel] [Plastic] [Stainless steel]**. Include two for each sealing element.
3. Connecting Bolts and Nuts: **[Carbon steel, with corrosion-resistant coating,] [Stainless steel]** of length required to secure pressure plates to sealing elements. Include once for each sealing element

2.4 SLEEVE-SEAL FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Presealed Systems.
2. **<Insert manufacturer's name>**.
3. or approved equal.

- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide [1-inch (25-mm)] <Insert dimension> annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas [2 inches (50 mm)] <Insert dimension> above finished floor level.
 - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.

3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

- D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 GROUT INSTALLATION

- A. Install grout in strict compliance with manufacturer's instructions, industry standards, and all applicable codes and standards.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Cure placed grout.

3.6 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than [NPS 6 (DN 150)] <Insert pipe size>: [Cast-iron wall sleeves] [Galvanized-steel wall sleeves] [Galvanized-steel-pipe sleeves] [Sleeve-seal fittings] <Insert material>.
 - b. Piping [NPS 6 (DN 150)] <Insert pipe size> and Larger: [Cast-iron wall sleeves] [Galvanized-steel wall sleeves] [Galvanized-steel-pipe sleeves] <Insert material>.
 2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than [NPS 6 (DN 150)] <Insert pipe size>: [Cast-iron wall sleeves with sleeve-seal system] [Galvanized-steel wall sleeves with sleeve-seal system] [Galvanized-steel-pipe sleeves with sleeve-seal system] [Sleeve-seal fittings] <Insert material>.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping [NPS 6 (DN 150)] <Insert pipe size> and Larger: [Cast-iron wall sleeves with sleeve-seal system] [Galvanized-steel wall sleeves with sleeve-seal system] [Galvanized-steel-pipe sleeves with sleeve-seal system] <Insert material>.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 3. Concrete Slabs-on-Grade:

- a. Piping Smaller Than [NPS 6 (DN 150)] <Insert pipe size>: [Cast-iron wall sleeves with sleeve-seal system] [Galvanized-steel wall sleeves with sleeve-seal system] [Galvanized-steel-pipe sleeves with sleeve-seal system] [Sleeve-seal fittings] <Insert material>.ol style="list-style-type: none;"> - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
- b. Piping [NPS 6 (DN 150)] <Insert pipe size> and Larger: [Cast-iron wall sleeves with sleeve-seal system] [Galvanized-steel wall sleeves with sleeve-seal system] [Galvanized-steel-pipe sleeves with sleeve-seal system] [Galvanized-steel-pipe sleeves] <Insert material>.ol style="list-style-type: none;">- 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
- a. Piping Smaller Than [NPS 6 (DN 150)] <Insert pipe size>: [Galvanized-steel-pipe sleeves] [PVC-pipe sleeves] [Stack-sleeve fittings] [Sleeve-seal fittings] [Molded-PE or -PP sleeves] [Molded-PVC sleeves] <Insert material>.
 - b. Piping [NPS 6 (DN 150)] <Insert pipe size> and Larger: [Galvanized-steel-pipe sleeves] [PVC-pipe sleeves] [Stack-sleeve fittings] <Insert material>.
5. Interior Partitions:
- a. Piping Smaller Than [NPS 6 (DN 150)] <Insert pipe size>: [Galvanized-steel-pipe sleeves] [PVC-pipe sleeves] <Insert material>.
 - b. Piping [NPS 6 (DN 150)] <Insert pipe size> and Larger: [Galvanized-steel-sheet sleeves] <Insert material>.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 210517

SECTION 210518 - ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include data substantiating that materials comply with requirements.
- B. Samples: For each type requested by DEN Project Manager.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Protect escutcheons from moisture and dirt.

1.5 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With **[polished, chrome-plated]** **[and]** **[rough-brass]** finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- D. Split-Casting Brass Type: With **[polished, chrome-plated]** **[and]** **[rough-brass]** finish and with concealed hinge and setscrew.
- E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, **[concealed]** **[and]** **[exposed-riquet]** hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange **[with holes for fasteners]**.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass **[or split-casting brass]** type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type **[or split-plate, stamped-steel type with concealed hinge]** **[or split-plate, stamped-steel type with exposed-riquet hinge]**.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass **[or split-casting brass]** type with polished, chrome-plated finish.

- e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type[**or split-plate, stamped-steel type with concealed hinge**] [**or split-plate, stamped-steel type with exposed-rivet hinge**].
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass[**or split-casting brass**] type with polished, chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type[**or split-plate, stamped-steel type with concealed hinge**] [**or split-plate, stamped-steel type with exposed-rivet hinge**].
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass[**or split-casting brass**] type with [**polished, chrome-plated**] [**rough-brass**] finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type[**or split-plate, stamped-steel type with concealed hinge**] [**or split-plate, stamped-steel type with exposed-rivet hinge**].
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass[**or split-casting brass**] type with [**polished, chrome-plated**] [**rough-brass**] finish.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type[**or split-plate, stamped-steel type with concealed hinge**] [**or split-plate, stamped-steel type with exposed-rivet hinge**].
2. Escutcheons for Existing Piping:
- a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with [**concealed**] [**or**] [**exposed-rivet**] hinge.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with [**concealed**] [**or**] [**exposed-rivet**] hinge.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with [**concealed**] [**or**] [**exposed-rivet**] hinge.
 - g. Bare Piping in Unfinished Service Spaces: Split-casting brass type with [**polished, chrome-plated**] [**rough-brass**] finish.
 - h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with [**concealed**] [**or**] [**exposed-rivet**] hinge.
 - i. Bare Piping in Equipment Rooms: Split-casting brass type with [**polished, chrome-plated**] [**rough-brass**] finish.
 - j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with [**concealed**] [**or**] [**exposed-rivet**] hinge.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
1. New Piping: One-piece, floor-plate type.

2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 210518

SECTION 210533 - HEAT TRACING FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes heat tracing for fire-suppression piping with the following electric heating cables:
 - 1. Plastic insulated, series resistance.
 - 2. Self-regulating, parallel resistance.
- B. Related Requirements:
 - 1. Section 220533 "Heat Tracing for Plumbing Piping."
 - 2. Section 230533 "Heat Tracing for HVAC Piping."
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
 - 2. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.
 - 3. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For electric heating cable.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Minimum **[three (3)] [five (5)] <Insert number>** years from date of Substantial Completion.

1.7 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PLASTIC-INSULATED, SERIES-RESISTANCE HEATING CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Delta-Therm Corporation.
 - 2. Easy Heat; a division of EGS Electrical Group LLC.
 - 3. Pyrotenax; a brand of Tyco Thermal Controls LLC.
 - 4. Raychem; a brand of Tyco Thermal Controls LLC.
 - 5. Watts Radiant, Inc.; a subsidiary of Watts Water Technologies, Inc.
 - 6. **<Insert manufacturer's name>**.
 - 7. or approved equal.
- B. Comply with IEEE 515.1.
- C. Heating Element: Single- or dual-stranded resistor wire. Terminate with waterproof, factory-assembled nonheating leads with connectors at both ends.

- D. Electrical Insulating Jacket: Minimum **4.0-mil** (0.10-mm) Kapton with silicone, Tefzel, or polyolefin.
- E. Cable Cover: Aluminum braid[**and silicone or Hylar outer jacket or TPR overjacket**].
- F. Maximum Operating Temperature (Power On): [**150 deg F** (65 deg C)] **<Insert temperature>**.
- G. Maximum Exposure Temperature (Power Off): [**185 deg F** (85 deg C)] **<Insert temperature>**.
- H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 and NFPA 13, by a qualified testing agency, and marked for intended location and application.
- I. Capacities and Characteristics:
 - 1. Maximum Heat Output: [**6 W/ft.** (19.7 W/m)] [**7.5 W/ft.** (24.6 W/m)] **<Insert value>**.
 - 2. Piping Diameter: **<Insert NPS (DN)>**.
 - 3. Number of Parallel Cables: **<Insert number>**.
 - 4. Spiral Wrap Pitch: **<Insert inches (mm)>**.
 - 5. Electrical Characteristics for Single-Circuit Connection:
 - a. Volts: [**120**] [**208**] [**240**] [**277**] [**480**] **<Insert value>**.
 - b. Phase: **<Insert value>**.
 - c. Hertz: **<Insert value>**.
 - d. Full-Load Amperes: **<Insert value>**.
 - e. Minimum Circuit Ampacity: **<Insert value>**.
 - f. Maximum Overcurrent Protection: **<Insert amperage>**.

2.2 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. BriskHeat.
 - 2. Chromalox.
 - 3. Delta-Therm Corporation.
 - 4. Easy Heat; a division of EGS Electrical Group LLC.
 - 5. Nelson Heat Trace; a division of EGS Electrical Group LLC.
 - 6. Pyrotenax; a brand of Tyco Thermal Controls LLC.
 - 7. Raychem; a brand of Tyco Thermal Controls LLC.
 - 8. Thermon Americas Inc.
 - 9. Trasor Corp.
 - 10. **<Insert manufacturer's name>**.
 - 11. or approved equal.
- B. Comply with IEEE 515.1.

- C. Heating Element: Pair of parallel **[No. 16] [No. 18]** AWG, **[tinned] [nickel-coated]**, stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.
- D. Electrical Insulating Jacket: Flame-retardant polyolefin.
- E. Cable Cover: **[Tinned-copper] [Stainless-steel]** braid **[and polyolefin outer jacket with ultraviolet inhibitor]**.
- F. Maximum Operating Temperature (Power On): **[150 deg F (65 deg C)] <Insert temperature>**.
- G. Maximum Exposure Temperature (Power Off): **[185 deg F (85 deg C)] <Insert temperature>**.
- H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. Capacities and Characteristics:
 - 1. Maximum Heat Output: **[3 W/ft. (9.8 W/m)] [5 W/ft. (16.4 W/m)] [8 W/ft. (26 W/m)] [10 W/ft. (32.8 W/m)] [12 W/ft. (39.4 W/m)] <Insert value>**.
 - 2. Piping Diameter: **<Insert NPS (DN)>**.
 - 3. Number of Parallel Cables: **<Insert number>**.
 - 4. Spiral Wrap Pitch: **<Insert inches (mm)>**.
 - 5. Electrical Characteristics for Single-Circuit Connection:
 - a. Volts: **[120] [208] [240] [277] [480] <Insert value>**.
 - b. Phase: **<Insert value>**.
 - c. Hertz: **<Insert value>**.
 - d. Full-Load Amperes: **<Insert value>**.
 - e. Minimum Circuit Ampacity: **<Insert value>**.
 - f. Maximum Overcurrent Protection: **<Insert amperage>**.

2.3 CONTROLS

- A. Remote bulb unit with adjustable temperature range from **[30 to 50 deg F (minus 1 to plus 10 deg C)] <Insert temperature range>**.
- B. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
- C. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
- D. Corrosion-resistant, waterproof control enclosure.

2.4 ACCESSORIES

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer or as recommended in writing by manufacturer.
- B. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least **3 mils** (0.08 mm) thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
 - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than **6 Inches** (150 mm): **3/4 inch** (19 mm) minimum.
 - 2. Width for Markers on Pipes with OD, Including Insulation, **6 Inches** (150 mm) or Larger: **1-1/2 inches** (38 mm) minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install electric heating cable where indicated and according to NFPA 70 and NFPA 13.
- B. Install electric heating cable across expansion joints according to manufacturer's written instructions; use cable to allow movement without damage to cable.
- C. Install electric heating cables after piping has been tested and before insulation is installed.
- D. Install electric heating cables according to IEEE 515.1.
- E. Install insulation over piping with electric cables according to Section 210700 "Fire-Suppression Systems Insulation."
- F. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- G. Set field-adjustable switches and circuit-breaker trip ranges.

3.3 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Connect heat-tracing controls to fire-alarm system according to NFPA 13. Comply with requirements in [**Section 283111 "Digital, Addressable Fire-Alarm System."**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System."**]

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections[**with the assistance of a factory-authorized service representative**]:
 - 1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
 - 2. Test cables for electrical continuity and insulation integrity before energizing.
 - 3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- D. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.
- E. Cables will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

3.5 PROTECTION

- A. Protect installed heating cables, including nonheating leads, from damage during construction.
- B. Remove and replace damaged heat-tracing cables.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 210533

SECTION 210548 - VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Restraining braces.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: [A] [B] [C] [D] [E] [F].
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: [I] [II] [III].
 - a. Component Importance Factor: [1.0] [1.5] <Insert value>.
 - b. Component Response Modification Factor: [1.5] [2.5] [3.5] [5.0] <Insert value>.
 - c. Component Amplification Factor: [1.0] [2.5] <Insert value>.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): **<Insert percent>**.
4. Design Spectral Response Acceleration at 1-Second Period: **<Insert percent>**.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by **[an evaluation service member of ICC-ES] [OSHPD] [an agency acceptable to authorities having jurisdiction]**.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Include data substantiating that materials comply with requirements.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
2. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Preapproval and Evaluation Documentation: By **[an evaluation service member of ICC-ES] [OSHPD] [an agency acceptable to authorities having jurisdiction]**, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For **[professional engineer] [and] [testing agency]**.

- B. Welding certificates.
- C. Manufacturer's Certificate: Certify that isolators are properly installed and adjusted to meet or exceed specified requirements.
- D. Project Record Documents:
 - 1. Record actual locations of hangers including attachment points.

1.7 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC and NFPA 13 unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ace Mountings Co., Inc.
 2. Amber/Booth Company, Inc.
 3. California Dynamics Corporation.
 4. Isolation Technology, Inc.
 5. Kinetics Noise Control.
 6. Mason Industries.
 7. Vibration Eliminator Co., Inc.
 8. Vibration Isolation.
 9. Vibration Mountings & Controls, Inc.
 10. **<Insert manufacturer's name>**.
 11. or approved equal.
- B. Pads **<Insert drawing designation>**: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
1. Resilient Material: Oil- and water-resistant [**neoprene**] [**rubber**] [**hermetically sealed compressed fiberglass**].
- C. Mounts **<Insert drawing designation>**: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- D. Restrained Mounts **<Insert drawing designation>**: All-directional mountings with seismic restraint.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

2.2 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amber/Booth Company, Inc.
 2. California Dynamics Corporation.
 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 4. Hilti, Inc.
 5. Kinetics Noise Control.
 6. Loos & Co.; Cableware Division.
 7. Mason Industries.
 8. TOLCO Incorporated; a brand of NIBCO INC.
 9. Unistrut; Tyco International, Ltd.
 10. **<Insert manufacturer's name>**.
 11. or approved equal.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by **[an evaluation service member of ICC-ES] [OSHPD] [an agency acceptable to authorities having jurisdiction]**.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least **[four] <Insert number>** times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. Hanger Rod Stiffener: **[Steel tube or steel slotted-support-system sleeve with internally bolted connections] [Reinforcing steel angle clamped]** to hanger rod.
- E. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- F. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.
- G. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- H. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- I. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid

mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by **[an evaluation service member of ICC-ES] [OSHPD] [an agency acceptable to authorities having jurisdiction]**.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds **0.125 inch** (3.2 mm).
2. Install seismic-restraint devices using methods approved by **[an evaluation service member of ICC-ES] [OSHPD] [an agency acceptable to authorities having jurisdiction]** providing required submittals for component.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127 and NFPA 13.
2. Space lateral supports a maximum of **[40 feet (12 m)] <Insert dimension>** o.c., and longitudinal supports a maximum of **[80 feet (24 m)] <Insert dimension>** o.c.
3. Brace a change of direction longer than **12 feet** (3.7 m).

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by **[an evaluation service member of ICC-ES] [OSHPD] [an agency acceptable to authorities having jurisdiction]** providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

H. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the DEN Project Manager if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of

the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 211200 "Fire-Suppression Standpipes," Section 211313 "Wet-Pipe Sprinkler Systems," and Section 211316 "Dry-Pipe Sprinkler Systems" for piping flexible connections.

3.5 FIRE-SUPPRESSION VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

- A. Supported or Suspended Equipment: **<Insert name and drawing designation>**.
 1. Equipment Location: **<Insert room number>**.
 2. Pads:
 - a. Material: **[Neoprene] [Rubber] [Hermetically sealed compressed fiberglass]**.
 - b. Thickness: **<Insert inches (mm)>**.
 - c. Number of Pads: **<Insert number>** thick.
 3. Isolator Type: **<Insert generic name or designation used in Part 2>**.
 4. Minimum Deflection: **<Insert inches (mm)>**.
 5. Component Importance Factor: **[1.0] [1.5]**.
 6. Component Response Modification Factor: **[1.5] [2.5] [3.5] [5.0]**.
 7. Component Amplification Factor: **[1.0] [2.5]**.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 210548

SECTION 210553 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 REFERENCES

- A. Materials and workmanship shall conform to the latest issue of all industry standards, publications, or regulations referenced in this section and with the following references as applicable. Refer to Section 014225 "Referenced Standards" for listing of issuing organizations or agencies.
- B. Applicable Standards:
 - 1. American Society of Mechanical Engineers (ASME).
 - 2. ASME A13.1 - Scheme for the Identification of Piping Systems.
 - 3. International Building Code (IBC) with the Denver Amendments.
 - 4. International Fire Code (IFC) with the Denver Amendments.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Provide manufacturers catalog literature for each product required.
 - 1. Include data substantiating that materials comply with requirements.

- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.
 - 1. Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- D. Valve Schedules: Valve numbering scheme.
 - 1. Include valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each piping system to include in maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".
 - 1. Record actual locations of all tagged valves.

1.6 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

1.7 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 SIGNAGE AND LABELING - GENERAL

- A. Signage shall be per the requirements of NFPA - 13, FM Global, and any applicable

Insurance underwriter.

- B. Signs shall be pre-manufactured metal, approximately 2" x 6", located at all valves, main drains, auxiliary drains, air, alarm, and similar devices.

2.2 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. W.H. Brady Co.
 - 2. Panduit Corp.
 - 3. Seton Name Plate Corp.
 - 4. Marking Services, Inc.
 - 5. <Insert manufacturer>
 - 6. or approved equal.

2.3 MATERIALS

- A. Color: Unless specified otherwise, conform to ASME A13.1.
- B. Plastic Nameplates: Laminated three-layer plastic with engraved black letters on light contrasting background color.
- C. Metal Tags: Brass or aluminum, with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- D. Chart: Typewritten letter size list in anodized aluminum frame.
- E. Stencils: With clean cut symbols and letters of 2-1/2 inch size.
- F. Stencil Paint: In accordance with Section 099123 "Interior Painting, semi-gloss enamel.
- G. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and fluid being conveyed.
- H. Underground Plastic Pipe Markers:
 - 1. Bright colored continuously printed plastic ribbon tape of not less than 6 inch wide by 4 mil thick, manufactured for direct burial service.
 - 2. For non-metallic buried piping provide printed foil type tape, enabling locating of runs by use of a metal detector.

2.4 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: **[Brass, 0.032 inch (0.8 mm)] [stainless steel, 0.025 inch (0.64 mm)] [aluminum, 0.032 inch (0.8 mm)] [or] [anodized aluminum, 0.032 inch (0.8 mm)]** thick, with predrilled holes for attachment hardware.
2. Letter Color: **[Black] [Blue] [Red] [White] [Yellow] <Insert color>**.
3. Background Color: **[Black] [Blue] [Red] [White] [Yellow] <Insert color>**.
4. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch (64 by 19 mm)**.
5. Minimum Letter Size: **1/4 inch (6.4 mm)** for name of units if viewing distance is less than **24 inches (600 mm)**, **1/2 inch (13 mm)** for viewing distances up to **72 inches (1830 mm)**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless-steel **[rivets] [or] [self-tapping screws]**.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, **[1/16 inch (1.6 mm)] [1/8 inch (3.2 mm)] <Insert dimension>** thick, with predrilled holes for attachment hardware.
2. Letter Color: **[Black] [Blue] [Red] [White] [Yellow] <Insert color>**.
3. Background Color: **[Black] [Blue] [Red] [White] [Yellow] <Insert color>**.
4. Maximum Temperature: Able to withstand temperatures up to **160 deg F (71 deg C)**.
5. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch (64 by 19 mm)**.
6. Minimum Letter Size: **1/4 inch (6.4 mm)** for name of units if viewing distance is less than **24 inches (600 mm)**, **1/2 inch (13 mm)** for viewing distances up to **72 inches (1830 mm)**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel **[rivets] [or] [self-tapping screws]**.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment-Label Schedule: For each item of equipment to be labeled, on **8-1/2-by-11-inch (A4)** bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

1. Provide typewritten letter size equipment chart and schedule in anodized aluminum frame.

2.5 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, **[1/16 inch (1.6 mm)] [1/8 inch (3.2 mm)] <Insert dimension>** thick, with predrilled holes for attachment hardware.
- B. Letter Color: **[Black] [Blue] [Red] [White] [Yellow] <Insert color>**.
- C. Background Color: **[Black] [Blue] [Red] [White] [Yellow] <Insert color>**.
- D. Maximum Temperature: Able to withstand temperatures up to **160 deg F (71 deg C)**.
- E. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch (64 by 19 mm)**.
- F. Minimum Letter Size: **1/4 inch (6.4 mm)** for name of units if viewing distance is less than **24 inches (600 mm)**, **1/2 inch (13 mm)** for viewing distances up to **72 inches (1830 mm)**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel **[rivets] [or] [self-tapping screws]**.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.6 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to **[partially cover] [cover full]** circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; pipe size; and an arrow indicating flow direction.
 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.

2. Lettering Size: At least 1-1/2 inches (38 mm) high.

E. Pipe-Label Colors:

1. Background Color: Red.
2. Letter Color: White.

2.7 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: **[Aluminum] [Brass] [Fiberboard] [Fiberboard or metal] <Insert material>**.
2. Stencil Paint: Exterior, gloss, **[alkyd enamel] [acrylic enamel] <Insert paint type>** black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, **[alkyd enamel] [acrylic enamel] <Insert paint type>** in colors according to ASME A13.1 unless otherwise indicated.

2.8 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping-system abbreviation and 1/2-inch (13-mm) numbers.

1. Tag Material: **[Brass, 0.032 inch (0.8 mm)] [stainless steel, 0.025 inch (0.64 mm)] [aluminum, 0.032 inch (0.8 mm)] [or] [anodized aluminum, 0.032 inch (0.8 mm)]** thick, with predrilled holes for attachment hardware.
2. Fasteners: Brass **[wire-link chain] [beaded chain] [or] [S-hook]**.
3. Valve-Tag Color: Red.
4. Letter Color: White.

- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.9 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: **[3 by 5-1/4 inches (75 by 133 mm) minimum] [Approximately 4 by 7**

- inches (100 by 178 mm)] <Insert size>.**
2. Fasteners: [**Brass grommet and wire**] [**Reinforced grommet and wire or string**].
 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 4. Color: Yellow background with black lettering.

2.10 CEILING TACKS

- A. Description: Steel with 3/4 inch diameter color coded head.
- B. Color code as follows:
 1. Red: Fire dampers/smoke dampers.
 2. Green: Plumbing valves.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.
- B. Prepare surfaces in accordance with Division 09 sections for stencil painting.

3.2 LABEL INSTALLATION

- A. Every drain and control valve shall be permanently labeled with the DEN designated system I.D. number and a consecutive number indicating quantity of drains on the system, i.e. T-4-43 / 3 of 7 in the terminal or FZ – 03 / 2 of 2 .
- B. Hydraulic plaques shall be provided at all risers with the appropriate information.
- C. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- D. Coordinate installation of identifying devices with locations of access panels and doors.
- E. Install or permanently fasten labels on each major item of mechanical equipment.
- F. Locate equipment labels where accessible and visible.
- G. Piping Color-Coding: Painting of piping is specified in [**Section 099123 "Interior Painting."**] [**Section 099600 "High-Performance Coatings."**]

- H. Stenciled Pipe-Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, [**with painted, color-coded bands or rectangles**] on each piping system.
1. Identification Paint: Use for contrasting background.
 2. Stencil Paint: Use for pipe marking.
 3. Apply in accordance with Division 09 requirements.
- I. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Install in accordance with manufacturer's instructions.
 2. Near each valve and control device.
 3. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
 4. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 5. At access doors, manholes, and similar access points that permit view of concealed piping.
 6. Near major equipment items and other points of origination and termination.
 7. Spaced at maximum intervals of [**50 feet (15 m)**] <Insert dimension> along each run. Reduce intervals to [**25 feet (7.6 m)**] <Insert dimension> in areas of congested piping and equipment.
 8. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- J. Plastic Nameplates: Install with corrosive-resistant mechanical fasteners and adhesive.
- K. Metal Tags: Install with corrosive-resistant chain.
- L. Plastic Pipe Markers: Install in accordance with manufacturer's instructions.
- M. Underground Plastic Pipe Markers: Install 6 to 8 inches below finished grade or paving, directly above buried pipe.
- N. Controls: Identify control panels and major control components outside panels with plastic nameplates. Key to control schematics.

3.3 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems. List tagged valves in a valve-tag schedule.
- B. Valves Identification:
1. Identify all valves, including fire protection valves, in main and branch piping located inside the building. Use tags secured with brass 'S' hooks or brass

- chains.
2. Stamp tags with a unique prefix to identify system to which applied, followed by a number (Example: CW-1, CW-2, etc.). In general, prefix shall match system abbreviations used on drawings where applicable.
 3. Provide a typewritten listing of valves including: valve identification number, location, function, normal position, service, and area served. Mount list as specified and directed. Include additional copy in operation and maintenance manuals.
 4. Show valve tag designations on the project record document drawings, including schematic flow diagrams where included with construction documents.
 5. Contractor shall prepare and install where directed, in aluminum frames with clear plastic protective cover, a valve location diagram in the form of a series of flow diagrams with each automatic or manually actuated control or shut-off valve clearly identified in sequence with its individual valve tag number. Automatic control valves shall be tagged to match designations shown on the temperature control drawings, and the specified valve charts shall be installed adjacent to valve location diagrams.
- C. Piping: Identify piping, concealed or exposed, with plastic pipe markers. Tags may be used on ½" or smaller diameter non-insulated piping. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and "T", at each side of penetration of structure or enclosure, and at each obstruction.
- D. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
1. Valve-Tag Size and Shape:
 - a. Fire-Suppression Standpipe: [1-1/2 inches (38 mm)] [2 inches (50 mm)], [round] [square] <Insert shape>.
 - b. Wet-Pipe Sprinkler System: [1-1/2 inches (38 mm)] [2 inches (50 mm)], [round] [square] <Insert shape>.
 - c. Dry-Pipe Sprinkler System: [1-1/2 inches (38 mm)] [2 inches (50 mm)], [round] [square] <Insert shape>.
 - d. Foam-Water System: [1-1/2 inches (38 mm)] [2 inches (50 mm)], [round] [square] <Insert shape>.
 - e. Clean-Agent Fire-Extinguishing System: [1-1/2 inches (38 mm)] [2 inches (50 mm)], [round] [square] <Insert shape>.
 2. Provide valve chart and schedule in aluminum frame with clear plastic shield. Install at location as directed by DEN Project Manager.

3.4 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.5 PIPING IDENTIFICATION SCHEDULE

- A. Pipe identification and color coding for fire-suppression piping systems shall be in accordance with the following schedule:

Classification:	Band Color:	Stenciled Legend:
Fire Protection Piping	Red	Fire Line
Fire Sprinkler Piping	Red	Fire Sprinkler. Line
Fire Hose Cabinets:		
Outside Trim/Hose Bracket	Red Enamel	
Interior	White Enamel	

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 210553

SECTION 210700 - FIRE-SUPPRESSION SYSTEMS INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Insulating indoor engine coolant piping for remote radiator of engine-driven fire pump.
 - 2. Insulating indoor engine exhaust piping and silencer.
 - 3. Insulating indoor and outdoor equipment.
 - 4. Insulating outdoor piping.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
 - 1. Include data substantiating that materials comply with requirements.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
 - 2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that product complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.

3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties and equipment connections.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for fire-suppression water storage tanks.

D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Preformed Pipe Insulation Materials: **12 inches** (300 mm) long by **NPS 2** (DN 50).
2. Sheet Form Insulation Materials: **12 inches** (300 mm) square.
3. Jacket Materials for Pipe: **12 inches** (300 mm) long by **NPS 2** (DN 50).
4. Sheet Jacket Materials: **12 inches** (300 mm) square.
5. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.
- C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket

materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by DEN Project Manager. Use materials indicated for the completed Work.
1. Piping Mockups:
 - a. One 10-foot (3-m) section of NPS 2 (DN 50) straight pipe.
 - b. One each of a 90-degree threaded, welded, and flanged elbow.
 - c. One each of a threaded, welded, and flanged tee fitting.
 - d. One NPS 2 (DN 50) or smaller valve, and one NPS 2-1/2 (DN 65) or larger valve.
 - e. Four support hangers including hanger shield and insert.
 - f. One threaded strainer and one flanged strainer with removable portion of insulation.
 - g. One threaded reducer and one welded reducer.
 - h. One pressure temperature tap.
 - i. One mechanical coupling.
 2. Equipment Mockups:
 - a. One tank or vessel.
 3. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
 4. Notify DEN Project Manager seven (7) days in advance of dates and times when mockups will be constructed.
 5. Obtain DEN Project Manager's approval of mockups before starting insulation application.
 6. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 8. Demolish and remove mockups when directed.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

- B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Store insulation in original wrapping and protect from weather and construction traffic.
- D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.8 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields.
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.9 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Calcium Silicate:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Industrial Insulation Group (IIG); Thermo-12 Gold.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
 2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I, asbestos free.
 3. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
 4. Comply with the following:
 - a. 'K' value: ASTM C 177 and C 518; 0.44 at 300 degrees F.
 - b. Maximum Service Temperature: 1200 degrees F.
 - c. Density: 13 lb/cu ft; compressive strength (block) 200 PSI with 5% compression at 1-1/2" thickness.
 - d. Tie with 16 gage stainless steel wire loops with twisted ends, spaced 12 inches on center.
- G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pittsburgh Corning Corporation; Foamglas.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
 2. Block Insulation: ASTM C 552, Type I.
 3. Special-Shaped Insulation: ASTM C 552, Type III.
 4. Board Insulation: ASTM C 552, Type IV.
 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 6. Preformed Pipe Insulation with Factory-Applied [ASJ] [ASJ-SSL]: Comply with ASTM C 552, Type II, Class 2.
 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
 8. Comply with the following:
 - a. 'K' value: 0.40 at 75 degrees F.

- b. Maximum Water Vapor Transmission: 0.1 perm.
- H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
 - I. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.
 - f. **<Insert manufacturer's name; product name or designation>**.
 - g. or approved equal.
 2. Comply with the following:
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 400 degrees F.
 - c. Maximum Moisture Absorption: 0.2 percent by volume.
 - J. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation [**without factory-applied jacket**] [**with factory-applied ASJ**] [**with factory-applied FSK jacket**]. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; CertaPro Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.
 - g. **<Insert manufacturer's name; product name or designation>**.
 - h. or approved equal.
 2. Comply with the following:

- a. Minimum Service Temperature: 0 degrees F.
- b. Maximum Service Temperature: 400 degrees F.
- c. Maximum Moisture Absorption: 0.2 percent by volume.

K. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - f. **<Insert manufacturer's name; product name or designation>**.
 - g. or approved equal.
2. Type I, **850 Deg F** (454 Deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, **[without factory-applied jacket] [with factory-applied ASJ] [with factory-applied ASJ-SSL]**. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
3. Type II, **1200 Deg F** (649 Deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, **[without factory-applied jacket] [with factory-applied ASJ] [with factory-applied ASJ-SSL]**. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
4. Comply with the following:
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 400 degrees F.
 - c. Maximum Moisture Absorption: 0.2 percent by volume.

L. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied **[ASJ] [FSK jacket]** complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is **2.5 lb/cu. ft.** (40 kg/cu. m) or more. Thermal conductivity (k-value) at **100 deg F** (55 deg C) is **0.29 Btu x in./h x sq. ft. x deg F** (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.
 - f. **<Insert manufacturer's name; product name or designation>**.
 - g. or approved equal.

2. Comply with the following:
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 400 degrees F.
 - c. Maximum Moisture Absorption: 0.2 percent by volume.

M. Phenolic:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Kingspan Tarec Industrial Insulation NV; Koolphen K.
 - b. Resolco International BV; Insul-phen.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
 - a. Preformed Pipe Insulation: **[None] [ASJ]**.
 - b. Board for Equipment Applications: **[None] [ASJ]**.

N. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); Trymer 2000 XP.
 - b. Duna USA Inc.; Corafoam.
 - c. Dyplast Products; ISO-25.
 - d. Elliott Company of Indianapolis; Elfoam.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed **0.19 Btu x in./h x sq. ft. x deg F** (0.027 W/m x K) at **75 deg F** (24 deg C) after 180 days of aging.
3. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to **1 inch** (25 mm) as tested by ASTM E 84.
4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
 - a. Pipe Applications: **[None] [ASJ] [ASJ-SSL] [PVDC] [PVDC-SSL]**.
 - b. Equipment Applications: **[None] [ASJ] [ASJ-SSL] [PVDC] [PVDC-SSL]**.

6. Comply with the following:

- a. Minimum Service Temperature: -250 degrees F.
- b. Maximum Service Temperature: 250 degrees F.
- c. Maximum Moisture Absorption: ASTM D 2842; 0.054 percent by volume.
- d. Moisture Vapor Transmission: 1.26 perm inches.
- e. Connection: Waterproof vapor barrier adhesive.

O. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Armacell LLC; Tubolit.
- b. Nomaco Insulation; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.
- c. **<Insert manufacturer's name; product name or designation>**.
- d. or approved equal.

P. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed **0.26 Btu x in./h x sq. ft. x deg F** (0.038 W/m x K) after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Dow Chemical Company (The); Styrofoam.
- b. **<Insert manufacturer's name; product name or designation>**.
- c. or approved equal.

2. Comply with the following:

- a. Maximum service temperature: 180 degrees F.
- b. Maximum Water Vapor Transmission: 0.1 perm.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Ramco Insulation, Inc.; Super-Stik.
- b. **<Insert manufacturer's name; product name or designation>**.
- c. or approved equal.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Ramco Insulation, Inc.; Thermokote V.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
- C. Mineral-Fiber, Hydraulic-Setting Insulating, and Finishing Cement: Comply with ASTM C 449.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of **50 to 800 deg F** (10 to 427 deg C).
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.
 - b. Eagle Bridges - Marathon Industries; 290.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.
 - d. Mon-Eco Industries, Inc.; 22-30.
 - e. Vimasco Corporation; 760.
 - f. **<Insert manufacturer's name; product name or designation>**.
 - g. or approved equal.
 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of **minus 100 to plus 200 deg F** (minus 73 to plus 93 deg C).
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- D. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aero seal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Phenolic and Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of **minus 75 to plus 300 deg F** (minus 59 to plus 149 deg C).
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-96.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-33.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of **minus 20 to plus 140 deg F** (29 to plus 60 deg C).
1. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-96.
- b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60.
- c. **<Insert manufacturer's name; product name or designation>**.
- d. or approved equal.

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, **0.013 perm** (0.009 metric perm) at **43-mil** (1.09-mm) dry film thickness.
 3. Service Temperature Range: **Minus 20 to plus 180 deg F** (Minus 29 to plus 82 deg C).
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
 - b. Eagle Bridges - Marathon Industries; 570.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
 2. Water-Vapor Permeance: ASTM F 1249, **0.05 perm** (0.033 metric perm) at **30-mil** (0.8-mm) dry film thickness.
 3. Service Temperature Range: **Minus 50 to plus 220 deg F** (Minus 46 to plus 104 deg C).
 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 5. Color: White.

- D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 - f. **<Insert manufacturer's name; product name or designation>**.
 - g. or approved equal.
 2. Water-Vapor Permeance: ASTM F 1249, **1.8 perms** (1.2 metric perms) at **0.0625-inch** (1.6-mm) dry film thickness.
 3. Service Temperature Range: **Minus 20 to plus 180 deg F** (Minus 29 to plus 82 deg C).
 4. Solids Content: 60 percent by volume and 66 percent by weight.
 5. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - c. Vimasco Corporation; 713 and 714.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
 2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
 3. Service Temperature Range: **0 to plus 180 deg F** (Minus 18 to plus 82 deg C).
 4. Color: White.

2.6 SEALANTS

- A. Joint Sealants:
1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - f. **<Insert manufacturer's name; product name or designation>**.
 - g. or approved equal.
2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, provide one of the following:
- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-70.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
3. Materials shall be compatible with insulation materials, jackets, and substrates.
4. Permanently flexible, elastomeric sealant.
5. Service Temperature Range: **Minus 100 to plus 300 deg F** (Minus 73 to plus 149 deg C).
6. Color: White or gray.
7. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: **Minus 40 to plus 250 deg F** (Minus 40 to plus 121 deg C).
 5. Color: Aluminum.
 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: **Minus 40 to plus 250 deg F** (Minus 40 to plus 121 deg C).
 5. Color: White.
 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 4. PVDC Jacket for Indoor Applications: **4-mil-** (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at **0.02 perm** (0.013 metric perm) when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 - 2) **<Insert manufacturer's name; product name or designation>**.
 - 3) or approved equal.
 5. PVDC Jacket for Outdoor Applications: **6-mil-** (0.15-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at **0.01 perm** (0.007 metric perm) when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, provide one of the following:

- 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 - 2) **<Insert manufacturer's name; product name or designation>**.
 - 3) or approved equal.
6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 - 2) **<Insert manufacturer's name; product name or designation>**.
 - 3) or approved equal.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately **2 oz./sq. yd.** (68 g/sq. m) with a thread count of **10 strands by 10 strands/sq. in.** (4 strands by 4 strands/sq. mm) for covering pipe and pipe fittings.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 10.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
- B. Woven Glass-Fiber Fabric for Equipment Insulation: Approximately **6 oz./sq. yd.** (203 g/sq. m) with a thread count of **5 strands by 5 strands/sq. in.** (2 strands by 2 strands/sq. mm) for covering equipment.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
- C. Woven Polyester Fabric: Approximately **1 oz./sq. yd.** (34 g/sq. m) with a thread count of **10 strands by 10 strands/sq. in.** (4 strands by 4 strands/sq. mm), in a Leno weave.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.

2.9 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of **8 oz./sq. yd.** (271 g/sq. m).
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.
 - b. **<Insert manufacturer's name; product name or designation>.**
 - c. or approved equal.

2.10 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 - e. **<Insert manufacturer's name; product name or designation>.**
 - f. or approved equal.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: **[White] [Color-code jackets based on system. Color as selected by DEN Project Manager]**.
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
 5. Factory-fabricated tank heads and tank side panels.
 6. Comply with the following:
 - a. Factory-fabricated fitting covers manufactured from 20-mil- thick, high-impact, ultraviolet-resistant PVC.
 - b. Factory-fabricated fitting covers manufactured from 30-mil-thick, high-impact, ultraviolet-resistant PVC.
 - c. Minimum Service Temperature: -40 degrees F.
 - d. Maximum Service Temperature: 150 degrees F.

- e. Moisture Vapor Transmission: ASTM E 96; 0.002 perm inches.
- f. Maximum Flame Spread: ASTM E 84; 25.
- g. Maximum Smoke Developed: ASTM E 84; 50.
- h. Minimum Thickness: 20 mil.
- i. Connections: Brush on welding adhesive or pressure sensitive color matching vinyl tape.

C. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
2. Aluminum Jacket: Comply with [ASTM B 209](#) (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. **[Sheet and roll stock ready for shop or field sizing] [Factory cut and rolled to size]**.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: **[1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper] [3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper] [2.5-mil- (0.063-mm-) thick polysurlyn]**.
 - d. Moisture Barrier for Outdoor Applications: **[3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper] [2.5-mil- (0.063-mm-) thick polysurlyn]**.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
 - f. Comply with the following:
 - 1) Minimum Thickness: 0.024-inch sheet.
 - 2) Finish: Embossed.
 - 3) Joining: Longitudinal slip joints and 2-inch laps.
 - 4) Fittings: 0.016-inch thick die shaped fitting covers with factory

- attached protective liner.
- 5) Metal Jacket Bands: 3/8 inch wide: .015-inch thick aluminum.
 - 6) Painted finish, 0.016 inch thick.
3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
- a. **[Sheet and roll stock ready for shop or field sizing] [Factory cut and rolled to size].**
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: **[1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper] [3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper] [2.5-mil- (0.063-mm-) thick polysurlyn].**
 - d. Moisture Barrier for Outdoor Applications: **[3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper] [2.5-mil- (0.063-mm-) thick polysurlyn].**
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
 - f. Comply with the following:
 - 1) Thickness: 0.016 inch.
 - 2) Finish: Corrugated.
 - 3) Elbows: Gore type, for 45- and 90-degree elbows in same material, finish, and thickness as jacket.
 - 4) Jacket Bands: Stain
 - 5) Metal Jacket Bands: 3/8 inch wide; 0.010-inch thick stainless steel.

2.11 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.

- d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
 2. Width: **3 inches** (75 mm).
 3. Thickness: **11.5 mils** (0.29 mm).
 4. Adhesion: **90 ounces force/inch** (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: **40 lbf/inch** (7.2 N/mm) in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. SK Tape: Ffoil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
 2. Width: **3 inches** (75 mm).
 3. Thickness: **6.5 mils** (0.16 mm).
 4. Adhesion: **90 ounces force/inch** (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: **40 lbf/inch** (7.2 N/mm) in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
 2. Width: **2 inches** (50 mm).
 3. Thickness: **6 mils** (0.15 mm).
 4. Adhesion: **64 ounces force/inch** (0.7 N/mm) in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: **18 lbf/inch** (3.3 N/mm) in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:

- a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
2. Width: **2 inches** (50 mm).
 3. Thickness: **3.7 mils** (0.093 mm).
 4. Adhesion: **100 ounces force/inch** (1.1 N/mm) in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: **34 lbf/inch** (6.2 N/mm) in width.
- E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
 2. Width: **3 inches** (75 mm).
 3. Film Thickness: **4 mils** (0.10 mm).
 4. Adhesive Thickness: **1.5 mils** (0.04 mm).
 5. Elongation at Break: 145 percent.
 6. Tensile Strength: **55 lbf/inch** (10.1 N/mm) in width.
- F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, **provide one of the following**:
 - a. Dow Chemical Company (The); Saran 560 Vapor Retarder Tape.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
 2. Width: **3 inches** (75 mm).
 3. Film Thickness: **6 mils** (0.15 mm).
 4. Adhesive Thickness: **1.5 mils** (0.04 mm).
 5. Elongation at Break: 145 percent.
 6. Tensile Strength: **55 lbf/inch** (10.1 N/mm) in width.

2.12 SECUREMENTS

- A. Bands:
1. Products: Subject to compliance with requirements, provide one of the following:

- a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
 - c. <Insert manufacturer's name; product name or designation>.
 - d. or approved equal.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, [Type 304] [or] [Type 316]; 0.015 inch (0.38 mm) thick, [1/2 inch (13 mm)] [3/4 inch (19 mm)] wide with [wing seal] [or] [closed seal].
 3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, [1/2 inch (13 mm)] [3/4 inch (19 mm)] wide with [wing seal] [or] [closed seal].
 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - 4) <Insert manufacturer's name; product name or designation>.
 - 5) or approved equal.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
 - c. Spindle: [Copper- or zinc-coated, low carbon steel] [Aluminum] [Stainless steel], fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 2. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - 4) <Insert manufacturer's name; product name or designation>.
 - 5) or approved equal.

- b. Baseplate: Galvanized carbon-steel sheet, **0.030 inch** (0.76 mm) thick by **2 inches** (50 mm) square.
 - c. Spindle: [**Copper- or zinc-coated, low-carbon steel**] [**Aluminum**] [**Stainless steel**], fully annealed, **0.106-inch-** (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
 3. Insulation-Retaining Washers: Self-locking washers formed from **0.016-inch-** (0.41-mm-) thick, [**galvanized-steel**] [**aluminum**] [**stainless-steel**] sheet, with beveled edge sized as required to hold insulation securely in place but not less than **1-1/2 inches** (38 mm) in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - 5) **<Insert manufacturer's name; product name or designation>**.
 - 6) or approved equal.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
 - C. Staples: Outward-clinching insulation staples, nominal **3/4-inch-** (19-mm-) wide, stainless steel or Monel.
 - D. Wire: [**0.080-inch** (2.0-mm) **nickel-copper alloy**] [**0.062-inch** (1.6-mm) **soft-annealed, stainless steel**] [**0.062-inch** (1.6-mm) **soft-annealed, galvanized steel**].
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.
- 2.13 CORNER ANGLES
- A. PVC Corner Angles: **30 mils** (0.8 mm) thick, minimum **1 by 1 inch** (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
 - B. Aluminum Corner Angles: **0.040 inch** (1.0 mm) thick, minimum **1 by 1 inch** (25 by 25 mm), aluminum according to **ASTM B 209** (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

- C. Stainless-Steel Corner Angles: **0.024 inch** (0.61 mm) thick, minimum **1 by 1 inch** (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, **[Type 304]** **[or]** **[Type 316]**.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer **5 mils** (0.127 mm) thick and an epoxy finish **5 mils** (0.127 mm) thick if operating in a temperature range between **140 and 300 deg F** (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 2. Carbon Steel: Coat carbon steel operating at a service temperature between **32 and 300 deg F** (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

3.4 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.

2. Cover circumferential joints with **3-inch-** (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced **4 inches** (100 mm) o.c.
 3. Overlap jacket longitudinal seams at least **1-1/2 inches** (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [**2 inches** (50 mm)] [**4 inches** (100 mm)] o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least **4 inches** (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.5 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least **2 inches** (50 mm) below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation

flush with sleeve seal. Seal terminations with flashing sealant.

- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least **2 inches** (50 mm).
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.6 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for **[100] [50] <Insert percentage>** percent coverage of tank and vessel surfaces.
 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 3. Protect exposed corners with secured corner angles.
 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is **3 inches** (75 mm) from insulation end joints, and **16 inches** (400 mm) o.c. in both directions.
 - d. Do not overcompress insulation during installation.

- e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately **6 inches** (150 mm) from each end. Install wire or cable between two circumferential girdles **12 inches** (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of **48 inches** (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
 7. Stagger joints between insulation layers at least **3 inches** (75 mm).
 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 2. Seal longitudinal seams and end joints.
- ### 3.7 GENERAL PIPE INSULATION INSTALLATION
- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be

- butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange

- cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical centerline of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least **2 inches** (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.8 CALCIUM SILICATE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure single-layer insulation with stainless-steel bands at **12-inch** (300-mm) intervals and tighten bands without deforming insulation materials.
2. Install two-layer insulation with joints tightly butted and staggered at least **3 inches** (75 mm). Secure inner layer with wire spaced at **12-inch** (300-mm) intervals. Secure outer layer with stainless-steel bands at **12-inch** (300-mm) intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least **1 inch** (25 mm). Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
4. Finish flange insulation same as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
3. Finish fittings insulation same as pipe insulation.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

3.9 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and applicable insulation joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at **6 inches** (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least **1 inch** (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.10 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.11 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and applicable insulation joint sealant.
 3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at **6 inches** (150 mm) o.c.
 4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as

recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least **1 inch (25 mm)**, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.12 PHENOLIC INSULATION INSTALLATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless-steel bands at **12-inch (300-mm)** intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least **3 inches (75 mm)**. Secure inner layer with **0.062-inch (1.6-mm)** wire spaced at **12-inch (300-mm)** intervals. Secure outer layer with stainless-steel bands at **12-inch (300-mm)** intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and applicable insulation joint sealant.

3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at **6 inches (150 mm)** o.c.
4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as straight segments of pipe insulation.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.13 POLYISOCYANURATE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3- and 9-o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed **1-1/2-inch (38-mm)** thickness.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyisocyanurate block insulation of same thickness as pipe insulation.

C. Insulation Installation on Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of polyisocyanurate insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.14 POLYOLEFIN INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.15 POLYSTYRENE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3- and 9-o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, and make thickness same as adjacent pipe insulation, not to exceed 1-1/2-inch (38-mm) thickness.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polystyrene block insulation of same thickness as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed section of polystyrene insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.16 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.

2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.
- E. Where PVDC jackets are indicated, install as follows:
1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
 2. Wrap factory-presizes jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches (50 mm) over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
 3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
 4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches (850 mm) or less. The 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
 5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.17 FINISHES

- A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 - 1. Flat Acrylic Finish: **[Two]** <Insert number> finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by DEN Project Manager. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.18 FIELD QUALITY CONTROL

- A. Testing Agency: **[Owner will engage]** **[Engage]** a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Inspect field-insulated equipment, randomly selected by DEN Project Manager, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to **[one]** <Insert number> location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 - 2. Inspect pipe, fittings, strainers, and valves, randomly selected by DEN Project Manager, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to **[three]** <Insert number> locations of straight pipe, **[three]** <Insert number> locations of threaded fittings, **[three]** <Insert number> locations of welded fittings, **[two]** <Insert number> locations of threaded strainers, **[two]** <Insert number> locations of welded strainers, **[three]** <Insert number> locations of threaded valves, and **[three]** <Insert number> locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.19 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment that is not factory insulated.
- C. Fire-suppression water storage tank insulation shall be [**one of**] the following:
 - 1. Cellular Glass: [2 inches (50 mm)] <Insert dimension> thick.
 - 2. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
 - 3. Mineral-Fiber Board: [1 inch (25 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
 - 4. Mineral-Fiber Pipe and Tank: [1 inch (25 mm)] <Insert dimension> thick.
 - 5. Phenolic: [1 inch (25 mm)] <Insert dimension> thick.
 - 6. Polyisocyanurate: [1 inch (25 mm)] <Insert dimension> thick.
 - 7. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.

3.20 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Indoor fire-suppression piping.
 - 2. Underground piping.

3.21 INDOOR PIPING INSULATION SCHEDULE

- A. Indoor Engine Coolant Piping for Remote Radiator of Engine-Driven Fire Pump:
 - 1. All Pipe Sizes: Insulation shall be [**one of**] the following:
 - a. Calcium Silicate: [2 inches (50 mm)] <Insert dimension> thick.
 - b. Cellular Glass: [2 inches (50 mm)] <Insert dimension> thick.
 - c. Mineral-Fiber, Preformed Pipe, Type I or II: [2 inches (50 mm)] <Insert dimension> thick.
- B. Indoor Engine Exhaust Piping and Silencer, All Pipe Sizes: Calcium silicate, [4 inches (100 mm)] <Insert dimension> thick.

3.22 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Fire-Suppression Water Piping:

1. All Pipe Sizes: Insulation shall be[**one of**] the following:
 - a. Cellular Glass: [2 inches (50 mm)] <Insert dimension> thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: [2 inches (50 mm)] <Insert dimension> thick.
 - c. Phenolic: [2 inches (50 mm)] <Insert dimension> thick.

- B. Outdoor Engine Coolant Piping for Remote Radiator of Engine-Driven Fire Pump:
 1. All Pipe Sizes: Insulation shall be[**one of**] the following:
 - a. Calcium Silicate: [2 inches (50 mm)] <Insert dimension> thick.
 - b. Cellular Glass: [2 inches (50 mm)] <Insert dimension> thick.
 - c. Mineral-Fiber, Preformed Pipe, Type I or II: [2 inches (50 mm)] <Insert dimension> thick.

- C. Outdoor Engine Exhaust Piping and Silencer, All Pipe Sizes: Calcium silicate, [4 inches (100 mm)] <Insert dimension> thick.

- D. Outdoor Fire-Suppression Piping Filled with Water:
 1. All Pipe Sizes: Insulation shall be[**one of**] the following:
 - a. Cellular Glass: [2 inches (50 mm)] <Insert dimension> thick.
 - b. Flexible Elastomeric: [2 inches (50 mm)] <Insert dimension> thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: [2 inches (50 mm)] <Insert dimension> thick.
 - d. Phenolic: [2 inches (50 mm)] <Insert dimension> thick.
 - e. Polyisocyanurate: [2 inches (50 mm)] <Insert dimension> thick.
 - f. Polyolefin: [2 inches (50 mm)] <Insert dimension> thick.
 - g. Polystyrene: [2 inches (50 mm)] <Insert dimension> thick.

3.23 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

- B. If more than one material is listed, selection from materials listed is Contractor's option.

- C. Piping, Concealed:
 1. None.
 2. Aluminum, [Smooth] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
 3. Painted Aluminum, [Smooth] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] thick.

4. Stainless Steel, [**Type 304**] [or] [**Type 316**], [**Smooth 2B Finish**] [**Corrugated**] [**Stucco Embossed**]: [0.010 inch (0.25 mm)] [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] thick.
5. <Insert jacket type>.

D. Piping, Exposed:

1. None.
2. [**PVC**] [**PVC, Color-Coded by System**]: [20 mils (0.5 mm)] [30 mils (0.8 mm)] thick.
3. Aluminum, [**Smooth**] [**Corrugated**] [**Stucco Embossed**]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
4. Painted Aluminum, [**Smooth**] [**Corrugated**] [**Stucco Embossed**]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] thick.
5. Stainless Steel, [**Type 304**] [or] [**Type 316**], [**Smooth 2B Finish**] [**Corrugated**] [**Stucco Embossed**]: [0.010 inch (0.25 mm)] [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] thick.
6. <Insert jacket type>.

3.24 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Concealed:

1. None.
2. [**PVC**] [**PVC, Color-Coded by System**]: [20 mils (0.5 mm)] [30 mils (0.8 mm)] thick.
3. Aluminum, [**Smooth**] [**Corrugated**] [**Stucco Embossed**]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
4. Painted Aluminum, [**Smooth**] [**Corrugated**] [**Stucco Embossed**]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] thick.
5. Stainless Steel, [**Type 304**] [or] [**Type 316**], [**Smooth 2B Finish**] [**Corrugated**] [**Stucco Embossed**]: [0.010 inch (0.25 mm)] [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] thick.
6. <Insert jacket type>.

- D. Equipment, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):

1. [**Painted**] Aluminum, [**Smooth**] [**Corrugated**] [**Stucco Embossed**] [**with Z-Shaped Locking Seam**]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024

- inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
 2. Stainless Steel, [Type 304] [or] [Type 316], [Smooth 2B Finish] [Corrugated] [Stucco Embossed] [with Z-Shaped Locking Seam]: [0.010 inch (0.25 mm)] [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] thick.
 3. <Insert jacket type>.
- E. Equipment, Exposed, Larger Than 48 Inches (1200 mm) in Diameter or with Flat Surfaces Larger Than 72 Inches (1800 mm):
1. [Painted] Aluminum, [Smooth] [Stucco Embossed] with [1-1/4-Inch- (32-mm-) Deep Corrugations] [2-1/2-Inch- (65-mm-) Deep Corrugations] [4-by-1-Inch (100-by-25-mm) Box Ribs]: [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
 2. Stainless Steel, [Type 304] [or] [Type 316], [Smooth] [Stucco Embossed], with [1-1/4-Inch- (32-mm-) Deep Corrugations] [2-1/2-Inch- (65-mm-) Deep Corrugations] [4-by-1-Inch (100-by-25-mm) Box Ribs]: [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] thick.
 3. <Insert jacket type>.
- F. Outdoor Exposed Piping:
1. PVC: [20 mils (0.5 mm)] [30 mils (0.8 mm)] [40 mils (1.0 mm)] thick.
 2. [Painted] Aluminum, [Smooth] [Corrugated] [Stucco Embossed] [with Z-Shaped Locking Seam]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
 3. Stainless Steel, [Type 304] [or] [Type 316], [Smooth 2B Finish] [Corrugated] [Stucco Embossed] [with Z-Shaped Locking Seam]: [0.010 inch (0.25 mm)] [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] thick.
 4. <Insert jacket type>.

PART 4 - PART 4- MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PART 5- PAYMENT

5.1 PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 210700

SECTION 211100 - FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes fire-suppression water-service piping and related components outside the building [**and service entrance piping through floor into the building**] [**and service entrance piping through wall into the building**].
- B. Include all pipe and fittings, valves and connections for fire-suppression water-service piping. All piping required to complete the fire protection systems shall be designed, fabricated, and installed based on approved hydraulic calculations and shop drawings prepared and submitted by the Fire Protection Work Contractor (FPWC).
- C. The FPWC shall provide all special tools required for installation or maintenance for the equipment provided. If conflicts occur in this specification or between this specification and the contract documents, the most stringent requirement shall apply.
- D. Work on all systems require DEN Shut Down Requests be completed and filed a minimum of five (5) days before work is to be done. Work on wet systems must be done during off hour periods, 10:00 p.m. to 6:00 a.m. Sunday night through Friday morning. No system may be shut down for periods longer than ten (10) hours. The Fire Sprinkler Contractor is responsible for the required fire watch and must remain ON SITE for the entire period of time that the system is not in service. Failure to comply may be reason for immediate suspension of work privileges
- E. Utility-furnished products include water meters that will be furnished to the site, ready for installation.
- F. Related Sections:
 - 1. Section 211200 "Fire-Suppression Standpipes" for fire-suppression standpipes inside the building.
 - 2. Section 211313 "Wet-Pipe Sprinkler Systems" for wet-pipe fire-suppression sprinkler systems inside the building.
 - 3. Section 211316 "Dry-Pipe Sprinkler Systems" for dry-pipe fire-suppression sprinkler systems inside the building.
 - 4. Section 211339 "Foam-Water Systems" for AFFF piping.
 - 5. [**Section 213113 "Electric-Drive, Centrifugal Fire Pumps"**] [**Section 213116 "Diesel-Drive, Centrifugal Fire Pumps"**] [**Section 213213 "Electric-Drive,**

Vertical-Turbine Fire Pumps"] [Section 213216 "Diesel-Drive, Vertical-Turbine Fire Pumps"] for fire pumps, pressure-maintenance pumps, and controllers.

- G. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. Pipe sizes used in this specification are Nominal Pipe Size (NPS).
- B. Other definitions for fire protection systems are listed in NFPA 13 and 14.
- C. "Working Plans" as used in this section means those documents (including drawings and calculations) prepared pursuant to the requirements contained in NFPA 13 for obtaining approval of the authority having jurisdiction.
- D. High-Pressure Piping System: Fire-suppression piping system designed to operate at working pressure higher than standard 175 psig
- E. Underground Service-Entrance Piping: Underground service piping below the building.
- F. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, including the following:
1. Piping materials and fittings.
 2. Valves and trim.
 3. Monitors.
 4. Fire hydrants.
 5. Fire department connections, including type; number, size, and arrangement of inlets; caps and chains; size and direction of outlet; escutcheon and marking; and finish.
 6. Include data substantiating that materials comply with requirements.
- B. Shop Drawings:
1. Submit working plans and product data under provisions of Division 01. Submittal shall include drawings, hydraulic calculations, hydraulic reference points, detailed pipe layout, components, accessories, and other items as defined by NFPA 13. Indicate pipe materials used, jointing methods, supports, and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
 2. Working Plans drawings shall be submitted in latest version of Revit format or latest version of Adobe Acrobat (bookmarked and free of security) in hard copy and on Compact Disk. Two (2) sets of full size drawings (34 x 44) and (1)

- Compact Disk containing all drawing files shall be submitted to the DEN Life Safety Team as part of each submittal.
3. Working plans submitted for approval shall have the signed wet stamp of a registered Fire Protection Engineer licensed in the State of Colorado (or N.I.C.E.T. 4), certifying that the fire sprinkler system has been designed and hydraulically calculated in compliance with NFPA and governing authorities requirements.
 4. Copy of City and County of Denver Fire Protection Contractors License, and Fire protection Supervisor's certificate for class of equipment being installed.
 5. Obtain DEN Life Safety Team review and stamp prior to submittal for permit.
 6. Submit working plans and product data to Denver Fire Department for approval. Subject to approval, submit copy of approved submittal and permit to the DEN Project Manager.
 7. Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
 8. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- B. Submit additional non returnable copies of current permits and agency approved working plan drawings with System Interruption Request.
- C. Maintenance data for each type of valve, piping specialty, fire protection specialty, and fire department valve specified, for inclusion in operating and maintenance manual specified in Division 01.
- D. Welders Certificate: Include welders' certification of compliance with **[ASME SEC 9]** **[AWS D1.1.]** <Insert>.
- E. "As Built" Plans shall be provided in the same format and manner as described above. Each set shall be equipped with a plan holder equal to "Stacor Plan Clamps" for the appropriate size drawings.
- F. Contractor shall submit fully dimensioned spool drawings for all welded piping work. Drawings shall indicate all weld types, sizes, and materials to be used. The spool drawing size shall match the full size contract documents of either 24x36 or 34x44. Spool drawings shall be submitted in either the latest version of Revit or the latest version of Adobe Acrobat (pdf). Adobe Acrobat files shall not contain security. Other file formats will not be accepted.
- G. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 EXTRA STOCK

- A. The following must be delivered and accepted prior to any testing:
 - 1. Provide a spare parts list. The list is to be provided with material submittal cut sheets.
 - 2. Provide one set of renewable parts for each type of valve installed. Spare parts are not required for the following: OS&Y valves and Butterfly valves.
 - 3. Provide DEN Representatives all special tools required for installation and maintenance.

1.8 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
 - 2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with the "Approval Guide," published by FM Global, or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-suppression water-service piping.
- F. Qualifications for Welding Processes and Operators: Comply with the requirements of AWS B2.1, Specifications for Procedure and Performance Qualifications.
- G. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum five (5) years' documented experience.
- H. Installer: Company specializing in performing the work of this section with minimum five (5) years documented experience.
- I. All field personnel must be a current holder of the City & County of Denver Fire Department Fire Protection Installers license.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
 - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.10 PROJECT CONDITIONS

- A. Interruption of Existing Fire-Suppression Water-Service Piping: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
 - 1. Notify DEN Project Manager no fewer than two (2) **<Insert number>** weeks in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without DEN Project Manager's written permission.

1.11 COORDINATION

- A. Coordinate connection to water main with utility company.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: [ASTM B 88, Type K (ASTM B 88M, Type A)] [and] [ASTM B 88, Type L (ASTM B 88M, Type B)], water tube, annealed temper.
- B. Hard Copper Tube: [ASTM B 88, Type K (ASTM B 88M, Type A)] [and] [ASTM B 88, Type L (ASTM B 88M, Type B)], water tube, drawn temper.
- C. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
- D. Copper, Pressure-Seal Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Viega; Plumbing & Heating Systems.
 - b. <Insert manufacturer's name>.
 - c. or approved equal.
 2. Standard: UL 213.
 3. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 4. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
- F. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.2 DUCTILE-IRON PIPE AND FITTINGS

- A. Threadable lightwall, black and galvanized, for threaded joints is not allowed.
- B. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end.

- C. Mechanical-Joint, Ductile-Iron Pipe: Sizes 3" and larger: Class 52 Tyton joint ductile iron, cement lined pipe in accordance with AWWA C110 and rubber gaskets per AWWA C111.
- D. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 1. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and Corten steel bolts.
- E. Flanges: ASME B16.1, Class 125, cast iron.

2.3 SPECIAL PIPE FITTINGS

- A. Ductile-Iron Flexible Expansion Joints:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. EBAA Iron, Inc.
 - b. ROMAC Industries Inc.
 - c. Star Pipe Products.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
 - 2. Description: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections. Assemble components for offset and expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - 3. Pressure Rating: **250 psig** (1725 kPa) minimum.
- B. Ductile-Iron Deflection Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. EBAA Iron, Inc.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.
 - 2. Description: Compound, ductile-iron coupling fitting with sleeve and one or two flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - 3. Pressure Rating: **250 psig** (1725 kPa) minimum.

2.4 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Material: [**Linear low-density PE film of 0.008-inch (0.20-mm)**] [**or**] [**High-density, cross-laminated PE film of 0.004-inch (0.10-mm)**] minimum thickness.
- C. Form: [**Sheet**] [**or**] [**tube**].
- D. Color: [**Black**] [**or**] [**natural**] <Insert color>.

2.5 JOINING MATERIALS

- A. Welding Materials: Field welding shall not be permitted; perform only shop welding. Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded. Welded outlets are permitted as long as the welding is done in compliance with NFPA welding requirements.
- B. Ductile Iron Fire Protection Service Piping: Mechanical joint restraint shall be incorporated in the design of the follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Flexibility of the joint shall be maintained after burial. Glands shall be manufactured of ductile iron conforming to ASTM A 536 80. Restraining devices shall be of ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee head bolts conforming to ANSI/AWWA A21.11 and ANSI/AWWA C153/A21.53 of latest revision. Twist-off nuts, sized same as tee head bolts, shall be used to insure proper actuating of restraining devices. The mechanical joint restraint device shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1 and shall be EBAA Iron, Inc., MEGALUG or equal.
- C. Gaskets for Ferrous Piping and Copper-Alloy Tubing: ASME B16.21, asbestos free.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series.
- E. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.

2.6 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Tubular-Sleeve Pipe Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Dresser Piping Specialties.
 - c. Ford Meter Box Company, Inc. (The); Pipe Products Division.
 - d. JCM Industries.
 - e. ROMAC Industries Inc.
 - f. Smith-Blair, Inc.; a Sensus company.
 - g. Viking Johnson.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.
2. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners, and with ends of same sizes as piping to be joined.
 3. Standard: AWWA C219.
 4. Center-Sleeve Material: **[Manufacturer's standard] [Carbon steel] [Stainless steel] [Ductile iron] [Malleable iron]**.
 5. Gasket Material: Natural or synthetic rubber.
 6. Pressure Rating: **[150 psig (1035 kPa)] [200 psig (1380 kPa)] <Insert value>** minimum.
 7. Metal Component Finish: Corrosion-resistant coating or material.

2.7 **[CORPORATION VALVES] [AND] [CURB VALVES]**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Amcast Industrial Corporation.
 2. Ford Meter Box Company, Inc. (The); Pipe Products Division.
 3. Jones, James Company.
 4. Master Meter, Inc.
 5. McDonald, A. Y. Mfg. Co.
 6. Mueller Co.; Water Products Division.
 7. Red Hed Manufacturing & Supply.
 8. **<Insert manufacturer's name>**.
 9. or approved equal.
- B. Corporation Valves: Comply with AWWA C800. Include saddle and valve compatible with tapping machine[**and manifold**].
 1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
 2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.
 3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.
- C. Curb Valves: Comply with AWWA C800 for high-pressure service-line valves. Valve has bronze body, ground-key plug or ball, wide tee head, and inlet and outlet matching service piping material.

- D. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches (75 mm) in diameter.
1. Shutoff Rods: Steel; with tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.
- E. Meter Valves: Comply with AWWA C800 for high-pressure service-line valves. Include angle- or straight-through-pattern bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.

2.8 GATE VALVES

A. AWWA Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American AVK Company; Valves & Fittings Division.
 - b. American Cast Iron Pipe Company; American Flow Control Division.
 - c. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - d. American R/D.
 - e. Clow Valve Company; a division of McWane, Inc.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. East Jordan Iron Works, Inc.
 - h. Kennedy Valve; a division of McWane, Inc.
 - i. M&H Valve Company; a division of McWane, Inc.
 - j. Mueller Co.; Water Products Division.
 - k. NIBCO INC.
 - l. Tyler Pipe; a division of McWane, Inc.; Utilities Division.
 - m. U.S. Pipe.
 - n. **<Insert manufacturer's name>**.
 - o. or approved equal.
2. Gate Valves - 2 Inch and Smaller: Body and bonnet of cast bronze, 175 pound cold water working pressure, nonshock, threaded ends, solid wedge, outside screw and yoke, rising stem, screw-in bonnet, and malleable iron handwheel. Valves shall be capable of being repacked under pressure, with valve wide open. Provide Supervisory switches.
3. Gate Valves - 2-1/2 Inch and Larger: Iron body, bronze mounted, 175 pound cold water working pressure, nonshock. Valves shall have solid taper wedge, outside screw and yoke, rising stem, flanged bonnet, with body and bonnet conforming to ASTM A 126, Class B; replaceable bronze wedge facing rings, flanged ends, and a packing assembly consisting of a cast iron gland flange, brass gland, packing, bonnet, and bronze bonnet bushing. Valves shall be capable of being repacked under pressure, with valve wide open. Provide Supervisory switches.

4. Iron body, bronze trim, rising stem, OS&Y, solid wedge.
5. Supervisory switches are required.
6. **200-psig** (1380-kPa), AWWA, Iron, Nonrising-Stem, Metal-Seated Gate Valves:
 - a. Description: Gray- or ductile-iron body and bonnet; with cast-iron or bronze double-disc gate, bronze gate rings, bronze stem, and stem nut.
 - b. Standard: AWWA C500.
 - c. Pressure Rating: **200 psig** (1380 kPa).
 - d. End Connections: Mechanical joint.
 - e. Interior Coating: Complying with AWWA C550.
7. **200-psig** (1380-kPa), AWWA, Iron, Nonrising-Stem, Resilient-Seated Gate Valves:
 - a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - b. Standard: AWWA C509.
 - c. Pressure Rating: **200 psig** (1380 kPa).
 - d. End Connections: Mechanical or push-on joint.
 - e. Interior Coating: Complying with AWWA C550.
8. **250-psig** (1725-kPa), AWWA, Iron, Nonrising-Stem, Resilient-Seated Gate Valves:
 - a. Description: Ductile-iron body and bonnet; with bronze or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - b. Standard: AWWA C509.
 - c. Pressure Rating: **250 psig** (1725 kPa).
 - d. End Connections: Mechanical or push-on joint.
 - e. Interior Coating: Complying with AWWA C550.
9. **200-psig** (1380-kPa), AWWA, Iron, OS&Y, Metal-Seated Gate Valves:
 - a. Description: Cast- or ductile-iron body and bonnet; with cast-iron double disc, bronze disc and seat rings, and bronze stem.
 - b. Standard: AWWA C500.
 - c. Pressure Rating: **200 psig** (1380 kPa).
 - d. End Connections: Flanged or grooved.
10. **200-psig** (1380-kPa), AWWA, Iron, OS&Y, Resilient-Seated Gate Valves:
 - a. Description: Cast- or ductile-iron body and bonnet; with bronze, gray-iron, or ductile-iron gate; resilient seats; and bronze stem.
 - b. Standard: AWWA C509.
 - c. Pressure Rating: **200 psig** (1380 kPa).
 - d. End Connections: Flanged or grooved.
11. **250-psig** (1725-kPa), AWWA, Iron, OS&Y, Resilient-Seated Gate Valves:
 - a. Description: Cast- or ductile-iron body and bonnet; with bronze, gray-iron, or ductile-iron gate; resilient seats; and bronze stem.

- b. Standard: AWWA C509.
 - c. Pressure Rating: 200 psig (1380 kPa).
 - d. End Connections: Flanged or grooved.
12. Class 125, Bronze, Nonrising-Stem Gate Valves:
- a. Description: Class 125, Type 1; bronze with solid wedge and malleable-iron handwheel.
 - b. Standard: MSS SP-80.
 - c. Pressure Rating: 200 psig (1380 kPa).
 - d. End Connections: Solder joint or threaded.
- B. UL-Listed or FM-Approved Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. American AVK Company; Valve & Fittings Division.
 - b. American Cast Iron Pipe Company; American Flow Control Division.
 - c. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - d. Clow Valve Company; a division of McWane, Inc.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. East Jordan Iron Works, Inc.
 - h. Hammond Valve.
 - i. Kennedy Valve; a division of McWane, Inc.
 - j. M&H Valve Company; a division of McWane, Inc.
 - k. Milwaukee Valve Company.
 - l. Mueller Co.; Water Products Division.
 - m. NIBCO INC.
 - n. Shurjoint Piping Products.
 - o. Troy Valve; a division of Penn-Troy Manufacturing, Inc.
 - p. Tyco Fire & Building Products LP.
 - q. United Brass Works, Inc.
 - r. U.S. Pipe.
 - s. Watts Water Technologies, Inc.
 - t. <Insert manufacturer's name>.
 - u. or approved equal.
2. 175-psig (1200-kPa), UL-Listed or FM-Approved, Iron, Nonrising-Stem Gate Valves:
- a. Description: Iron body and bonnet, bronze seating material, and inside screw.
 - b. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
 - c. Pressure Rating: 175 psig (1200) minimum.
 - d. End Connections: Mechanical or push-on joint.
 - e. Indicator-Post Flange: Include on valves used with indicator posts.

3. **250-psig** (1725-kPa), UL-Listed or FM-Approved, Iron, Nonrising-Stem Gate Valves:
 - a. Description: Iron body and bonnet, bronze seating material, and inside screw.
 - b. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
 - c. Pressure Rating: **250 psig** (1725 kPa) minimum.
 - d. End Connections: Mechanical or push-on joint.
 - e. Indicator-Post Flange: Include on valves used with indicator posts.

4. **175-psig** (1200-kPa), UL-Listed or FM-Approved, Iron, OS&Y, Gate Valves:
 - a. Description: Iron body and bonnet and bronze seating material.
 - b. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
 - c. Pressure Rating: **175 psig** (1200 kPa) minimum.
 - d. End Connections: Flanged or grooved.

5. **250-psig** (1725-kPa), UL-Listed or FM-Approved, Iron, OS&Y Gate Valves:
 - a. Description: Iron body and bonnet and bronze seating material.
 - b. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
 - c. Pressure Rating: **250 psig** (1725 kPa) minimum.
 - d. End Connections: Flanged or grooved.

6. UL-Listed or FM-Approved, OS&Y Bronze, Gate Valves:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Crane Co.; Crane Valve Group; Crane Valves.
 - 2) Crane Co.; Crane Valve Group; Stockham Division.
 - 3) Milwaukee Valve Company.
 - 4) NIBCO INC.
 - 5) United Brass Works, Inc.
 - 6) **<Insert manufacturer's name>**.
 - 7) or approved equal.

 - b. Description: Bronze body and bonnet and bronze stem.
 - c. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
 - d. Pressure Rating: **175 psig** (1200 kPa) minimum.
 - e. End Connections: Threaded.

2.9 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.

- b. Clow Valve Company; a division of McWane, Inc.
 - c. East Jordan Iron Works, Inc.
 - d. Flowserve.
 - e. Kennedy Valve; a division of McWane, Inc.
 - f. M&H Valve Company; a division of McWane, Inc.
 - g. Mueller Co.; Water Products Division.
 - h. U.S. Pipe.
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
 2. Description: Sleeve and valve compatible with drilling machine.
 3. Standard: MSS SP-60.
 4. Tapping Sleeve: Cast-iron, ductile-iron, or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Sleeve shall match size and type of pipe material being tapped and have recessed flange for branch valve.
 5. Valve: AWWA, cast-iron, nonrising-stem, **[metal] [resilient]**-seated gate valve with one raised-face flange mating tapping-sleeve flange.
- B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches (125 mm) in diameter.
 1. Operating Wrenches: Steel; with tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
- C. Indicator Posts:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American AVK Company; Valves & Fittings Division.
 - b. American Cast Iron Pipe Company; American Flow Control Division.
 - c. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - d. Clow Valve Company; a division of McWane, Inc.
 - e. Crane Co.; Crane Valve Group; Stockham Division.
 - f. Kennedy Valve; a division of McWane, Inc.
 - g. Mueller Co.; Water Products Division.
 - h. NIBCO INC.
 - i. Tyco Fire & Building Products LP.
 - j. **<Insert manufacturer's name>**.
 - k. or approved equal.
 2. Description: Vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.
 3. Standards: UL 789 and "Approval Guide," published by FM Global, listing.

2.10 GLOBE (OR ANGLE) VALVES

- A. Brass body with renewable composition disc.

2.11 BUTTERFLY VALVES

- A. AWWA Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DeZurik/Copes-Vulcan; a unit of SPX Corporation.
 - b. Milliken Valve Company.
 - c. Mosser Valve; a division of Olson Technologies, Inc.
 - d. Mueller Co.; Water Products Division.
 - e. Pratt, Henry Company.
 - f. Val-Matic Valve & Manufacturing Corp.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
2. Description: Rubber seated.
3. Standard: AWWA C504.
4. Body Material: Cast or ductile iron.
5. Body Type: **[Wafer] [or] [flanged]**.
6. Pressure Rating: **150 psig** (1035 kPa).

- B. UL Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kennedy Valve; a division of McWane, Inc.
 - b. Milwaukee Valve Company.
 - c. Mueller Co.; Water Products Division.
 - d. NIBCO INC.
 - e. Pratt, Henry Company.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
2. Description: Metal on resilient material seating.
3. Standards: UL 1091 and "Approval Guide," published by FM Global, listing.
4. Body Material: Cast or ductile iron.
5. Body Type: **[Wafer] [or] [flanged]**.
6. Pressure Rating: **175 psig** (1200 kPa).

2.12 CHECK VALVES

- A. UL-Listed or FM-Approved Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. Clow Valve Company; a division of McWane, Inc.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Globe Fire Sprinkler Corporation.
 - e. Kennedy Valve; a division of McWane, Inc.
 - f. Kidde Fire Fighting.
 - g. Matco-Norca.
 - h. Mueller Co.; Water Products Division.
 - i. NIBCO INC.
 - j. Reliable Automatic Sprinkler Co., Inc.
 - k. Tyco Fire & Building Products LP.
 - l. United Brass Works, Inc.
 - m. Victaulic Company.
 - n. Viking Corporation.
 - o. Watts Water Technologies, Inc.
 - p. **<Insert manufacturer's name>**.
 - q. or approved equal.
2. Description: Swing-check type with pressure rating, rubber-face checks unless otherwise indicated, and ends matching piping.
3. Standards: UL 312 and "Approval Guide," published by FM Global, listing.
4. Pressure Rating: [175 psig (1200 kPa)] [250 psig (1725 kPa)].

2.13 DETECTOR CHECK VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 2. Badger Meter, Inc.
 3. FEBCO; SPX Valves & Controls.
 4. Globe Fire Sprinkler Corporation.
 5. Kennedy Valve; a division of McWane, Inc.
 6. Mueller Co.; Hersey Meters Division.
 7. Victaulic Company.
 8. Viking Corporation.
 9. Watts Water Technologies, Inc.
 10. **<Insert manufacturer's name>**.
 11. or approved equal.
- B. Description: Galvanized cast-iron body, bolted cover with air-bleed device for access to internal parts, and flanged ends. Include one-piece bronze disc with bronze bushings, pivot, and replaceable seat. Include threaded bypass taps in inlet and outlet for bypass meter connection. Set valve to allow minimal water flow through bypass meter when major water flow is required.

- C. Standards: UL 312 and "Approval Guide," published by FM Global, listing.
- D. Pressure Rating: 175 psig (1200 kPa).
- E. Water Meter: AWWA C700, disc type, at least one-fourth size of detector check valve. Include meter, bypass piping, gate valves, check valve, and connections to detector check valve.

2.14 WATER METERS

- A. Water meters will be furnished by utility company.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AMCO Water Metering Systems.
 - 2. Badger Meter, Inc.
 - 3. Carlon Meter.
 - 4. Hays Fluid Controls.
 - 5. McCrometer.
 - 6. Mueller Co.; Hersey Meters Division.
 - 7. Neptune Technology Group Inc.
 - 8. Sensus Metering Systems.
 - 9. <Insert manufacturer's name>.
 - 10. or approved equal.
- C. Displacement-Type Water Meters:
 - 1. Description: With bronze main case.
 - 2. Standard: AWWA C700.
 - 3. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].
- D. Turbine-Type Water Meters:
 - 1. Standard: AWWA C701.
 - 2. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].
- E. Compound-Type Water Meters:
 - 1. Standard: AWWA C702.
 - 2. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].
- F. Remote Registration System:
 - 1. Description: Utility company's standard; direct-reading type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
 - 2. Standard: AWWA C706.
 - 3. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].

G. Remote Registration System:

1. Description: Utility company's standard; encoder type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
2. Standard: AWWA C707.
3. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].
4. Data-Acquisition Units: Comply with utility company's requirements for type and quantity.
5. Visible Display Units: Comply with utility company's requirements for type and quantity.

2.15 DETECTOR-TYPE WATER METERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Badger Meter, Inc.
2. Mueller Co.; Hersey Meters Division.
3. Neptune Technology Group Inc.
4. Sensus Metering Systems.
5. <Insert manufacturer's name>.
6. or approved equal.

B. AWWA, Detector Check Water Meters:

1. Description: Main line, turbine meter with second meter on bypass.
2. Standard: AWWA C703.
3. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].
4. Pressure Rating: 150 psig (1035 kPa).
5. Bypass Meter: [AWWA C701, turbine] [AWWA C702, compound]-type, bronze case.
 - a. Size: At least one-half nominal size of main-line meter.

C. Fire-Protection, Detector Check Water Meters:

1. Description: Main-line turbine meter with strainer and second meter on bypass.
2. Standards: UL's "Fire Protection Equipment Directory" listing and "Approval Guide," published by FM Global, listing.
3. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].
4. Pressure Rating: 175 psig (1200 kPa) minimum.
5. Bypass Meter: AWWA C701, turbine-type, bronze case.
 - a. Size: At least NPS 2 (DN 50).

D. Remote Registration System:

1. Description: Utility company's standard; direct-reading type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
2. Standard: AWWA C706.
3. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].

E. Remote Registration System:

1. Description: Utility company's standard; encoder type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
2. Standard: AWWA C707.
3. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].
4. Data-Acquisition Units: Comply with utility company's requirements for type and quantity.
5. Visible Display Units: Comply with utility company's requirements for type and quantity.

2.16 PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme; a division of The Reliance Worldwide Corporation.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Honeywell Water Controls.
 - d. Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
 - f. <Insert manufacturer's name>.
 - g. or approved equal.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial pressure of 150 psig (1035 kPa).
4. Size: <Insert NPS (DN)>.
5. Design Flow Rate: <Insert gpm (L/s)>.
6. Design Inlet Pressure: <Insert psig (kPa)>.
7. Design Outlet Pressure Setting: <Insert psig (kPa)>.
8. Body Material: Bronze[**with chrome-plated finish**] for NPS 2 (DN 50) and smaller; cast iron[**with interior lining complying with AWWA C550 or that is FDA approved**] for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).
9. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).

B. Water Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. CLA-VAL Automatic Control Valves.
 - b. Flomatic Corporation.
 - c. OCV Control Valves.
 - d. Watts Regulator Company; Ames Fluid Control Systems.
 - e. Watts Regulator Company; Watts ACV Division.
 - f. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
2. Description: Pilot-operation, diaphragm-type, single-seated main water control valve with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot control valve, restrictor device, specialty fittings, and sensor piping.
 3. Pressure Rating: Initial pressure of **150 psig** (1035 kPa) minimum.
 4. Main Valve Body: Cast or ductile iron with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
 - a. Size: **<Insert NPS (DN)>**.
 - b. Pattern: **[Angle] [Globe]**-valve design.
 - c. Trim: Stainless steel.
 5. Design Flow Rate: **<Insert gpm (L/s)>**.
 6. Design Inlet Pressure: **<Insert psig (kPa)>**.
 7. Design Outlet Pressure Setting: **<Insert psig (kPa)>**.
 8. End Connections: Threaded for **NPS 2** (DN 50) and smaller; **[flanged] <Insert type>** for **NPS 2-1/2** (DN 65) and larger.

2.17 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
2. Standard: **[ASSE 1013] [or] [AWWA C511]**.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: **[12 psig (83 kPa)] <Insert value>** maximum, through middle one-third of flow range.
5. Size: **<Insert NPS (DN)>**.
6. Design Flow Rate: **<Insert gpm (L/s)>**.
7. Selected Unit Flow Range Limits: **<Insert gpm (L/s)>**.

8. Pressure Loss at Design Flow Rate: <Insert psig (kPa)> for NPS 2 (DN 50) and smaller; <Insert psig (kPa)> for NPS 2-1/2 (DN 65) and larger.
 9. Body Material: Bronze for NPS 2 (DN 50) and smaller; **[cast iron with interior lining complying with AWWA C550 or that is FDA approved]** **[steel with interior lining complying with AWWA C550 or that is FDA approved]** **[stainless steel]** for NPS 2-1/2 (DN 65) and larger.
 10. End Connections: Threaded for NPS 2 (DN 50) and smaller; **[flanged]** <Insert type> for NPS 2-1/2 (DN 65) and larger.
 11. Configuration: Designed for **[horizontal, straight through]** **[vertical inlet, horizontal center section, and vertical outlet]** **[vertical]** <Insert configuration> flow.
 12. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; OS&Y gate type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.
- B. Double-Check, Backflow-Prevention Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
 - g. <Insert manufacturer's name>.
 - h. or approved equal.
 2. Standard: **[ASSE 1015]** **[or]** **[AWWA C510]**.
 3. Operation: Continuous-pressure applications unless otherwise indicated.
 4. Pressure Loss: **[5 psig (35 kPa)]** <Insert value> maximum, through middle one-third of flow range.
 5. Size: <Insert NPS (DN)>.
 6. Design Flow Rate: <Insert gpm (L/s)>.
 7. Selected Unit Flow Range Limits: <Insert gpm (L/s)>.
 8. Pressure Loss at Design Flow Rate: <Insert psig (kPa)> for NPS 2 (DN 50) and smaller; <Insert psig (kPa)> for NPS 2-1/2 (DN 65) and larger.
 9. Body Material: Bronze for NPS 2 (DN 50) and smaller; **[cast iron with interior lining complying with AWWA C550 or that is FDA approved]** **[steel with interior lining complying with AWWA C550 or that is FDA approved]** **[stainless steel]** for NPS 2-1/2 (DN 65) and larger.
 10. End Connections: Threaded for NPS 2 (DN 50) and smaller; **[flanged]** <Insert type> for NPS 2-1/2 (DN 65) and larger.
 11. Configuration: Designed for **[horizontal, straight through]** <Insert configuration> flow.

12. Accessories: Ball valves with threaded ends on inlet and outlet of **NPS 2** (DN 50) and smaller; OS&Y gate valves with flanged ends on inlet and outlet of **NPS 2-1/2** (DN 65) and larger.

C. Reduced-Pressure-Detector, Fire-Protection Backflow Preventer Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. FEBCO; SPX Valves & Controls.
 - d. Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
2. Standards: ASSE 1047 and UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: [**12 psig** (83 kPa)] **<Insert value>** maximum, through middle one-third of flow range.
5. Size: **<Insert NPS (DN)>**.
6. Design Flow Rate: **<Insert gpm (L/s)>**.
7. Selected Unit Flow Range Limits: **<Insert gpm (L/s)>**.
8. Pressure Loss at Design Flow Rate: **<Insert psig (kPa)>**.
9. Body Material: [**Cast iron with interior lining complying with AWWA C550 or that is FDA approved**] [**Steel with interior lining complying with AWWA C550 or that is FDA approved**] [**Stainless steel**].
10. End Connections: Flanged.
11. Configuration: Designed for [**horizontal, straight through**] [**vertical inlet, horizontal center section, and vertical outlet**] [**vertical**] **<Insert configuration>** flow.
12. Accessories:
 - a. Valves: UL 262, "Approval Guide," published by FM Global, listing; OS&Y gate type with flanged ends on inlet and outlet.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.
 - c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

D. Double-Check, Detector-Assembly Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. FEBCO; SPX Valves & Controls.
 - d. Watts Water Technologies, Inc.

- e. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
2. Standards: ASSE 1048 and UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: [5 psig (35 kPa)] **<Insert value>** maximum, through middle one-third of flow range.
 5. Size: **<Insert NPS (DN)>**.
 6. Design Flow Rate: **<Insert gpm (L/s)>**.
 7. Selected Unit Flow Range Limits: **<Insert gpm (L/s)>**.
 8. Pressure Loss at Design Flow Rate: **<Insert psig (kPa)>**.
 9. Body Material: **[Cast iron with interior lining complying with AWWA C550 or that is FDA approved] [Steel with interior lining complying with AWWA C550 or that is FDA approved] [Stainless steel]**.
 10. End Connections: Flanged.
 11. Configuration: Designed for **[horizontal, straight through] [vertical inlet, horizontal center section, and vertical outlet] [vertical] <Insert configuration>** flow.
 12. Accessories:
 - a. Valves: UL 262, "Approval Guide," published by FM Global, listing, approved; OS&Y gate type with flanged ends on inlet and outlet.
 - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.
- E. Backflow Preventer Test Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. FEBCO; SPX Valves & Controls.
 - c. Flomatic Corporation.
 - d. Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
 2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.
- F. At every backflow preventer there shall be displayed, on the assembly a permanent placard with the greatest total flow anticipated by the hydraulic calculations and the corresponding net pressure lose utilized for the device in the hydraulic data. This information must be substantiated by means of a full flow discharge test during system acceptance to assure proper valve operation per NFPA. The placard shall be a standard red background, white letters, a minimum of ¾" tall. A ball valve shall be provided on each end of the device and a common liquid filled gauge cross connected

to achieve a net differential reading for comparison to the hydraulic calculations.

2.18 WATER METER BOXES

- A. Description: Cast-iron body and cover for disc-type water meter, with lettering "WATER METER" on cover; and with slotted, open-bottom base section of length to fit over service piping.
 - 1. Option: Base section may be cast-iron, PVC, clay, or other pipe.
- B. Description: Cast-iron body and double cover for disc-type water meter, with lettering "WATER METER" on top cover; and with separate inner cover; air space between covers; and slotted, open-bottom base section of length to fit over service piping.
- C. Description: Polymer-concrete body and cover for disc-type water meter, with lettering "WATER" on cover; and with slotted, open-bottom base section of length to fit over service piping. Include vertical and lateral design loadings of **15,000 lb minimum over 10 by 10 inches** (6 800 kg minimum over 254 by 254 mm) square.

2.19 CONCRETE VAULTS

- A. Description: Precast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C 857, and made according to ASTM C 858.
- B. Ladder: ASTM A 36/A 36M, steel ladder; or PE-encased steel steps.
- C. Manhole: ASTM A 48/A 48M, Class No. 35A minimum tensile strength, gray-iron traffic frame and cover.
 - 1. Dimension: **24-inch** (610-mm) minimum diameter unless otherwise indicated.
- D. Manhole: ASTM A 536, Grade 60-40-18, ductile-iron traffic frame, and cover.
 - 1. Dimension: **24-inch** (610-mm) minimum diameter unless otherwise indicated.
- E. Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

2.20 PROTECTIVE ENCLOSURES

- A. Freeze-Protection Enclosures:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AquaShield.
 - b. BF Products.

- c. DekoRRa Products LLC.
 - d. Dunco Manufacturing, Inc.
 - e. G&C Enclosures.
 - f. Hot Box, Inc.
 - g. HydroCowl, Inc.
 - h. Piedmont Well Covers, Inc.
 - i. Watts Water Technologies, Inc.
 - j. **<Insert manufacturer's name>**.
 - k. or approved equal.
2. Description: Insulated enclosure designed to protect aboveground water piping, equipment, or specialties from freezing and damage, with heat source to maintain minimum internal temperature of **40 deg F (4 deg C)** when external temperatures reach as low as **minus 34 deg F (minus 36 deg C)**.
 3. Standard: ASSE 1060.
 4. Class I: For equipment or devices other than pressure or atmospheric vacuum breakers.
 5. Class I-V: For pressure or atmospheric vacuum breaker equipment or devices. Include drain opening in housing.
 - a. Housing: Reinforced~~[-aluminum]~~ **[or]** ~~[-fiberglass]~~ **<Insert housing>** construction.
 - 1) Size: Of dimensions indicated but not less than those required for access and service of protected unit.
 - 2) Drain opening for units with drain connection.
 - 3) Access doors with locking devices.
 - 4) Insulation inside housing.
 - 5) Anchoring devices for attaching housing to concrete base.
 - b. Electric heating cable or heater with self-limiting temperature control.

B. Weather-Resistant Enclosures:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AquaShield.
 - b. BF Products.
 - c. DekoRRa Products LLC.
 - d. Dunco Manufacturing, Inc.
 - e. G&C Enclosures.
 - f. Hot Box, Inc.
 - g. HydroCowl, Inc.
 - h. Piedmont Well Covers, Inc.
 - i. Watts Water Technologies, Inc.
 - j. **<Insert manufacturer's name>**.
 - k. or approved equal.

2. Description: Uninsulated enclosure designed to protect aboveground water piping, equipment, or specialties from weather and damage.
3. Standard: ASSE 1060.
4. Class III: For equipment or devices other than pressure or atmospheric vacuum breakers.
5. Class III-V: For pressure or atmospheric vacuum breaker equipment or devices. Include drain opening in housing.
 - a. Housing: Reinforced[-aluminum] [or] [-fiberglass] <Insert housing> construction.
 - 1) Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
 - 2) Drain opening for units with drain connection.
 - 3) Access doors with locking devices.
 - 4) Anchoring devices for attaching housing to concrete base.

C. Expanded-Metal Enclosures:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Backflow Prevention Device InnClosures, Inc.
 - b. BF Products.
 - c. Cross Brothers Inc.
 - d. Le Meur Welding & Manufacturing Co.
 - e. V.I.T. Products, Inc.
 - f. <Insert manufacturer's name>.
 - g. or approved equal.
2. Description: Enclosure designed to protect aboveground water piping, equipment, or specialties from damage.
3. Material: ASTM F 1267, expanded metal side and top panels, of weight and with reinforcement of same metal at edges as required for rigidity.
4. Type: [I, expanded] [II, expanded and flattened].
5. Class: [Class 1, uncoated carbon steel] [Class 2, hot-dip, zinc-coated carbon steel] [Class 3, corrosion-resistant steel].
6. Finish: Manufacturer's enamel paint.
7. Size: Of dimensions indicated but not less than those required for access and service of protected unit.
8. Locking device.
9. Lugs or devices for securing enclosure to base.
10. Enclosure Bases: [4-inch- (100-mm-)] [6-inch- (150-mm-)] minimum thickness precast concrete, of dimensions required to extend at least 6 inches (150 mm) beyond edges of enclosure housings. Include openings for piping.

2.21 FIRE HYDRANTS

A. AWWA Dry-Barrel Fire Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American AVK Company; Valves & Fittings Division.
 - b. American Cast Iron Pipe Company; American Flow Control Division.
 - c. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - d. American Foundry Group, Inc.
 - e. Clow Valve Company; a division of McWane, Inc.
 - f. East Jordan Iron Works, Inc.
 - g. Kennedy Valve; a division of McWane, Inc.
 - h. M&H Valve Company; a division of McWane, Inc.
 - i. Mueller Co.; Water Products Division.
 - j. Troy Valve; a division of Penn-Troy Manufacturing, Inc.
 - k. U.S. Pipe.
 - l. **<Insert manufacturer's name>**.
 - m. or approved equal.
 2. Description: Post type, with one **NPS 4-1/2** (DN 115) and two **NPS 2-1/2** (DN 65) outlets; and with **5-1/4-inch** (133-mm) main valve, drain valve, and **NPS 6** (DN 150) mechanical-joint inlet. Include interior coating according to AWWA C550. Hydrant shall have cast-iron body and compression-type valve opening against pressure and closing with pressure.
 3. Standard: AWWA C502.
 4. Pressure Rating: [**150 psig** (1035 kPa) **minimum**] [**200 psig** (1380 kPa) **minimum**] [**250 psig** (1725 kPa)].
- B. UL-Listed, Dry-Barrel Fire Hydrants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; American Flow Control Division.
 - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - c. American Foundry Group, Inc.
 - d. Clow Valve Company; a division of McWane, Inc.
 - e. East Jordan Iron Works, Inc.
 - f. Kennedy Valve; a division of McWane, Inc.
 - g. M&H Valve Company; a division of McWane, Inc.
 - h. Mueller Co.; Water Products Division.
 - i. Troy Valve; a division of Penn-Troy Manufacturing, Inc.
 - j. U.S. Pipe.
 - k. **<Insert manufacturer's name>**.
 2. Description: Freestanding, with one **NPS 4-1/2** (DN 115) and two **NPS 2-1/2** (DN 65) outlets; and with **5-1/4-inch** (133-mm) main valve, drain valve, and **NPS 6** (DN 150) mechanical-joint inlet. Hydrant shall have cast-iron body and compression-type valve opening against pressure and closing with pressure.
 3. Standards: UL 246 and "Approval Guide," published by FM Global, listing.
 4. Design: Base valve.

5. Pressure Rating: [150 psig (1035 kPa) **minimum**] [175 psig (1200 kPa) **minimum**] [200 psig (1380 kPa) **minimum**] [250 psig (1725 kPa)].
6. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
7. Operating and Cap Nuts: Pentagon, 1-1/2 inches (38 mm) point to flat.
8. Direction of Opening: Hydrant valve opens by turning operating nut to left or counterclockwise.
9. Exterior Finish: Red alkyd-gloss enamel paint unless otherwise indicated.

C. AWWA Wet-Barrel Fire Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American AVK Company; Valves & Fittings Division.
 - b. Clow Valve Company; a division of McWane, Inc.
 - c. Jones, James Company.
 - d. Mueller Co.; Water Products Division.
 - e. <Insert manufacturer's name>.
 - f. or approved equal.
2. Description: Post type, with one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets and with NPS 6 (DN 150) threaded or flanged inlet, and base section with NPS 6 (DN 150) mechanical-joint inlet. Include interior coating according to AWWA C550.
3. Standard: AWWA C503.
4. Pressure Rating: [150 psig (1035 kPa) **minimum**] [200 psig (1380 kPa) **minimum**] [250 psig (1725 kPa)].

D. UL-Listed, Wet-Barrel Fire Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American AVK Company; Valves & Fittings Division.
 - b. Clow Valve Company; a division of McWane, Inc.
 - c. Jones, James Company.
 - d. Mueller Co.; Water Products Division.
 - e. <Insert manufacturer's name>.
 - f. or approved equal.
2. Description: Freestanding, with one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets and with NPS 6 (DN 150) threaded or flanged inlet, and base section with NPS 6 (DN 150) mechanical-joint inlet.
3. Standards: UL 246 and "Approval Guide," published by FM Global, listing.
4. Design: Wet barrel.
5. Pressure Rating: [150 psig (1035 kPa) **minimum**] [175 psig (1200 kPa) **minimum**] [200 psig (1380 kPa)].
6. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.

7. Operating and Cap Nuts: Pentagon, 1-1/2 inches (38 mm) point to flat.
8. Direction of Opening: Hydrant valves open by turning operating nut to left or counterclockwise.
9. Exterior Finish: Red alkyd-gloss enamel paint unless otherwise indicated.

2.22 FIRE-DEPARTMENT CONNECTIONS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Potter Roemer: Two-Way [2], Potter Roemer 5020 series or equal, flush mounted wall type, Fire Department Connection, (threading as required by Denver Fire Department), complete with 3/4 inch automatic ball drip. Provide additional 2.5 inch outlet for each 250 GPM design discharge over 500 GPM per NFPA 13.
 2. **<Insert manufacturer's name>**.
 3. or approved equal.
- B. Description: Wall-mounted, with cast-bronze body, thread inlets according to NFPA 1963 and matching local fire department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch- (460-mm-) high brass sleeve; and round escutcheon plate.
- C. Standard: UL 405.
- D. Finish Including Sleeve: [**Polished chrome plated**] [**Rough chrome plated**]**Polished bronze**].
- E. Escutcheon Plate Marking: "[**AUTO SPKR - STP**] ".

2.23 ALARM DEVICES

- A. General: UL 753 and "Approval Guide," published by FM Global, listing, of types and sizes to mate and match piping and equipment.
- B. Water-Flow Indicators: Vane-type water-flow detector, rated for 250-psig (1725-kPa) working pressure; designed for horizontal or vertical installation; with two single-pole, double-throw circuit switches to provide isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal when cover is removed.
 1. Retard feature must be of the instantly recycling type so that flows less than retard period will not produce a cumulative effect.
 2. Flow switch shall not be installed in a fitting or within 12 inches of any fitting that changes the direction of water flow.
 3. Design detector with a sensitivity setting to signal any flow of water that equals or exceeds the discharge from one sprinkler head.
 4. Provide weatherproof and dust tight flow detector.

5. Provide a 3/4 inch conduit entrance per detector.
 - C. Pressure Alarm Switches: Rated to 250 psig; designed for vertical installation; having two, spdt circuit switches to provide isolated alarm and auxiliary contacts, 7 ampere, 125 Vac and 0.25 ampere, 24 Vdc; complete with factory-set, field-adjustable tamperproof cover.
 - D. Design detector with a sensitivity setting to signal any flow of water that equals or exceeds the discharge from one sprinkler head.
 - E. Provide weatherproof and dust tight flow detector.
 - F. Provide a 3/4 inch conduit entrance per detector.
 - G. Supervisory Tamper Switches: SPDT, normally closed contacts, designed to signal valve in other than full open position.
 - H. Supervisory Tamper Switches: SPDT, normally closed contacts, single pole, double throw; designed to signal valve in other than fully open position.
 - I. Pressure Switches: Single pole, double throw; designed to signal increase in pressure.
- 2.24 SIGNAGE AND LABELING
- A. Signage shall be per the requirements of NFPA – 13, FM Global, and any applicable Insurance underwriter.
 1. Signs shall be pre-manufactured metal, approximately 2" x 6", located at all valves, main drains, auxiliary drains, air, alarm, and similar devices.
 2. Every drain and control valve shall be permanently labeled with the D.I.A. designated system I.D. number and a consecutive number indicating quantity of drains on the system, i.e. T-4-43 / 3 of 7 in the terminal or FZ – 03 / 2 of 2 .
 3. Hydraulic Plaques shall be provided at all risers with the appropriate information.

PART 3 - EXECUTION

3.1 SEQUENCING AND SCHEDULING

- A. Comply with DEN Maintenance and Engineering system interruption requirements and provide Denver Fire Department approved Fire Watch during entire time of system interruption.
- B. In no case shall the building structure remain without fire protection for more than ten (10) hours.
- C. Schedule rough-in installations with installations of other building components.

3.2 EARTHWORK

- A. Comply with excavating, trenching, and backfilling requirements in Section 312000 "Earth Moving."

3.3 PREPARATION

- A. Ream pipe and tube ends to full inside diameter.
- B. Remove burrs, and bevel plain end ferrous pipe.
- C. Remove scale and foreign material, inside and outside, before assembly.

3.4 PIPING INSTALLATION

- A. Water-Main Connection: Arrange with water utility company for tap of size and in location indicated in water main.
- B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
- C. Make connections larger than **NPS 2 (DN 50)** with tapping machine according to the following:
 - 1. Install tapping sleeve and tapping valve according to MSS SP-60.
 - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
 - 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
 - 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- D. Make connections **NPS 2 (DN 50)** and smaller with drilling machine according to the following:
 - 1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company's standards.
 - 2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
 - 3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
 - 4. Install corporation valves into service-saddle assemblies.
 - 5. Install manifold for multiple taps in water main.
 - 6. Install curb valve in water-service piping with head pointing up and with service box.
- E. Comply with NFPA 24 for fire-service-main piping materials and installation.
- F. Install copper tube and fittings according to CDA's "Copper Tube Handbook."

1. Install encasement for tubing according to ASTM A 674 or AWWA C105.
- G. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
 1. Install encasement for piping according to ASTM A 674 or AWWA C105.
- H. Bury piping with depth of cover over top at least [30 inches (750 mm)] <Insert dimension>, with top at least [12 inches (300 mm)] <Insert dimension> below level of maximum frost penetration, and according to the following:
 1. Under Driveways: With at least [36 inches (910 mm)] <Insert dimension> of cover over top.
 2. Under Railroad Tracks: With at least [48 inches (1220 mm)] <Insert dimension> of cover over top.
 3. In Loose Gravelly Soil and Rock: With at least [12 inches (300 mm)] <Insert dimension> of additional cover.
- I. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- J. Extend fire-suppression water-service piping and connect to water-supply source and building fire-suppression water-service piping systems at locations and pipe sizes indicated.
 1. Terminate fire-suppression water-service piping at building [floor slab] [wall] until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building's fire-suppression water-service piping systems when those systems are installed.
- K. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
- L. Comply with requirements in Section 211200 "Fire-Suppression Standpipes," Section 211313 "Wet-Pipe Sprinkler Systems," and Section 211316 "Dry-Pipe Sprinkler Systems" for fire-suppression-water piping inside the building.
- M. Comply with requirements in Section 221116 "Domestic Water Piping" for potable-water piping inside the building.
- N. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- O. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

3.5 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure rating same as or higher than systems pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in tubing **NPS 2** (DN 50) and smaller.
- C. Install flanges, flange adaptors, or couplings for grooved-end piping on valves, apparatus, and equipment having **NPS 2-1/2** (DN 65) and larger end connections.
- D. Ream ends of tubes and remove burrs.
- E. Remove scale, slag, dirt, and debris from outside and inside of pipes, tubes, and fittings before assembly.
- F. Copper-Tubing, Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- G. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.
- H. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
- I. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts.
- J. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with bolts according to ASME B31.9.
- K. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
- L. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.
- M. Do not use flanges or unions for underground piping.

3.6 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
 - 1. Concrete thrust blocks.
 - 2. Locking mechanical joints.
 - 3. Set-screw mechanical retainer glands.
 - 4. Bolted flanged joints.
 - 5. Heat-fused joints.
 - 6. Pipe clamps and tie rods.
 - 7. **<Insert devices>**.

- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches in fire-suppression water-service piping according to NFPA 24 and the following:
 - 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
 - 2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
 - 3. Bonded-Joint Fiberglass, Water-Service Piping: According to AWWA M45.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.7 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
- C. UL-Listed or FM-Approved Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
- D. UL-Listed or FM-Approved Valves Other Than Gate Valves: Comply with NFPA 24.
- E. MSS Valves: Install as component of connected piping system.
- F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.
- G. Pressure-Reducing Valves: Install in vault or aboveground between shutoff valves. [**Install full-size valved bypass.**]
- H. Support valves and piping, not direct buried, on concrete piers. Comply with requirements for concrete piers in [**Section 033000 "Cast-in-Place Concrete."**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete."**]

3.8 DETECTOR CHECK VALVE INSTALLATION

- A. Install in vault or aboveground.
- B. Install for proper direction of flow. Install bypass with water meter, gate valves on each side of meter, and check valve downstream from meter.
- C. Support detector check valves and piping on concrete piers. Comply with requirements for concrete piers in [**Section 033000 "Cast-in-Place Concrete."**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete."**]

3.9 WATER METER INSTALLATION

- A. Install water meters, piping, and specialties according to utility company's written instructions.
- B. Water Meters: Install **[displacement] [turbine]**-type water meters **NPS 2** (DN 50) and smaller in meter boxes with shutoff valves on water meter inlets. Include valves on water meter outlets, and include valved bypass around meters unless prohibited by authorities having jurisdiction.
- C. Water Meters: Install **[compound] [turbine]**-type water meters **NPS 3** (DN 80) and larger in meter vaults. Include shutoff valves on water meter inlets and outlets, and include valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.
- D. Water Meters: Install detector-type water meters in meter vault according to AWWA M6. Include shutoff valves on water meter inlets and outlets, and include full-size valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.
- E. Support water meters and piping **NPS 3** (DN 80) and larger on concrete piers. Comply with requirements for concrete piers in **[Section 033000 "Cast-in-Place Concrete. "] [Section 033053 "Miscellaneous Cast-in-Place Concrete. "]**

3.10 ROUGHING-IN FOR WATER METERS

- A. Rough-in piping and specialties for water meter installation according to utility company's written instructions.

3.11 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.
- D. Support **NPS 2-1/2** (DN 65) and larger backflow preventers and piping on concrete piers. Comply with requirements for concrete piers in **[Section 033000 "Cast-in-Place Concrete. "] [Section 033053 "Miscellaneous Cast-in-Place Concrete. "]**

3.12 WATER METER BOX INSTALLATION

- A. Install water meter boxes in paved areas flush with surface.

- B. Install water meter boxes in grass or earth areas with top [2 inches (50 mm)] <Insert dimension> above surface.

3.13 CONCRETE VAULT INSTALLATION

- A. Install precast concrete vaults according to ASTM C 891.

3.14 PROTECTIVE ENCLOSURE INSTALLATION

- A. Install concrete base level and with top approximately [2 inches (50 mm)] <Insert dimension> above grade.
- B. Install protective enclosure over valves and equipment.
- C. Anchor protective enclosure to concrete base.

3.15 FIRE HYDRANT INSTALLATION

- A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.
- B. Wet-Barrel Fire Hydrants: Install with valve below frost line. Provide for drainage.
- C. AWWA Fire Hydrants: Comply with AWWA M17.
- D. UL-Listed or FM-Approved Fire Hydrants: Comply with NFPA 24.

3.16 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install ball drip valves at each check valve for fire-department connection to mains.
- B. Install protective pipe bollards [on two sides of] [on three sides of] <Insert arrangement> each fire-department connection. Pipe bollards are specified in Section 055000 "Metal Fabrications."

3.17 ALARM DEVICE INSTALLATION

- A. General: Comply with NFPA 24 for devices and methods of valve supervision. Underground valves with valve box do not require supervision.
- B. Supervisory Switches: Supervise valves in open position.
 1. Valves: Grind away portion of exposed valve stem. Bolt switch, with plunger in stem depression, to OS&Y gate-valve yoke.
 2. Indicator Posts: Drill and thread hole in upper-barrel section at target plate. Install switch, with toggle against target plate, on barrel of indicator post.

- C. Locking and Sealing: Secure unsupervised valves as follows:
 - 1. Valves: Install chain and padlock on open OS&Y gate valve.
 - 2. Post Indicators: Install padlock on wrench on indicator post.
- D. Pressure Switches: Drill and thread hole in exposed barrel of fire hydrant. Install switch.
- E. Water-Flow Indicators: Install in water-service piping in vault. Select indicator with saddle and vane matching pipe size. Drill hole in pipe, insert vane, and bolt saddle to pipe.
- F. Connect alarm devices to building's fire-alarm system. Wiring and fire-alarm devices are specified in [**Section 283111 "Digital, Addressable Fire-Alarm System."**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System."**]

3.18 CONNECTIONS

- A. Connect fire-suppression water-service piping to [**utility water main**] [**existing water main**] <Insert piping system>. Use [**tapping sleeve and tapping valve**] [**service clamp and corporation valve**] <Insert method>.
- B. Connect fire-suppression water-service piping to interior fire-suppression piping.
- C. Connect waste piping from concrete vault drains to [**sanitary sewerage system. Comply with requirements in Section 221313 "Facility Sanitary Sewers" for connection to sanitary sewer**] [**storm-drainage system. Comply with requirements in Section 334100 "Storm Utility Drainage Piping" for connection to storm sewer**].

3.19 FIELD QUALITY CONTROL

- A. Use test procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described below.
- B. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- C. Hydrostatic Tests: Test at not less than one-and-one-half times the working pressure for two hours.
 - 1. Increase pressure in **50-psig (350-kPa)** increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to **0 psig (0 kPa)**. Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is **2 quarts (1.89 L)** per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

- D. Prepare test and inspection reports.

3.20 IDENTIFICATION

- A. Install continuous underground[**detectable**] warning tape during backfilling of trench for underground fire-suppression water-service piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."
- B. Permanently attach equipment nameplate or marker indicating plastic fire-suppression water-service piping or fire-suppression water-service piping with electrically insulated fittings, on main electrical meter panel. Comply with requirements for identifying devices in Section 220553 "Identification for Plumbing Piping and Equipment."

3.21 CLEANING

- A. Clean[**and disinfect**] fire-suppression water-service piping as follows:
1. Purge new piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 2. Use purging[**and disinfecting**] procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for three hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

- B. Prepare reports of purging[**and disinfecting**] activities.

3.22 PIPING SCHEDULE

- A. Underground fire-suppression water-service piping [NPS 2 (DN 50) **and smaller**] <Insert pipe size range> shall be[**one of**] the following:

1. **[Hard] [Soft]** copper tube, **[ASTM B 88, Type K (ASTM B 88M, Type A)] [ASTM B 88, Type L (ASTM B 88M, Type B)]**; **[wrought-copper, solder-joint fittings; and brazed] [copper, pressure-seal fittings; and pressure-sealed]** joints.
 2. **NPS 2 (DN 50) PE, [Class 150] [Class 200]**, fire-service pipe; molded PE fittings; and heat-fusion joints.
- B. Underground fire-suppression water-service piping **NPS 3 (DN 80)** shall be **[one of]** the following:
1. **[Hard] [Soft]** copper tube, **[ASTM B 88, Type K (ASTM B 88M, Type A)] [ASTM B 88, Type L (ASTM B 88M, Type B)]**; **[wrought-copper, solder-joint fittings; and brazed] [copper, pressure-seal fittings; and pressure-sealed]** joints.
 2. Mechanical-joint, ductile-iron pipe; mechanical-joint, **[ductile- or gray-iron, standard-pattern] [or] [ductile-iron, compact-pattern]** fittings; glands, gaskets, and bolts; and gasketed joints.
 3. Push-on-joint, ductile-iron pipe; push-on-joint, ductile-iron compact-pattern fittings; and gasketed joints.
- C. Underground fire-suppression water-service piping **NPS 4 (DN 100)** shall be **[one of]** the following:
1. **[Hard] [Soft]** copper tube, **[ASTM B 88, Type K (ASTM B 88M, Type A)] [ASTM B 88, Type L (ASTM B 88M, Type B)]**; **[wrought-copper, solder-joint fittings; and brazed] [copper, pressure-seal fittings; and pressure-sealed]** joints.
 2. Mechanical-joint, ductile-iron pipe; mechanical-joint, **[ductile- or gray-iron, standard-pattern] [or] [ductile-iron, compact-pattern]** fittings; glands, gaskets, and bolts; and gasketed joints.
 3. Push-on-joint, ductile-iron pipe; push-on-joint, ductile-iron compact-pattern fittings; and gasketed joints.
- D. Underground fire-suppression water-service piping **[NPS 6 to NPS 12 (DN 150 to DN 300)] <Insert pipe size range>** shall be **[one of]** the following:
1. Mechanical-joint, ductile-iron pipe; mechanical-joint, **[ductile- or gray-iron, standard-pattern] [or] [ductile-iron, compact-pattern]** fittings; glands, gaskets, and bolts; and gasketed joints.
 2. Push-on-joint, ductile-iron pipe; push-on-joint, ductile-iron compact-pattern fittings; and gasketed joints.
- E. **[Aboveground] [and] [vault]** fire-suppression water-service piping **[NPS 2 (DN 50) and smaller] <Insert pipe size range>** shall be hard copper tube, **[ASTM B 88, Type K (ASTM B 88M, Type A)] [ASTM B 88, Type L (ASTM B 88M, Type B)]**; **[wrought- or cast-copper-alloy, solder-joint fittings; and brazed] [copper, pressure-seal fittings; and pressure-sealed]** joints.
- F. **[Aboveground] [and] [vault]** fire-suppression water-service piping **[NPS 3 and NPS 4 (DN 80 and DN 100)] <Insert pipe size range>** shall be **[one of]** the following:
1. Hard copper tube, **[ASTM B 88, Type K (ASTM B 88M, Type A)] [ASTM B 88, Type L (ASTM B 88M, Type B)]**; **[wrought-copper, solder-joint fittings; and brazed] [copper, pressure-seal fittings; and pressure-sealed]** joints.

- G. **[Aboveground] [and] [vault]** fire-suppression water-service piping **[NPS 5 to NPS 12 (DN 125 to DN 300)]** **<Insert pipe size range>** shall be grooved-end, ductile-iron pipe; grooved-end, ductile-iron pipe appurtenances; and grooved joints.
- H. Underslab fire-suppression water-service piping **[NPS 2 (DN 50) and smaller]** **<Insert pipe size range>** shall be **[hard] [soft]** copper tube, **[ASTM B 88, Type K (ASTM B 88M, Type A)] [ASTM B 88, Type L (ASTM B 88M, Type B)]**; **[wrought-copper, solder-joint fittings; and brazed] [copper, pressure-seal fittings; and pressure-sealed]** joints.
- I. Underslab fire-suppression water-service piping **[NPS 3 and NPS 4 (DN 80 and DN 100)]** **<Insert pipe size range>** shall be **[one of]** the following:
1. **[Hard] [Soft]** copper tube, **[ASTM B 88, Type K (ASTM B 88M, Type A)] [ASTM B 88, Type L (ASTM B 88M, Type B)]**; **[wrought-copper, solder-joint fittings; and brazed] [copper, pressure-seal fittings; and pressure-sealed]** joints.
 2. Mechanical-joint, ductile-iron pipe; mechanical-joint, **[ductile- or gray-iron, standard-pattern] [or] [ductile-iron, compact-pattern]** fittings; glands, gaskets, and bolts; and restrained, gasketed joints.
 3. Push-on-joint, ductile-iron pipe; push-on-joint, ductile-iron compact-pattern fittings; and restrained, gasketed joints.
- J. Underslab fire-suppression water-service piping **[NPS 6 to NPS 12 (DN 150 to DN 300)]** **<Insert pipe size range>** shall be **[one of]** the following:
1. Mechanical-joint, ductile-iron pipe; mechanical-joint, **[ductile- or gray-iron, standard-pattern] [or] [ductile-iron, compact-pattern]** fittings; glands, gaskets, and bolts; and restrained, gasketed joints.
 2. Push-on-joint, ductile-iron pipe; push-on-joint, ductile-iron compact-pattern fittings; and restrained, gasketed joints.

3.23 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
- B. Underground fire-suppression water-service shutoff valves **NPS 2 (DN 50)** and smaller shall be corporation valves or curb valves with ends compatible with piping.
- C. Meter box fire-suppression water-service shutoff valves **NPS 2 (DN 50)** and smaller shall be meter valves.
- D. Vault fire-suppression water-service shutoff valves **NPS 2 (DN 50)** and smaller shall be **[Class 125, MSS, bronze, nonrising stem] [or] [UL-listed or FM-approved, OS&Y, bronze,]** gate valves.
- E. Underground fire-suppression water-service shutoff valves **NPS 3 (DN 80)** and larger shall be **[one of]** the following:

1. 200-psig (1380-kPa), AWWA, iron, nonrising-stem, **[metal] [resilient]**-seated gate valves.
 2. 250-psig (1725-kPa), AWWA, iron, nonrising-stem, resilient-seated gate valves.
 3. **[175-psig (1200-kPa)] [250-psig (1725-kPa)]**, UL-listed or FM-approved, iron, nonrising-stem gate valves.
- F. Indicator-post underground fire-suppression water-service valves **NPS 3** (DN 80) and larger shall be **[175-psig (1200-kPa)] [250-psig (1725-kPa)]**, UL-listed or FM-approved, iron, nonrising-stem gate valves with indicator-post flange.
- G. Standard-pressure, **[aboveground] [and] [vault]** fire-suppression water-service shutoff valves **NPS 3** (DN 80) and larger shall be **[one of]** the following:
1. 200-psig (1380-kPa), AWWA, iron, OS&Y, **[metal] [resilient]**-seated gate valves.
 2. 250-psig (1725-kPa), AWWA, iron, OS&Y, resilient-seated gate valves.
 3. **[175-psig (1200-kPa)] [250-psig (1725-kPa)]**, UL-listed or FM-approved, iron, OS&Y gate valves.
 4. **[AWWA] [or] [UL-listed or FM-approved]** butterfly valves.
- H. Fire-suppression water-service check valves **NPS 3** (DN 80) and larger shall be **[one of]** the following:
1. **[AWWA] [or] [UL-listed or FM-approved]** check valves.
 2. UL-listed or FM-approved detector check valves.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 211100

SECTION 211200 - FIRE-SUPPRESSION STANDPIPES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Hose connections.
4. Monitors.
5. Fire-department connections.
6. Alarm devices.
7. Manual control stations.
8. Control panels.
9. Pressure gages.

B. Related Sections:

1. Section 211313 "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
2. Section 211316 "Dry-Pipe Sprinkler Systems" for dry-pipe sprinkler piping.
3. Section 211339 "Foam-Water Systems" for AFFF piping.
4. **[Section 213113 "Electric-Drive, Centrifugal Fire Pumps"] [Section 213116 "Diesel-Drive, Centrifugal Fire Pumps"] [Section 213213 "Electric-Drive, Vertical-Turbine Fire Pumps"] [Section 213216 "Diesel-Drive, Vertical-Turbine Fire Pumps"]** for fire pumps, pressure-maintenance pumps, and fire-pump controllers.
5. **[Section 283111 "Digital, Addressable Fire-Alarm System"] [Section 283112 "Zoned (DC Loop) Fire-Alarm System"]** for alarm devices not specified in this Section.

- C. Include all design, pipe and fittings, valves, connections, fabrication, and installation of all standpipe and fire hose protection systems in association with the fire pump installation, wet-pipe and dry-pipe sprinkler installation, and all fire and smoke alarm interface in accordance with design criteria and fire/smoke zoning requirements indicated on drawings.

- D. Major bulk runs, standpipe mains and risers, and sprinkler crossmains are shown to assist the contractor where interference with other trades may occur. However, all piping required to complete the fire protection systems shall be designed, fabricated

and installed based on approved hydraulic calculations and shop drawings prepared and submitted by the Fire Protection Work Contractor (FPWC).

- E. The FPWC shall provide all special tools required for installation or maintenance for the equipment provided. If conflicts occur in this specification or between this specification and the contract documents, most stringent requirement shall apply.
- F. Work on all systems require DEN Shut Down Requests be completed and filed five (5) days before work is to be done. Work on wet systems must be done during off hour periods, 10:00 p.m. to 6:00 a.m. Sunday night through Friday morning. No system may be shut down for periods longer than ten (10) hours. The FPWC is responsible for the required Fire Watch and must remain ON SITE for the entire period of time that the system is not in service. Failure to comply may be reason for immediate suspension of work privileges.
- G. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. High-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure higher than standard 175 psig (1200 kPa), but not higher than [250 psig (1725 kPa)] [300 psig (2070 kPa)].
- B. Standard-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure 175 psig (1200 kPa) maximum.
- C. Pipe sizes used in this specification are Nominal Pipe Size (NPS).
- D. Other definitions for fire protection systems are listed in NFPA 10, 13 and 14.
- E. "Working Plans" as used in this section means those documents (including drawings and calculations) prepared pursuant to the requirements contained in NFPA 13 for obtaining approval of the authority having jurisdiction.
- F. High-Pressure Piping System: Fire-suppression piping system designed to operate at working pressure higher than standard 175 psig
- G. Underground Service-Entrance Piping: Underground service piping below the building.

1.4 REFERENCE STANDARDS

- A. Materials and workmanship shall conform to the latest issue of all industry standards, publications, or regulations referenced in this section and with the following references as applicable. Appendices and/or Annexes referenced by these standards shall apply.
- B. International Building Code (IBC) with the Denver Amendments.
- C. International Fire Code (IFC) with the Denver Amendments.

- D. National Fire Protection Association (NFPA).
- E. UL and FM Global Compliance: Fire protection system materials and components shall be UL listed and labeled, and FM Global approved.
- F. All applicable insurance authorities underwriting requirements.

1.5 SYSTEM DESCRIPTIONS

- A. Provide fire proofing repair damaged by this work.
- B. Provide all required fire sealants and smoke stopping required by this work.
- C. Current Denver Water Department test reports (less than 6 months old) for the underground supply shall be provided for all new calculations. Where accepted by all AHJ's the most current DEN Fire Pump Test may be used.
- D. Automatic Wet-Type, Class I Standpipe System: Includes **NPS 2-1/2** (DN 65) hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.
- E. Automatic Wet-Type, Class II Standpipe System: Includes **NPS 1-1/2** (DN 40) hose stations. Has open water-supply valve with pressure maintained and is capable of supplying water demand.
- F. Automatic Wet-Type, Class III Standpipe System: Includes **NPS 1-1/2** (DN 40) hose stations and **NPS 2-1/2** (DN 65) hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.
- G. Automatic Dry-Type, Class I Standpipe System: Includes **NPS 2-1/2** (DN 65) hose connections. Has open water-supply valve and dry-pipe valve with standpipes containing compressed air. Opening fire-hose valve releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into standpipes.
- H. Automatic Dry-Type, Class II Standpipe System: Includes **NPS 1-1/2** (DN 40) hose stations. Has open water-supply valve and dry-pipe valve with standpipes containing compressed air. Opening fire-hose valve releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into standpipes.
- I. Automatic Dry-Type, Class III Standpipe System: Includes **NPS 1-1/2** (DN 40) hose stations and **NPS 2-1/2** (DN 65) hose connections. Has open water-supply valve and dry-pipe valve with standpipes containing compressed air. Opening fire-hose valve releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into standpipes.
- J. Semiautomatic Dry-Type, Class I Standpipe System: Includes **NPS 2-1/2** (DN 65) hose connections. Has open water-supply valve and deluge valve with standpipes containing air. Actuation of detection device permits water pressure to open deluge valve. Water then flows into standpipes.

- K. Semiautomatic Dry-Type, Class II Standpipe System: Includes **NPS 1-1/2 (DN 40)** hose stations. Has open water-supply valve and deluge valve with standpipes containing air. Actuation of detection device permits water pressure to open deluge valve. Water then flows into standpipes.
- L. Semiautomatic Dry-Type, Class III Standpipe System: Includes **NPS 1-1/2 (DN 40)** hose stations and **NPS 2-1/2 (DN 65)** hose connections. Has open water-supply valve and deluge valve with standpipes containing air. Actuation of detection device permits water pressure to open deluge valve. Water then flows into standpipes.
- M. Manual Wet-Type, Class I Standpipe System: Includes **NPS 2-1/2 (DN 65)** hose connections. Has small water supply to maintain water in standpipes. Piping is wet, but water must be pumped into standpipes to satisfy demand.
- N. Manual Dry-Type, Class I Standpipe System: Includes **NPS 2-1/2 (DN 65)** hose connections. Does not have permanent water supply. Piping is dry. Water must be pumped into standpipes to satisfy demand.

1.6 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure, Fire-Suppression Standpipe System Component: Listed for **175-psig (1200-kPa)** minimum working pressure.
- B. High-Pressure, Fire-Suppression Standpipe System Component: Listed for **[250-psig (1725-kPa) minimum] [300-psig (2070-kPa)]** working pressure.
- C. Delegated Design: Design fire-suppression standpipes, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - 1. Available fire-hydrant flow test records indicate the following conditions:
 - a. Date: **<Insert test date>**.
 - b. Time: **<Insert time> [a.m.] [p.m.]**
 - c. Performed by: **<Insert operator's name> of <Insert firm>**.
 - d. Location of Residual Fire Hydrant R: **<Insert location>**.
 - e. Location of Flow Fire Hydrant F: **<Insert location>**.
 - f. Static Pressure at Residual Fire Hydrant R: **<Insert psig (kPa)>**.
 - g. Measured Flow at Flow Fire Hydrant F: **<Insert gpm (L/s)>**.
 - h. Residual Pressure at Residual Fire Hydrant R: **<Insert psig (kPa)>**.
- D. Fire-suppression standpipe design shall be approved by authorities having jurisdiction.
 - 1. Minimum residual pressure at each hose-connection outlet is as follows:
 - a. **NPS 1-1/2 (DN 40) Hose Connections: [65 psig (450 kPa)] <Insert value>**.
 - b. **NPS 2-1/2 (DN 65) Hose Connections: [100 psig (690 kPa)] <Insert value>**.
 - 2. Maximum residual pressure at required flow at each hose-connection outlet is as follows unless otherwise indicated:

- a. **NPS 1-1/2** (DN 40) Hose Connections: [**100 psig** (690 kPa)] **<Insert value>**.
 - b. **NPS 2-1/2** (DN 65) Hose Connections: [**175 psig** (1200 kPa)] **<Insert value>**.
- E. Seismic Performance: Fire-suppression standpipes shall withstand the effects of earthquake motions determined according to NFPA 13 and **[ASCE/SEI 7]** **<Insert requirement>**.

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.[**Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.**] Include the following:
1. Piping materials, including [**dielectric fittings and**] [**dielectric fittings, flexible connections, and**] [**flexible connections and**] specialty fittings.
 2. Pipe hangers and supports.
 3. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.
 4. Air compressors, including electrical data.
 5. Excess-pressure pumps, including electrical data.
 6. Hose connections, including size, type, and finish.
 7. Hose stations, including size, type, and finish of hose connections; type and length of fire hoses; finish of fire hose couplings; type, material, and finish of nozzles; and finish of rack.
 8. Roof hose cabinets.
 9. Monitors.
 10. Fire hydrants.
 11. Fire department connections, including type; number, size, and arrangement of inlets; caps and chains; size and direction of outlet; escutcheon and marking; and finish.
 12. Alarm devices, including electrical data.
- B. Shop Drawings: For fire-suppression standpipes. Include plans, elevations, sections, details, and attachments to other work.
1. Submittal shall include drawings, hydraulic calculations, hydraulic reference points, detailed pipe layout, hangers and supports, components and accessories and other items as defined by NFPA 13.
 2. Indicate pipe materials used, jointing methods, supports, floor, and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
 3. Drawings shall be submitted in latest version of Revit format or latest version of Adobe Acrobat (bookmarked and free of security) in hard copy and on Compact Disk. Two (2) sets of full size drawings (34x44) and one (1) Compact Disk containing all drawing files shall be submitted to the DEN Life Safety Team as part of each submittal.
 4. Wiring Diagrams: For power, signal, and control wiring.

- C. Delegated-Design Submittal: For standpipe systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Final Submittal: Working plans submitted for approval shall have the signed wet stamp of a registered Fire Protection Engineer licensed in the State of Colorado (or N.I.C.E.T. 4), certifying that the system has been designed and hydraulically calculated in compliance with NFPA and governing authorities requirements.
- E. Copy of City and County of Denver Fire Protection Contractors License, and Fire protection Supervisor's certificate for class of equipment being installed.
- F. Obtain DEN Life Safety Team review and stamp prior to submittal for permit.
- G. Submit working plans and product data to Denver Fire Department for approval. Subject to approval, submit copy of approved submittal and permit to the DEN Project Manager.
- H. Submit additional non returnable copies of current permits and agency approved working plan drawings with System Interruption Request.
- I. Contractor shall submit fully dimensioned spool drawings for all welded piping work. Drawings shall indicate all weld types, sizes, and materials to be used. The spool drawing size shall match the full size contract documents of either 24x36 or 34x44. Spool drawings shall be submitted in either the latest version of Revit or the latest version of Adobe Acrobat (pdf). Adobe Acrobat files shall not contain security. Other file formats will not be accepted.

1.8 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Fire-suppression standpipes, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Domestic water piping.
 - 2. Compressed air piping.
 - 3. HVAC hydronic piping.
 - 4. **<Insert item>**.
- B. Qualification Data: For qualified Installer[**and professional engineer**].
- C. Approved Standpipe Drawings: Working plans, prepared according to NFPA 14, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- D. Welding certificates.
- E. Fire-hydrant flow test report.

- F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- G. Field quality-control reports.

1.9 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-suppression standpipes specialties to include in emergency, operation, and maintenance manuals. Include valve data, servicing requirements, and test schedule.
 - 1. Maintenance data for each type of valve, piping specialty, fire protection specialty, fire department valve, and hose cabinet specified, for inclusion in operating and maintenance manual specified in Division 01.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".
- C. Extra Stock:
 - 1. Provide one set of renewable parts and seals for each valve installed.
 - 2. Provide to DEN Representatives all special tools required for installation and maintenance.
 - 3. Provide two (2) spanner wrenches for caps and adapters.
- D. Provide a spare parts list. The list is to be provided with material submittal cut sheets.

1.10 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Company specializing in performing the work of this section with minimum five (5) years documented experience.
 - 2. All field personnel must be a current holder of the City & County of Denver Fire Department Fire Protection Installers license.
 - 3. Installer's responsibilities include designing, fabricating, and installing fire-suppression standpipes and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with NFPA 14, "Installation of Standpipe and Hose Systems."
- E. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five (5) years documented experience.
- F. Comply with all requirements of Owner's Insurance Underwriter.

1.11 PROJECT CONDITIONS

- A. Interruption of Existing Fire-Suppression Standpipe Service: Do not interrupt fire-suppression standpipe service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fire-suppression standpipe service according to requirements indicated:
 - 1. Notify DEN Project Manager no fewer than five (5) days in advance of proposed interruption of fire-suppression standpipe service.
 - 2. Do not proceed with interruption of fire-suppression standpipe service without DEN Project Manager's written permission.
- B. Environmental Conditions:
 - 1. The equipment shall be designed and constructed to operate successfully at the rated values under the following environmental conditions:
 - a. Location: Indoors and Outdoors.
 - b. Altitude: 5,500 feet (1677 m) above sea level.
 - c. Ambient temperature range: Minus 30 deg F (minus 35 deg C) to 120 deg F (49 deg C).
 - d. Wind Load: 115 mph with gust factor of 1.3.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube,

and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

- B. Equipment and Components: Bear UL or FM Global label or marking.

2.2 STEEL PIPE AND FITTINGS

- A. Threadable lightwall, black and galvanized, for threaded joints is NOT ALLOWED.

- B. Buried Pipe Within Project Limits:

1. Sizes 3" and larger: Class 52 Tyton joint ductile iron, cement lined pipe in accordance with AWWA C110 and rubber gaskets per AWWA C111.
 - a. Rods shall be 3/4" diameter, number of rods required shall be in accordance with NFPA 24, Table 8-6.2.2(b) with the exception that a minimum of 2 rods shall be used on pipe sizes 6" and smaller. Bolts shall be Cortan steel packaged complete with gaskets, nuts, and follower glands.
 - b. After installation, rods, nuts, bolts, washers, clamps, and other restraining devices except thrust blocks shall be cleaned and thoroughly coated with a bituminous or other acceptable corrosion-retarding material.
 - c. Concrete thrust blocks or other suitable means of thrust restraint shall be provided at each change in direction of a pipeline and at all tees, plugs, caps, and bends. Concrete mix requirement and area of bearing face of concrete thrust blocks shall be in accordance with NFPA 24, chapter 8 recommendations.
 - d. Comply with Denver Water Board requirements.
2. Cathodic Protection: Provide joints and connections in compliance with cathodic protection requirements. Reference Section 264200 "Cathodic Protection".

- C. Interior Standpipe Piping: Steel Pipe: ASTM A 795, Schedule 40, seamless, black and galvanized, plain ends or ASTM A 53 continuous weld or ERW. Minimum Working pressure: 175 psig. Temperature: 110 degrees F or as conditions require. All black steel pipe shall have a protective coating. Reference Section 211316 "Dry-Pipe Sprinkler Systems" for additional instructions for dry pipe system piping.

1. Sizes 2" and smaller pipe: ASTM A53 Type "F" continuous welded black carbon steel, schedule 40, threaded and coupled ends. Only pipe identified and conforming to schedule 40 wall thickness shall be used. In example, "Dyna Flow", "Eddy Pipe", "Super Flow" and / or similar products which are not true Schedule 40 thickness will not be allowed. Do not weld pipe or attach welded flanges or fittings.
2. Sizes 2-1/2" and larger pipe: ASTM A53 Type "E" ERW black carbon steel, Schedule 40, butt weld ends.
3. Joints: Shall be cut grooved for ASTM A106, Gr. B couplings.

- D. Optional Standpipe Piping (if approved by DEN Project Manager): ASTM A135 Gr. B ERW thinwall pipe or acceptable alternates per NFPA 13. Maximum pressure shall be

300 psig conforming to NFPA 13, Chapter 3. Reference Section 211316 "Dry-Pipe Sprinkler Systems" for additional instructions for dry pipe system piping.

1. Sizes 2-1/2" through 5": Schedule 10 or an NFPA approved alternate.
 2. 6" size: 0.134" wall thickness or an NFPA approved alternate.
 3. 8" and 10" size: 0.188" wall thickness or an NFPA approved alternate.
 4. Joints: ASTM A536, dimensionally compatible with mechanical couplings.
- E. **[Galvanized] [and] [Uncoated]**, Steel Couplings: ASTM A 865, threaded.
- F. **[Galvanized] [and] [Uncoated]**, Gray-Iron Threaded Fittings: ASME B16.4, Class 125 or 250 as required, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1., standard pattern.
- G. Malleable- or Ductile-Iron Unions: UL 860.
- H. Malleable Iron Threaded Fittings: ANSI B16.3, Class 150 or 300 as required, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.
1. Exterior dry systems connections must have galvanized fittings.
- I. Cast-Iron Flanges: ASME B16.1, Class 125 or 250 as required. Raised face flanges shall be mated with raised face, and flat face flanges shall be mated with flat face only..
- J. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- K. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- L. Grooved-Joint, Steel-Pipe Appurtenances:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Corcoran Piping System Co.
 - c. National Fittings, Inc.
 - d. Shurjoint Piping Products.
 - e. Tyco Fire & Building Products LP.
 - f. Victaulic Company.
 - g. **<Insert manufacturer's name>**
 - h. or approved equal.
 2. Pressure Rating: **[175 psig (1200 kPa)] [250 psig (1725 kPa)] [300 psig (2070 kPa)]** minimum.
 3. **[Galvanized] [and] [Uncoated]**, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

- M. Use of Hooker style fittings and/or any similar rubber gasketed, drill to mount, 2" and smaller clamp on tees will NOT be permitted.
- N. Use of threaded thin wall pipe. Pressfit fittings or similar non-threaded connections of any kind will NOT be permitted.
- O. "EZ-T's" are NOT permitted.
- P. Unions: 150 to 300psi as required malleable iron for threaded ferrous piping.

2.3 FLANGES, AND COUPLINGS

- A. Flanges: 150 psi forged steel slip on or weld-neck flanges for ferrous piping. Raised face flanges shall be mated with raised face, and flat face flanges shall be mated with flat face only.
- B. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; "C" shaped composition sealing gasket, steel bolts, nuts, and washers.

2.4 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: [**AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick**] [or] [**ASME B16.21, nonmetallic and asbestos free**].
 - 1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
 - 2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. Welding Materials: Field welding shall not be permitted; perform only shop welding. Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded. Welded outlets are permitted as long as the welding is done in compliance with NFPA welding requirements and Division 05 specifications.
- F. Gasket Materials: Thickness, material, and type suitable for fluid or gas to be handled, and design temperatures and pressures.
- G. Threaded Joint Compound or "Teflon" tape.

- H. Ductile Iron Fire Protection Service Piping: Mechanical joint restraint shall be incorporated in the design of the follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Flexibility of the joint shall be maintained after burial. Glands shall be manufactured of ductile iron conforming to ASTM A 536 80. Restraining devices shall be of ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee head bolts conforming to ANSI/AWWA A21.11 and ANSI/AWWA C153/A21.53 of latest revision. Twist-off nuts, sized same as tee head bolts, shall be used to insure proper actuating of restraining devices. The mechanical joint restraint device shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. EBAA Iron, Inc., MEGALUG.
 - b. <Insert manufacturer's name>
 - c. or approved equal.

2.5 PIPE HANGERS AND SUPPORTS

- A. All supports shall conform to the requirements of NFPA 13. Reference Section 220529 "Hangers and Supports for Plumbing Piping and Equipment".
- B. Hangers for Pipe Sizes 1/2 to 12 Inch: Adjustable band hanger or malleable iron split ring in accordance with NFPA 13.
- C. All beam clamp type hangers shall be provided with retaining straps and surge restrainers.
- D. All hangers attached to metal grated mezzanines or floors and conveyor systems shall be provided with vibration spring isolators.
- E. All hangers support under the AGTS Tunnel must be only clevis style with double nuts for locking purposes.
- F. All hangers supported by attachment to the concrete structure shall be provided with fender washers and double nuts against the washer to assure locking.

2.6 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
 1. Valves shall be UL listed or FM approved.
 2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig (1200 kPa).
 3. Minimum Pressure Rating for High-Pressure Piping: [250 psig (1725 kPa)] [300 psig (2070 kPa)].

B. VALVE OPERATORS

1. Provide hand wheels for gate, globe [**or angle,**] and drain valves.
2. Butterfly valves provide gear operators for all sizes.
3. For valves located with a centerline more than 7 feet above finish floor, provide endless chain operated sheaves. Extend chains to 5 feet above floor and secure clear of walkways, as applicable.

C. VALVE CONNECTIONS

1. Provide valve connections to match pipe joints. Use valves of pipe size.
2. Provide butterfly valve for isolating service.

D. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Victaulic Company.
 - c. **<Insert manufacturer's name>**
 - d. or approved equal.
2. Standard: UL 1091 except with ball instead of disc.
3. Valves **NPS 1-1/2 (DN 40)** and Smaller: Bronze body with threaded ends.
4. Valves **NPS 2 and NPS 2-1/2 (DN 50 and DN 65)**: Bronze body with threaded ends or ductile-iron body with grooved ends.
5. Valves **NPS 3 (DN 80)**: Ductile-iron body with grooved ends.

E. Bronze Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fivalco Inc.
 - b. Global Safety Products, Inc.
 - c. Milwaukee Valve Company.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
2. Standard: UL 1091.
3. Pressure Rating: **175 psig** (1200 kPa).
4. Body Material: Bronze.
5. End Connections: Threaded.

F. Iron Butterfly Valves:

1. Per NFPA 13: UL listed and FM Global approved butterfly control valves for use with tamper switches, flanged or grooved connections. Carbon steel body, 150 lb full ANSI rated bi directional, 316 SS electrodeposit nickel plated eccentric rotating disc, dynamic sealed, TFE seal ring, 17 4 PH stainless steel shaft, teflon

- chevron stem packing, 316 SS graphite impregnated bearings, and gear operator. Provide Supervisory switches.
2. Per NFPA-13 UL-Listed and FM Global approved grooved end control valves for use as zone control and/or sectional valves may be used with appropriate pressure ratings for intended service.
 3. Supervisory switches are required on all control valves.
 4. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Fivalco Inc.
 - c. Global Safety Products, Inc.
 - d. Kennedy Valve; a division of McWane, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Pratt, Henry Company.
 - h. Shurjoint Piping Products.
 - i. Tyco Fire & Building Products LP.
 - j. Victaulic Company.
 - k. **<Insert manufacturer's name>**.
 - l. or approved equal.
 5. Standard: UL 1091.
 6. Pressure Rating: 175 psig (1200 kPa).
 7. Body Material: Cast or ductile iron.
 8. Style: Lug or wafer.
 9. End Connections: Grooved.

G. Check Valves:

1. UL listed and FM Global approved wafer check valves, flanged or grooved connections.
 - a. Iron body, bronze trim, swing disc, renewable disc and seat.
 - b. Iron body, bronze trim spring loaded, renewable composition disc, where indicated on drawings.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - c. Anvil International, Inc.
 - d. Clow Valve Company; a division of McWane, Inc.
 - e. Crane Co.; Crane Valve Group; Crane Valves.
 - f. Crane Co.; Crane Valve Group; Jenkins Valves.
 - g. Crane Co.; Crane Valve Group; Stockham Division.
 - h. Fire-End & Croker Corporation.
 - i. Fire Protection Products, Inc.
 - j. Fivalco Inc.

- k. Globe Fire Sprinkler Corporation.
 - l. Groeniger & Company.
 - m. Kennedy Valve; a division of McWane, Inc.
 - n. Matco-Norca.
 - o. Metraflex, Inc.
 - p. Milwaukee Valve Company.
 - q. Mueller Co.; Water Products Division.
 - r. NIBCO INC.
 - s. Potter Roemer.
 - t. Reliable Automatic Sprinkler Co., Inc.
 - u. Shurjoint Piping Products.
 - v. Tyco Fire & Building Products LP.
 - w. United Brass Works, Inc.
 - x. Venus Fire Protection Ltd.
 - y. Victaulic Company.
 - z. Viking Corporation.
 - aa. Watts Water Technologies, Inc.
 - bb. **<Insert manufacturer's name>**.
 - cc. or approved equal.
3. Standard: UL 312.
 4. Pressure Rating: [250 psig (1725 kPa) **minimum**] [300 psig (2070 kPa)].
 5. Type: Swing check.
 6. Body Material: Cast iron.
 7. End Connections: Flanged or grooved.
- H. Bronze OS&Y Gate Valves:
1. Gate Valves - 2 inch and smaller: Body and bonnet of cast bronze, 175 pound cold water working pressure, nonshock, threaded ends, solid wedge, outside screw and yoke (OS&Y), rising stem, screw-in bonnet, and malleable iron handwheel. Valves shall be capable of being repacked under pressure, with valve wide open.
 2. Supervisory switches are required.
 3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. United Brass Works, Inc.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
 4. Standard: UL 262.
 5. Pressure Rating: 175 psig (1200 kPa).
 6. Body Material: Bronze.
 7. End Connections: Threaded.

I. Iron OS&Y Gate Valves:

1. Gate Valves - 2-1/2 inch and Larger: Iron body, bronze mounted, 175 pound cold water working pressure, nonshock. Valves shall have solid taper wedge, outside screw and yoke (OS&Y), rising stem, flanged bonnet, with body and bonnet conforming to ASTM A 126, Class B; replaceable bronze wedge facing rings, flanged ends, and a packing assembly consisting of a cast iron gland flange, brass gland, packing, bonnet, and bronze bonnet bushing. Valves shall be capable of being repacked under pressure, with valve wide open.
2. Supervisory switches are required.
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Crane Valves.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. Hammond Valve.
 - h. Milwaukee Valve Company.
 - i. Mueller Co.; Water Products Division.
 - j. NIBCO INC.
 - k. Shurjoint Piping Products.
 - l. Tyco Fire & Building Products LP.
 - m. United Brass Works, Inc.
 - n. Watts Water Technologies, Inc.
 - o. **<Insert manufacturer's name>**.
 - p. or approved equal.
4. Standard: UL 262.
5. Pressure Rating: [250 psig (1725 kPa) **minimum**] [300 psig (2070 kPa)].
6. Body Material: Cast or ductile iron.
7. End Connections: Flanged or grooved.

J. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Fivalco Inc.
 - c. Global Safety Products, Inc.
 - d. Kennedy Valve; a division of McWane, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Shurjoint Piping Products.
 - h. Tyco Fire & Building Products LP.
 - i. Victaulic Company.
 - j. **<Insert manufacturer's name>**.

- k. or approved equal.
 2. Standard: UL 1091.
 3. Pressure Rating: **175 psig** (1200 kPa) minimum.
 4. Valves **NPS 2** (DN 50) and Smaller:
 - a. Valve Type: Ball or butterfly.
 - b. Body Material: Bronze.
 - c. End Connections: Threaded.
 5. Valves **NPS 2-1/2** (DN 65) and Larger:
 - a. Valve Type: Butterfly.
 - b. Body Material: Cast or ductile iron.
 - c. End Connections: Flanged, grooved, or wafer.
 6. Valve Operation: Integral [**electrical, 115-V ac, prewired, single-circuit, supervisory switch**] [**electrical, 115-V ac, prewired, two-circuit, supervisory switch**] [**visual**] indicating device.
- K. NRS Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Kennedy Valve; a division of McWane, Inc.
 - f. Mueller Co.; Water Products Division.
 - g. NIBCO INC.
 - h. Tyco Fire & Building Products LP.
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
 2. Standard: UL 262.
 3. Pressure Rating: [**250 psig** (1725 kPa) **minimum**] [**300 psig** (2070 kPa)].
 4. Body Material: Cast iron with indicator post flange.
 5. Stem: Nonrising.
 6. End Connections: Flanged or grooved.
- L. Indicator Posts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.

- d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Kennedy Valve; a division of McWane, Inc.
 - f. Mueller Co.; Water Products Division.
 - g. NIBCO INC.
 - h. Tyco Fire & Building Products LP.
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
2. Standard: UL 789.
 3. Type: Horizontal for wall mounting.
 4. Body Material: Cast iron with extension rod and locking device.
 5. Operation: **[Wrench] [Hand wheel]**.

2.7 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: **175 psig** (1200 kPa) minimum.
3. Ball or Globe valve: Ball valves are required for all dry system auxiliary drum drip drains.

B. Angle Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire Protection Products, Inc.
 - b. United Brass Works, Inc.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.

C. Ball Valves:

1. Valves up to 2 Inches: Bronze, two piece body, stainless steel ball, Teflon seats and stuffing box ring, lever handle, threaded ends.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Affiliated Distributors.
 - b. Anvil International, Inc.
 - c. Barnett.
 - d. Conbraco Industries, Inc.; Apollo Valves.
 - e. Fire-End & Croker Corporation.
 - f. Fire Protection Products, Inc.
 - g. Flowserve.
 - h. FNW.

- i. Jomar International, Ltd.
- j. Kennedy Valve; a division of McWane, Inc.
- k. Kitz Corporation.
- l. Legend Valve.
- m. Metso Automation USA Inc.
- n. Milwaukee Valve Company.
- o. NIBCO INC.
- p. Potter Roemer.
- q. Red-White Valve Corporation.
- r. Southern Manufacturing Group.
- s. Stewart, M. A. and Sons Ltd.
- t. Tyco Fire & Building Products LP.
- u. Victaulic Company.
- v. Watts Water Technologies, Inc.
- w. <Insert manufacturer's name>.
- x. or approved equal.

D. Globe Valves:

- 1. Brass body with renewable composition disc.
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire Protection Products, Inc.
 - b. United Brass Works, Inc.
 - c. <Insert manufacturer's name>.
 - d. or approved equal.

E. Plug Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Southern Manufacturing Group.
 - b. <Insert manufacturer's name>.
 - c. or approved equal.

2.8 SPECIALTY VALVES

A. General Requirements:

- 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
- 2. Pressure Rating:
 - a. Standard-Pressure Piping Specialty Valves: 175 psig (1200 kPa) minimum.
 - b. High-Pressure Piping Specialty Valves: [250 psig (1725 kPa) **minimum**] [300 psig (2070 kPa)].

3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Globe Fire Sprinkler Corporation.
 - c. Reliable Automatic Sprinkler Co., Inc.
 - d. Tyco Fire & Building Products LP.
 - e. Venus Fire Protection Ltd.
 - f. Victaulic Company.
 - g. Viking Corporation.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.
2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, [**retarding chamber**,] and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Dry-Pipe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Globe Fire Sprinkler Corporation.
 - c. Reliable Automatic Sprinkler Co., Inc.
 - d. Tyco Fire & Building Products LP.
 - e. Venus Fire Protection Ltd.
 - f. Victaulic Company.
 - g. Viking Corporation.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.
2. Standard: UL 260.
3. Design: Differential-pressure type.
4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
5. Air-Pressure Maintenance Device:
 - a. Manufacturers: Subject to compliance with requirements, provide products

by one of the following:

- 1) AFAC Inc.
- 2) Globe Fire Sprinkler Corporation.
- 3) Reliable Automatic Sprinkler Co., Inc.
- 4) Tyco Fire & Building Products LP.
- 5) Venus Fire Protection Ltd.
- 6) Victaulic Company.
- 7) Viking Corporation.
- 8) **<Insert manufacturer's name>**.
- 9) or approved equal.

- b. Standard: UL 260.
- c. Type: Automatic device to maintain minimum air pressure in piping.
- d. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with **14- to 60-psig** (95- to 410-kPa) adjustable range, and **[175-psig** (1200-kPa)] **[300-psig** (2070-kPa)] outlet pressure.

6. Air Compressor:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Gast Manufacturing Inc.
 - 2) General Air Products, Inc.
 - 3) Viking Corporation.
 - 4) **<Insert manufacturer's name>**.
 - 5) or approved equal.
- b. Standard: UL's "Fire Protection Equipment Directory" listing.
- c. Motor Horsepower: Fractional.
- d. Power: 120-V ac, 60 Hz, single phase.

D. Deluge Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. BERMAD Control Valves.
 - c. CLA-VAL Automatic Control Valves.
 - d. Globe Fire Sprinkler Corporation.
 - e. OCV Control Valves.
 - f. Reliable Automatic Sprinkler Co., Inc.
 - g. Tyco Fire & Building Products LP.
 - h. Venus Fire Protection Ltd.
 - i. Victaulic Company.
 - j. Viking Corporation.

- k. **<Insert manufacturer's name>**.
 - l. or approved equal.
 2. Standard: UL 260.
 3. Design: Hydraulically operated, differential-pressure type.
 4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.
 5. Wet, Pilot-Line Trim Set: Include gage to read push-rod chamber pressure, globe valve for manual operation of deluge valve, and connection for actuation device.
 6. Dry, Pilot-Line Trim Set: Include dry, pilot-line actuator; air- and water-pressure gages; low-air-pressure warning switch; air relief valve; and actuation device. Dry, pilot-line actuator includes cast-iron, operated, diaphragm-type valve with resilient facing plate, resilient diaphragm, and replaceable bronze seat. Valve includes threaded water and air inlets and water outlet. Loss of air pressure on dry, pilot-line side allows pilot-line actuator to open and causes deluge valve to open immediately.
 7. Air-Pressure Maintenance Device:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) AFAC Inc.
 - 2) Globe Fire Sprinkler Corporation.
 - 3) Reliable Automatic Sprinkler Co., Inc.
 - 4) Tyco Fire & Building Products LP.
 - 5) Venus Fire Protection Ltd.
 - 6) Victaulic Company.
 - 7) Viking Corporation.
 - 8) **<Insert manufacturer's name>**.
 - 9) or approved equal.
 - b. Standard: UL 260.
 - c. Type: Automatic device to maintain minimum air pressure in piping.
 - d. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator, or switch to maintain pressure, strainer, pressure ratings with **14- to 60-psig** (95- to 410-kPa) adjustable range, and **[175-psig (1200-kPa)] [300-psig (2070-kPa)]** outlet pressure.
 8. Air Compressor:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Gast Manufacturing Inc.
 - 2) General Air Products, Inc.
 - 3) Viking Corporation.
 - 4) **<Insert manufacturer's name>**.
 - 5) or approved equal.

- b. Standard: UL's "Fire Protection Equipment Directory" listing.
- c. Motor Horsepower: Fractional.
- d. Power: 120-V ac, 60 Hz, single phase.

E. Pressure-Reducing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Elkhart Brass Mfg. Company, Inc.
 - c. Fire-End & Croker Corporation.
 - d. Fire Protection Products, Inc.
 - e. GMR International Equipment Corporation.
 - f. Guardian Fire Equipment, Inc.
 - g. Potter Roemer.
 - h. Tyco Fire & Building Products LP.
 - i. Wilson & Cousins Inc.
 - j. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
 - k. **<Insert manufacturer's name>**.
 - l. or approved equal.
2. UL 668 hose valve, with integral UL 1468 reducing device.
3. Pressure Rating: **300 psig** (2070 kPa) minimum.
4. Material: Brass or bronze.
5. Inlet: Female pipe threads.
6. Outlet: Threaded with or without adapter having male hose threads.
7. Pattern: **[Angle] [or] [gate]**.
8. Finish: **[Polished chrome plated] [Rough brass or bronze] [Rough chrome plated]**.

F. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
2. Standard: UL 1726.
3. Pressure Rating: **175 psig** (1200 kPa) minimum.
4. Type: Automatic draining, ball check.
5. Size: **NPS 3/4** (DN 20).
6. End Connections: Threaded.

G. SWING CHECK VALVES

1. Per NFPA 13: UL listed and FM Global approved butterfly control valves for use with tamper switches, flanged or grooved connections. Carbon steel body, 150 lb full ANSI rated bidirectional, 316 SS electrodeposit nickel plated eccentric rotating disc, dynamic sealed, TFE seal ring, 17 4 PH stainless steel shaft, teflon chevron stem packing, 316 SS graphite impregnated bearings, and gear operator. Provide Supervisory switches.
2. Per NFPA 13 UL-Listed and FM Global approved grooved end control valves for use as zone control and/or sectional valves may be used with appropriate pressure ratings for intended service.
3. Supervisory switches are required on all control valves.

H. DOUBLE CHECK VALVE ASSEMBLY (BACK FLOW PREVENTER)

1. Provide UL/FM Global approved, double check valve assembly, in fire pump room or at service entry points, between flange spigot piece and fire pump suction.
2. At every backflow preventer there shall be displayed, on the assembly, a permanent placard with the greatest total flow anticipated by the hydraulic calculations and the corresponding net pressure lose utilized for the device in the hydraulic data. This information must be substantiated by means of a full flow discharge test during system acceptance to assure proper valve operation per NFPA. The placard shall be a standard red background, white letters, a minimum of $\frac{3}{4}$ " tall. A ball valve shall be provided on each end of the device and a common liquid filled gauge cross connected to achieve a net differential reading for comparison to the hydraulic calculations.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Febco Master Series 850
 - 2) Watts
 - 3) **<Insert manufacturer's name>**
 - 4) or approved equal.

2.9 HOSE CONNECTIONS

A. Adjustable-Valve Hose Connections:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Elkhart Brass Mfg. Company, Inc.
 - c. Fire-End & Croker Corporation.
 - d. Fire Protection Products, Inc.
 - e. GMR International Equipment Corporation.
 - f. Guardian Fire Equipment, Inc.
 - g. Potter Roemer.
 - h. Tyco Fire & Building Products LP.

- i. Wilson & Cousins Inc.
 - j. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
 - k. **<Insert manufacturer's name>**.
 - l. or approved equal.
2. Standard: UL 668 hose valve, with integral UL 1468 reducing or restricting pressure-control device, for connecting fire hose.
 3. Pressure Rating: **300 psig** (2070 kPa) minimum.
 4. Material: Brass or bronze.
 5. Size: **NPS 1-1/2 or NPS 2-1/2** (DN 40 or DN 65, as indicated) , as indicated.
 6. Inlet: Female pipe threads.
 7. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
 8. Pattern: **[Angle] [or] [gate]**.
 9. Pressure-Control Device Type: Pressure **[reducing] [restricting]**.
 10. Design Outlet Pressure Setting: **<Insert psig (kPa)>**.
 11. Finish: **[Polished chrome plated] [Rough brass or bronze] [Rough chrome plated]**.
 - a. Nonadjustable-Valve Hose Connections:
 12. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Potter Roemer 4065, w/5941 cap and chain, w/2810 reducer and cap and chain.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.
 13. Standard: UL 668 hose valve for connecting fire hose.
 14. Pressure Rating: **300 psig** (2070 kPa) minimum.
 15. Material: Brass
 16. Size: **NPS 2-1/2** (DN 65), as indicated.
 17. Reducer: NPS 2-1/2 x 1-1/2 (DN 65 x DN 40) chrome-plated reducer.
 18. Inlet: Female pipe threads.
 19. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching Denver Fire Department threads.
 20. Pattern: **[Angle]** .
 21. Finish: **[Rough brass or bronze] [Rough chrome plated]**.

2.10 MONITORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. AFAC Inc.
 2. Elkhart Brass Mfg. Company, Inc.
 3. Fire-End & Croker Corporation.
 4. Guardian Fire Equipment, Inc.

5. Potter Roemer.
 6. **<Insert manufacturer's name>**.
 7. or approved equal.
- B. Type: Stationary.
- C. Nozzle: UL 401, **NPS 2-1/2** (DN 65), brass, adjustable from fog spray to straight stream to shutoff.
- D. Horizontal Rotation: 360 degrees with locking device.
- E. Vertical Rotation: 80-degree elevation and 60-degree depression with locking device.
- F. Waterway: [**Double**] [**Single**] brass or stainless-steel tube.
- G. Waterway Size: [**NPS 2-1/2** (DN 65)] **<Insert value>** minimum.
- H. Water Stream Flow: [**500 gpm** (31.5 L/s)] [**750 gpm** (47.3 L/s)] [**1000 gpm** (63 L/s)] **<Insert value>**.
- I. Operation: [**Lever**] [**Wheel**].
- J. Base Inlet Size: [**NPS 2-1/2** (DN 65)] [**NPS 3** (DN 80)] [**NPS 4** (DN 100)].
- K. Finish: Red-painted body with brass trim.

2.11 FIRE-DEPARTMENT CONNECTIONS

- A. Flush-Type, Fire-Department Connection:
1. Fire Department Connection: Two-Way [2], flush-mounted wall type, Fire Department Connection, (threading as required by Denver Fire Department. Complete with 3/4 inch automatic ball drip.
 2. Provide additional 2.5 inch outlet for each 250 GPM design discharge over 500 GPM per NFPA 13.
 3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Potter Roemer 5020 Series.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.
 4. Standard: UL 405.
 5. Type: Flush, for wall mounting.
 6. Pressure Rating: **175 psig** (1200 kPa) minimum.
 7. Body Material: Corrosion-resistant metal.
 8. Inlets: Brass with threads according to NFPA 1963 and matching Denver Fire Department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.

9. Caps: Brass, lugged type, with gasket and chain.
10. Escutcheon Plate: Rectangular, brass, wall type.
11. Outlet: With pipe threads.
12. Body Style: **[Horizontal]** **[Square]** **[Vertical]**.
13. Number of Inlets: **[Two]** **[Three]** **[Four]** **[Six]**.
14. Outlet Location: **[Back]** **[Bottom]** **[Left side]** **[Right side]** **[Top]**.
15. Escutcheon Plate Marking: Similar to "AUTO SPKR & STP "
16. Finish: Polished chrome plated.
17. Outlet Size: **[NPS 4 (DN 100)]** **[NPS 5 (DN 125)]** **[NPS 6 (DN 150)]** **[NPS 8 (DN 200)]**.

B. Fire Department Outlet Connections:

1. Flush mounted wall type; chrome plated finish; 2 1/2 inch size, thread to match Denver Fire Department requirements, 300 psig working pressure, with threaded cap and chain of same material and finish.

C. Hose Outlet Valves:

1. Install 2-1/2 inch hose outlet valves with quick-disconnect 2-1/2 to 1-1/2 inch reducing coupling and flow restriction device at each standpipe outlet for hose connections. Valve shall be nonadjustable pressure regulating valve. Hose threads shall be compatible with local fire department specifications.
 - a. Subject to compliance with requirements, provide products by one of the following:
 - 1) Potter Roemer Model 4053
 - 2) or approved equal.

D. Yard-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Elkhart Brass Mfg. Company, Inc.
 - c. Fire-End & Croker Corporation.
 - d. Fire Protection Products, Inc.
 - e. GMR International Equipment Corporation.
 - f. Guardian Fire Equipment, Inc.
 - g. Wilson & Cousins Inc.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.
2. Standard: UL 405.
3. Type: Exposed, freestanding.
4. Pressure Rating: **[175 psig (1200 kPa) minimum]** **[300 psig (2070 kPa)]**.
5. Body Material: Corrosion-resistant metal.

6. Inlets: Brass with threads according to NFPA 1963 and matching Denver Fire Department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, floor type.
9. Outlet: Bottom, with pipe threads.
10. Number of Inlets: **[Two]** **[Three]** **[Four]**.
11. Sleeve: **[Brass]** **[Not required]**.
12. Sleeve Height: **18 inches** (460 mm).
13. Escutcheon Plate Marking: Similar to "**[AUTO SPKR & STP] [STANDPIPE]**."
14. Finish, **including Sleeve**: **[Polished chrome plated]** **[Rough brass or bronze]** **[Rough chrome plated]**.
15. Outlet Size: **[NPS 4 (DN 100)]** **[NPS 5 (DN 125)]** **[NPS 6 (DN 150)]**.

2.12 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Water-Motor-Operated Alarm:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Globe Fire Sprinkler Corporation.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
 - e. **<Insert manufacturer's name>**.
 - f. or approved equal.
 2. Standard: UL 753.
 3. Type: Mechanically operated, with Pelton wheel.
 4. Alarm Gong: Cast aluminum with red-enamel factory finish.
 5. Size: **10-inch** (250-mm) diameter.
 6. Components: Shaft length, bearings, and sleeve to suit wall construction.
 7. Inlet: **NPS 3/4** (DN 20).
 8. Outlet: **NPS 1** (DN 25) drain connection.
- C. Electrically Operated Alarm Bell:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Notifier; a Honeywell company.
 - c. Potter Electric Signal Company.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.

2. Standard: UL 464.
3. Type: Vibrating, metal alarm bell.
4. Size: [6-inch (150-mm) **minimum**] [8-inch (200-mm) **minimum**] [10-inch (250-mm)] diameter.
5. Finish: Red-enamel factory finish, suitable for outdoor use.

D. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ADT Security Services, Inc.
 - b. McDonnell & Miller; ITT Industries.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 - e. Viking Corporation.
 - f. Watts Industries (Canada) Inc.
 - g. <Insert manufacturer's name>
 - h. or approved equal.
2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig (1725 kPa).
7. Design Installation: Horizontal or vertical.
8. Retard feature must be of the instantly recycling type so that flows less than retard period will not produce a cumulative effect.
9. Flow switch shall not be installed in a fitting or within 12 inches of any fitting that changes the direction of water flow.
10. Design detector with a sensitivity setting to signal any flow of water that equals or exceeds the discharge from one sprinkler head.
11. Provide weatherproof and dust tight flow detector.
12. Provide a 3/4 inch conduit entrance per detector.

E. Pressure Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Barksdale, Inc.
 - c. Detroit Switch, Inc.
 - d. Potter Electric Signal Company.
 - e. System Sensor; a Honeywell company.
 - f. Tyco Fire & Building Products LP.
 - g. United Electric Controls Co.

- h. Viking Corporation.
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
 2. Standard: UL 346.
 3. Type: Electrically supervised water-flow switch with retard feature.
 4. Components: Single-pole, double-throw switch with normally closed contacts.
 5. Design Operation: Rising pressure signals water flow.
 6. Rated to 250 psig; designed for vertical installation; having two, spdt circuit switches to provide isolated alarm and auxiliary contacts, 7 ampere, 125 Vac and 0.25 ampere, 24 Vdc; complete with factory-set, field-adjustable tamperproof cover.
 7. Design detector with a sensitivity setting to signal any flow of water that equals or exceeds the discharge from one sprinkler head.
 8. Provide weatherproof and dust tight flow detector.
 9. Provide a 3/4 inch conduit entrance per detector.
- F. Valve Supervisory Switches:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 - e. **<Insert manufacturer's name>**.
 - f. or approved equal.
 2. Standard: UL 346.
 3. Type: Electrically supervised.
 4. Components: Single-pole, double-throw switch with normally closed contacts.
 5. Design: Signals that controlled valve is in other than fully open position.
- G. Indicator-Post Supervisory Switches:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Potter Electric Signal Company.
 - b. System Sensor; a Honeywell company.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.
 2. Standard: UL 346.
 3. Type: Electrically supervised.
 4. Components: Single-pole, double-throw switch with normally closed contacts.
 5. Design: Signals that controlled indicator-post valve is in other than fully open position.

2.13 MANUAL CONTROL STATIONS

- A. Description: UL listed or FM approved, hydraulic operation, with union, **NPS 1/2 (DN 15)** pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.14 CONTROL PANELS

- A. Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.

1. Panels: UL listed and FM approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
2. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.
3. Manual Control Stations: Hydraulic operation, with union, **NPS 1/2 (DN 15)** pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.15 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AMETEK; U.S. Gauge Division.
 2. Ashcroft Inc.
 3. Brecco Corporation.
 4. WIKA Instrument Corporation.
 5. **<Insert manufacturer's name>**.
 6. or approved equal.
- B. Standard: UL 393.
- C. Dial Size: **3-1/2- to 4-1/2-inch** (90- to 115-mm) diameter.
- D. Pressure Gage Range: **[0 to 250 psig (0 to 1725 kPa) minimum] [0 to 300 psig (0 to 2070 kPa)]**.
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

- F. Air System Piping Gage: Include[**retard feature and**] "AIR" or "AIR/WATER" label on dial face.

2.16 SIGNAGE AND LABELING

- A. Signage shall be per the requirements of NFPA 13, FM Global, and any applicable Insurance Underwriter.
 - 1. Signs shall be pre-manufactured metal, approximately 3" x 6", located at all valves, main drains, auxiliary drains, air, alarm, and similar devices.
 - 2. Every drain and control valve shall be permanently labeled with the DEN designated system I.D. number and a consecutive number indicating quantity of drains on the system, i.e. T-4-43 / 3 of 7 in the terminal or FZ – 03 / 2 of 2 .
 - 3. Hydraulic Plaques shall be provided at all risers with the appropriate information.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 14 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.
- C. Ream pipe and tube ends to full inside diameter.
- D. Remove burrs, and bevel plain end ferrous pipe.
- E. Remove scale and foreign material, inside and outside, before assembly.

3.2 SEQUENCE AND SCHEDULING

- A. Comply with DEN Maintenance and Engineering system interruption requirements and provide Denver Fire Department approved Fire Watch during entire time of system interruption.
- B. In no case shall the building structure remain without fire protection for more than four (4) hours.
- C. Schedule rough-in installations with installations of other building components.

3.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver and store valves, cabinets, extinguishers and other equipment in shipping containers, with labeling in place, under provisions of Division 01.

- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures. Maintain in place until installation.

3.4 EXAMINATION

- A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.
- B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.5 SERVICE-ENTRANCE PIPING

- A. Connect fire-suppression standpipe piping to water-service piping at service entrance into building. Comply with requirements for exterior piping in Section 211100 "Facility Fire-Suppression Water-Service Piping."
- B. Install shutoff valve,[**backflow preventer,**] pressure gage, drain, and other accessories at connection to fire-suppression water-service piping.[**Comply with requirements for backflow preventers in Section 211100 "Facility Fire-Suppression Water-Service Piping."**]
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.6 WATER-SUPPLY CONNECTIONS

- A. Connect fire-suppression standpipe piping to building's interior water-distribution piping. Comply with requirements for interior piping in Section 221116 "Domestic Water Piping."
- B. Install shutoff valve,[**backflow preventer,**] pressure gage, drain, and other accessories at connection to water-distribution piping.[**Comply with requirements for backflow preventers in Section 221119 "Domestic Water Piping Specialties."**]
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.7 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with DEN Project Manager before deviating from approved working plans.
- B. Piping Standard: Comply with requirements in NFPA 14 for installation of fire-suppression standpipe piping.
- C. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- D. Install piping to conserve building space, to not interfere with use of space and other work.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. In steel piping, main sized saddle branch connections or direct connection of branch lines to mains is permitted if main is one pipe size larger than the branch for up to 6 inch mains and if main is two pipe sizes larger than branch for 8 inch and larger mains. Do not project branch pipes inside the main pipe.
- G. Use approved fittings to make all changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- H. Install unions in pipes 2 inch and smaller, adjacent to each valve. Unions are not required on flanged devices or in piping installations using grooved mechanical couplings.
- I. Install flanges or flange adapters on valves, apparatus, and equipment having a 2-1/2 inch and larger connections.
- J. Install test connections sized and located in accordance with NFPA 13 complete with shutoff valve. Test connections may also serve as drainpipes. Victaulic "Test Master" or DEN Project Manager approved equal may be used in lieu of test and drainpipe and fittings. Test and drain discharge pipe shall have hose thread connection or discharge as indicated.
- K. Install pressure gauge on the riser or feed main at or near each test connection. Provide gauge with a connection not less than 1/4 inch and having a soft metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and where they will not be subject to freezing.
- L. Locate fire department connection 18 inches above grade, unless directed otherwise by Denver Fire Department.
- M. Provide a minimum of 100 psi at any hose station, provide pressure reducing valve to prevent pressure on hose exceeding Denver Fire Department maximum.
- N. Provide outlet branch piping on standpipes for sprinkler systems where indicated and/or required.

- O. Fire Proofing: Where hangers require removal of fire proofing, remove minimum amount of fire proofing for hanger attachment. Repair fire proofing per Section 078100 "Applied Fireproofing"..
- P. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.
- Q. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- R. Install drain valves on standpipes. Extend drain piping to outside of building.
- S. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or outside building.
- T. Install alarm devices in piping systems.
- U. Install hangers and supports for standpipe system piping according to NFPA 14. Comply with requirements in NFPA 13 for hanger materials.
- V. Hanger and support spacing and locations for piping joined with grooved mechanical couplings shall be in accordance with NFPA 13 and the grooved mechanical coupling manufacturer's written instructions, for rigid systems. Indicate all hangers on shop drawings.
 - 1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 2. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 - 3. Modifications or additions to system: Provide new independent supports from existing building structural components or walls suitable for the support of the added or modified sprinkler piping system.
 - 4. Install new piping, hangers, supports, etc. to avoid interference with existing building systems and operational characteristics of material handling systems.
 - 5. Supports not addressed by NFPA 13 or 14: Submit pipe support shop drawings bearing the wet stamp of a Licensed Colorado Professional Structural engineer for approval. All welding and drilling of existing structural components must be reviewed and approved by the DEN Project Manager prior to proceeding.
 - 6. Support all horizontal piping within 1'-0" of end.
- W. Install pressure gages on riser or feed main and at top of each standpipe. Include pressure gages with connection not less than **NPS 1/4 (DN 8)** and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- X. Drain dry-type standpipe system piping.
- Y. Pressurize and check dry-type standpipe system piping and **[air-pressure maintenance devices] [air compressors]**.

- Z. Fill wet-type standpipe system piping with water.
 - AA. Install electric heating cables and pipe insulation on wet-type, fire-suppression standpipe piping in areas subject to freezing. Comply with requirements for heating cables in Section 210533 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 210700 "Fire-Suppression Systems Insulation."
 - BB. Connect compressed-air supply to dry-pipe sprinkler piping.
 - CC. Connect air compressor to the following piping and wiring:
 - 1. Pressure gages and controls.
 - 2. Electrical power system.
 - 3. Fire-alarm devices, including low-pressure alarm.
 - DD. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
 - 1. Do not penetrate building structural members unless indicated. Penetration of structural members requires structural engineer review and approval.
 - 2. X-RAY: Provide X-ray of structural walls and floors prior to attempting drilling or saw cutting to guarantee structural or electrical members are not interrupted by process. Comply with DEN Standard X-ray procedures.
 - EE. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
 - FF. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."
 - GG. Prepare pipe, fittings, supports, and accessories for finish painting.
 - HH. All work in existing areas shall require daily cleaning, including cleaning and removal of any foreign materials. Final cleaning will require all dust to be recovered and removed.
- 3.8 JOINT CONSTRUCTION
- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
 - B. Install unions adjacent to each valve in pipes **NPS 2** (DN 50) and smaller.
 - C. Criteria:
 - 1. Up to and including 2 inch diameter: Screw joint and grooved joint steel piping.

2. 2 -1/2 inch diameter and larger: Welded joints (only shop welds), screw joints, or grooved joints.
- D. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- E. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- F. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- G. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
1. Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.
- H. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads.
 2. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 3. Below grade joints: Die cut screw joints with full cut standard taper pipe threads with red lead and linseed oil or other nontoxic joint compound applied to male threads only.
 4. Assemble joint to appropriate thread depth. When using a wrench on valves, place the wrench on the valve end into which the pipe is being threaded.
 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
1. Mechanical grooved joints may be used instead of threaded or welded joints at accessible aboveground locations. Cut grooves on pipe ends dimensionally compatible with the couplings.
- J. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- K. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

- L. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- M. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- N. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.9 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 14 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Install valves with stems upright or horizontal, not inverted.
- E. Provide gate valves for shut off or isolating service. Provide double check valve (Back flow preventer) assembly at sprinkler system water source connection.
- F. Gate Valves: Install supervised-open gate valves indicating type so located to control all sources of water supply, except fire department connections. Where there is more than one control valve, provide permanently marked identification signs indicating the portion of the system controlled by each valve. Refer to Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and signs.
- G. Where approved and/or indicated, butterfly valves may be used instead of gate valves.
- H. Provide drain valves at main shut off valves, low points of piping and apparatus.
- I. Valves: Bear UL, FM Global label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- J. Specialty Valves:
 - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 - 2. Alarm Valves: Install bypass check valve and retarding chamber drain-line connection.

3. **[Dry-Pipe] [and] [Deluge]** Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
 - a. Install air compressor and compressed-air supply piping.
 - b. Air-Pressure Maintenance Device: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with [14- to 60-psig (95- to 410-kPa)] **<Insert value>** adjustable range; and [175-psig (1200-kPa)] **<Insert value>** maximum inlet pressure.
 - c. Install compressed-air supply piping from building's compressed-air piping system.

3.10 HOSE-CONNECTION INSTALLATION

- A. Install hose connections adjacent to standpipes.
- B. Install freestanding hose connections for access and minimum passage restriction.
- C. Install **NPS 2-1/2** (DN 65) hose connections with quick-disconnect **NPS 2-1/2** by **NPS 1-1/2** (DN 65 by DN 40) reducer adapter and flow-restricting device.
- D. Install wall-mounted-type hose connections in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Comply with requirements for cabinets in Section 104413 "Fire Extinguisher Cabinets."

3.11 MONITOR INSTALLATION

- A. Install monitors on standpipe piping.

3.12 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire-department connections.
- B. Install yard-type, fire-department connections in concrete slab support. Comply with requirements for concrete in Section 033000 "Cast-in-Place Concrete."
 1. Install [**two**] [**three**] **<Insert number>** protective pipe bollards [**around**] [**on sides of**] each fire-department connection. Comply with requirements for bollards in Section 055000 "Metal Fabrications."
- C. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.13 CLEANING

- A. Clean all dirt and all debris from work area.
- B. Clean exterior of all installation to be painted. Reference Section "Identification for Plumbing Piping and Equipment".

3.14 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.15 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Start and run air compressors.
 - 6. Coordinate with fire-alarm tests. Operate as required.
 - 7. Coordinate with fire-pump tests. Operate as required.
 - 8. Verify that equipment hose threads are same as local fire-department equipment.
- C. Fire-suppression standpipe system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Water Damage: The Fire Protection Work Contractor shall be responsible for any damage to the work of others, to building and property/materials of others caused by leaks in automatic sprinkler equipment, unplugged or disconnected pipes or fittings, and shall pay for necessary replacement or repair of work or items so damaged during the installation and testing periods of the automatic sprinkler work.

3.16 CLEANING

- A. Flush entire system of foreign matter.

- B. Clean exterior surfaces to be painted.

3.17 DEMONSTRATION

- A. Engage a factory-authorized service representative to assist Contractor and train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.
- B. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

3.18 WARRANTY

- A. All work and equipment shall be warranted to be free from defects in workmanship and material for a period of twelve (12) months from the date of Substantial Completion. Any material or equipment found to be defective during this period shall be repaired or replaced without expense to the Owner.

3.19 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with **[threaded ends; cast-iron threaded fittings; and threaded] [grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved]** joints.
- B. Standard-pressure, wet-type, fire-suppression standpipe piping, **[NPS 2]** (DN 50) **and smaller]** **<Insert pipe size range>**, shall be **[one of]** the following:
 - 1. **[Schedule 40]**, ASTM A53 Type "F" continuous welded black-steel pipe with threaded and coupled ends; with protective coating , gray-iron threaded fittings; and threaded joints. Only pipe identified and conforming to schedule 40 wall thickness shall be used. In example, "Dyna Flow", "Eddy Pipe", "Super Flow" and / or similar products which are not true Schedule 40 thickness will not be allowed. Do not weld pipe or attach welded flanges or fittings.
- C. Standard-pressure, wet-type, fire-suppression standpipe piping, **[NPS 2.5 and larger]** (DN 50 and larger) **<Insert pipe size range>**, shall be **[one of]** the following:
 - 1. **Schedule 40** ,ASTM A53 Type "E" ERW black-steel pipe with threaded ends; with protective coating , gray-iron threaded fittings; butt weld ends. .
 - a. Joints: Shall be cut grooved for ASTM A106, Gr. B couplings.
 - 2. Optional Standpipe Piping (if approved by DEN Project Manager): ASTM A135 Gr. B ERW thinwall pipe or acceptable alternates per NFPA 13. Maximum pressure shall be 300 psig conforming to NFPA 13, Chapter 3. Reference Section 211316 "Dry-Pipe Sprinkler Systems" for additional instructions for dry pipe system piping.

- a. Sizes 2-1/2" through 5": Schedule 10 or an NFPA approved alternate.
- b. 6" size: 0.134" wall thickness or an NFPA approved alternate.
- c. 8" and 10" size: 0.188" wall thickness or an NFPA approved alternate.
- d. Joints: ASTM A536, dimensionally compatible with mechanical couplings.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 211200

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connections.
4. Sprinklers.
5. Alarm devices.
6. Manual control stations.
7. Control panels.
8. Pressure gages.

B. Related Sections:

1. Section 210500 "Common Work Results for Fire Suppression".
2. Section 210517 "Sleeves and Sleeve Seals for Fire Suppression Piping".
3. Section 210518 "Escutcheons for Fire Suppression Piping".
4. Section 210529 "Hangers & Supports for Fire Suppression Piping and Equipment".
5. Section 210533 "Heat Tracing for Fire Suppression Piping".
6. Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment".
7. Section 210553 "Identification for Fire Suppression Piping and Equipment".
8. Section 210700 "Fire Suppression Systems Insulation".
9. Section 211100 "Facility Fire-Suppression Water-Service Piping".
10. Section 211200 "Fire-Suppression Standpipes" for standpipe piping.
11. Section 211316 "Dry-Pipe Sprinkler Systems" for dry-pipe sprinkler piping.
12. Section 211339 "Foam-Water Systems" for AFFF piping.
13. Section 212200 "Clean Agent Fire Extinguishing Systems".
14. Section 213113 "Electric-Drive, Centrifugal Fire Pumps" for fire pumps, pressure-maintenance pumps, and fire-pump controllers.
15. Section 283100 "Intelligent Life Safety Fire Management System" for alarm devices not specified in this Section.

C. Work furnished under other Sections:

1. Furnish pipe sleeves, complete with drawing(s) locating all sleeves and indicating sleeve size to Divisions 03, 04 or 09 contractors for placement.
 2. Fireproofing repair.
 3. Fire sealants.
 4. Painting.
- D. Include all design, fabrication, and installation of all wet-pipe fire protection systems in association with fire pump installation, dry-pipe sprinkler installation, and all fire and smoke alarm interface in accordance with design criteria and fire/smoke zoning requirements indicated on drawings. The Fire Protection Work Contractor (FPWC) shall provide all special tools required for installation or maintenance for the equipment provided. If conflicts occur in this specification or between this specification and the contract documents, the most stringent requirement shall apply.
- E. Work on all systems require DEN Shut Down Requests be completed and filed five (5) days before work is to be done. Work on wet systems must be done during off hour periods, 10:00 p.m. to 6:00 a.m. Sunday night through Friday morning. No system may be shut down for periods longer than ten (10) hours. The Fire Sprinkler Contractor is responsible for the required fire watch and must remain ON SITE for the entire period of time that the system is not in service. Failure to comply may be reason for immediate suspension of work privileges.
- F. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 REFERENCE STANDARDS

- A. Materials and workmanship shall conform to the latest issue of all industry standards, publications, or regulations referenced in this section and with the following references as applicable. Appendices and/or Annexes referenced by these standards shall apply.
- B. International Building Code (IBC) with the Denver Amendments.
- C. International Fire Code (IFC) with the Denver Amendments.
- D. National Fire Protection Association (NFPA):
 1. NFPA 13 - Installation of Sprinkler Systems.
 2. The most stringent interpretations shall apply. All appendices and/or Annexes shall apply.

1.4 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of **175 psig** (1200 kPa) maximum.
- B. High-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard **175 psig** (1200 kPa), but not higher than **[250 psig** (1725 kPa)] **[300 psig** (2070 kPa)].

- C. Pipe sizes used in this specification are Nominal Pipe Size (NPS).
- D. Working plans as used in this Section refer to documents, including drawings and calculations, prepared pursuant to requirements in NFPA 13 and City and County of Denver Code agencies for obtaining approval of authority having jurisdiction.
- E. Other definitions for fire protection systems are included in referenced NFPA standards.

1.5 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.
- B. Deluge Sprinkler System: Open sprinklers are attached to piping connected to water supply through deluge valve. Fire-detection system, in same area as sprinklers, opens valve. Water flows into piping system and discharges from attached sprinklers when valve opens.
- C. Interface system with building fire alarm system.
- D. All conveyor and baggage handling openings and escalator openings shall be protected with a closed head water curtain.
- E. Closed head water curtains shall be designed with heads 6 feet o.c. and discharge shall be calculated in accordance with NFPA 13 for water curtains.
- F. Design Criteria:
 - 1. Occupancy hazard class: [**ordinary hazard**] [], Group [**2**] [].
 - 2. Density: [**.20**] [] GPM/SF flowing over [**1,500**] [] of the remote area.
 - 3. Hose stream allowance: Include [**250**] [] GPM for hose stream at the riser.
 - 4. Provide a 10% safety margin in hydraulic calculations.
 - 5. Velocities in pipes shall be shown on hydraulic calculations. Velocities in overhead piping shall not exceed 20 feet per second. Velocities in underground piping shall not exceed 16 feet per second.
 - 6. Hydraulic calculation submittal shall clearly define all devices that will cause friction loss with equivalent lengths of pipe. This includes vane type electric water flow switches. Assume 10 feet of equivalent length of pipe unless actual pressure drop data is available from the manufacturer.
 - 7. Design information shall be permanently affixed to the risers as described in NFPA 13.
 - 8. Sprinkler shop drawings and hydraulic calculations shall be prepared in accordance with NFPA 13 and FM Global.
 - 9. Like or similar small volume drains shall be increased to 1" minimum size and shall be tied together.
 - 10. Current Denver Water Department test reports (less than 6 months old) for the

underground supply shall be provided for all new calculations. Where accepted by all authorities having jurisdiction, the most current DEN Fire Pump Test may be used.

11. Provide fire proofing repair damaged by this work.
12. Provide all required fire sealants and smoke stopping required by this work

1.6 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for **175-psig** (1200-kPa) minimum working pressure.
- B. High-Pressure Piping System Component: Listed for **[250-psig** (1725-kPa) **minimum]** **[300-psig** (2070-kPa)] working pressure.
- C. Design and obtain approval from authority having jurisdiction for fire protection systems specified.
- D. Minimum Pipe Sizes: Not smaller than existing pipe sizes of sprinklers being relocated.
- E. Should the relocation of sprinkler heads cause the calculated remote zone to change, hydraulic calculations shall be performed and approved by the authority having jurisdiction.
- F. Sprinkler system zone shall not serve multiple smoke control zones. Verify that the no conflict exists between the design drawings and this requirement.
- G. System modifications, remodeling:
 1. Minimum Pipe Sizes: Not smaller than existing pipe sizes of sprinklers being relocated.
 2. Should the relocation of sprinkler heads cause the calculated remote zone to change, hydraulic calculations shall be performed and approved by the Authority Having Jurisdiction (AHJ). Verify with AHJ all requirements for new calculations.
- H. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 1. Available fire-hydrant flow test records indicate the following conditions:
 - a. Date: **<Insert test date>**.
 - b. Time: **<Insert time>** [a.m.] [p.m.]
 - c. Performed by: **<Insert operator's name>** of **<Insert firm>**.
 - d. Location of Residual Fire Hydrant R: **<Insert location>**.
 - e. Location of Flow Fire Hydrant F: **<Insert location>**.
 - f. Static Pressure at Residual Fire Hydrant R: **<Insert psig** (kPa)>.
 - g. Measured Flow at Flow Fire Hydrant F: **<Insert gpm** (L/s)>.
 - h. Residual Pressure at Residual Fire Hydrant R: **<Insert psig** (kPa)>.
- I. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: **[10] [20] <Insert number>** percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications:
 - a. Automobile Parking Areas: **[Ordinary Hazard, Group 1] <Insert classification>**.
 - b. Building Service Areas: **[Ordinary Hazard, Group 1] <Insert classification>**.
 - c. Electrical Equipment Rooms: **[Ordinary Hazard, Group 1] <Insert classification>**.
 - d. General Storage Areas: **[Ordinary Hazard, Group 1] <Insert classification>**.
 - e. Laundries: **[Ordinary Hazard, Group 1] <Insert classification>**.
 - f. Machine Shops: **[Ordinary Hazard, Group 2] <Insert classification>**.
 - g. Mechanical Equipment Rooms: **[Ordinary Hazard, Group 1] <Insert classification>**.
 - h. Office and Public Areas: **[Light Hazard] <Insert classification>**.
 - i. Repair Garages: **[Ordinary Hazard, Group 2] <Insert classification>**.
 - j. Restaurant Service Areas: **[Ordinary Hazard, Group 1] <Insert classification>**.
 - k. Solvent Cleaning Areas: **[Extra Hazard, Group 2] <Insert classification>**.
 - l. **<Insert classification>**.
3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: **[0.10 gpm over 1500-sq. ft. (4.1 mm/min. over 139-sq. m)] <Insert value>** area.
 - b. Ordinary-Hazard, Group 1 Occupancy: **[0.15 gpm over 1500-sq. ft. (6.1 mm/min. over 139-sq. m)] <Insert value>** area.
 - c. Ordinary-Hazard, Group 2 Occupancy: **[0.20 gpm over 1500-sq. ft. (8.1 mm/min. over 139-sq. m)] <Insert value>** area.
 - d. Extra-Hazard, Group 1 Occupancy: **[0.30 gpm over 2500-sq. ft. (12.2 mm/min. over 232-sq. m)] <Insert value>** area.
 - e. Extra-Hazard, Group 2 Occupancy: **[0.40 gpm over 2500-sq. ft. (16.3 mm/min. over 232-sq. m)] <Insert value>** area.
 - f. Special Occupancy Hazard: As determined by authorities having jurisdiction.
4. Minimum Density for Deluge-Sprinkler Piping Design:
 - a. Ordinary-Hazard, Group 1 Occupancy: **[0.15 gpm (6.1 mm/min.) <Insert value>** over entire area.
 - b. Ordinary-Hazard, Group 2 Occupancy: **[0.20 gpm (8.1 mm/min.) <Insert value>** over entire area.
 - c. Extra-Hazard, Group 1 Occupancy: **[0.30 gpm (12.2 mm/min.) <Insert value>** over entire area.
 - d. Extra-Hazard, Group 2 Occupancy: **[0.40 gpm (16.3 mm/min.) <Insert value>** over entire area.

- e. Special Occupancy Hazard: As determined by authorities having jurisdiction.
- 5. Maximum Protection Area per Sprinkler: Per UL listing.
- 6. Maximum Protection Area per Sprinkler:
 - a. Residential Areas: [400 sq. ft. (37 sq. m)] **<Insert dimension>**.
 - b. Office Spaces: [120 sq. ft. (11.1 sq. m)] [225 sq. ft. (20.9 sq. m)] **<Insert dimension>**.
 - c. Storage Areas: [130 sq. ft. (12.1 sq. m)] **<Insert dimension>**.
 - d. Mechanical Equipment Rooms: [130 sq. ft. (12.1 sq. m)] **<Insert dimension>**.
 - e. Electrical Equipment Rooms: [130 sq. ft. (12.1 sq. m)] **<Insert dimension>**.
 - f. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
- 7. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
 - a. Light-Hazard Occupancies: [100 gpm (6.3 L/s) for 30 minutes] **<Insert requirement>**.
 - b. Ordinary-Hazard Occupancies: [250 gpm (15.75 L/s) for 60 to 90 minutes] **<Insert requirement>**.
 - c. Extra-Hazard Occupancies: [500 gpm (31.5 L/s) for 90 to 120 minutes] **<Insert requirement>**.
 - d. **<Insert requirements>**.
- J. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and [ASCE/SEI 7] **<Insert requirement>**.

1.7 REGULATORY REQUIREMENTS

- A. Comply with NFPA 13 - Standard for the Installation of Sprinkler Systems, latest edition.
- B. Comply with NFPA 72 - Installation, Maintenance, and Use of Protective Signaling Systems.
- C. Comply with City and County of Denver Code Agency requirements.
- D. UL and FM Global Compliance: Fire protection system materials and components shall be UL listed and labeled, and FM Global approved.
- E. Hydraulic Calculations, Product Data, Shop Drawings, Dry Pipe System Equipment, and Low Air Switch, Air Maintenance Device: Bear stamp of approval of Designer of Record, DEN Life Safety Team and Owner's Representative and Denver Fire Department.
- F. All applicable insurance authorities underwriting requirements.

1.8 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. [**Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.**]
1. Include data substantiating that materials comply with requirements.
- B. LEED Submittal:
1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content and chemical components.
- C. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
1. Wiring Diagrams: For power, signal, and control wiring.
- D. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Submit working plans and product data under provisions of Division 01. Submittal shall include drawings, hydraulic calculations, hydraulic reference points, detailed pipe layout, hangers and supports, components and accessories and other items as defined by NFPA 13. Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
- F. Working Plans drawings shall be submitted in Revit format in hard copy and on Compact Disk. (2) sets of full size drawings (34x44) and (1) Compact Disk containing all drawing files shall be submitted to the DEN Life Safety Team as part of each submittal.
- G. Working Plan drawings for remodel areas shall include as built depiction of all sprinkler work within at least a 50 foot radius of the work proposed. Risers and main supply pipes shall also be indicated by size and location.
- H. Final Submittal: Working plans submitted for approval shall have the signed wet stamp of a registered Fire Protection Engineer licensed in the State of Colorado (or N.I.C.E.T. 4), certifying that the fire sprinkler system has been designed and hydraulically calculated in compliance with NFPA and governing authorities requirements.
- I. Obtain DEN Life Safety Team review and stamp prior to submittal for permit.
- J. Submit working plans and product data to Denver Fire Department for approval. Subject to approval, submit copy of approved submittal and permit to the DEN Project Manager.
- K. Submit additional non-returnable copies of current permits and agency approved working plan drawings with System Interruption Request.

- L. Contractor shall submit fully dimensioned spool drawings for all welded piping work. Drawings shall indicate all weld types, sizes, and materials to be used. The spool drawing size shall match the full size contract documents of either 24x36 or 34x44. Spool drawings shall be submitted in either the latest version of Revit or the latest version of Adobe Acrobat (pdf). Adobe Acrobat files shall not contain security. Other file formats will not be accepted.
- M. Supports not addressed by NFPA 13 or 14: Submit pipe support shop drawings bearing the wet stamp of a Licensed Colorado Professional Structural Engineer for approval. All welding and drilling of existing structural components must be reviewed and approved by the DEN Project Manager prior to proceeding.

1.9 INFORMATIONAL SUBMITTALS

- A. Subject to approval, submit copy of permit and submittal approved by Denver Fire Department to the DEN Project Manager.
- B. Current Welders' qualification certificates and procedures. Reference Section 059990 "Welding".
- C. Test reports and certificates including "Contractor's Material and Test Certificate for Aboveground Piping" as described in NFPA 13.
- D. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Domestic water piping.
 - 2. Compressed air piping.
 - 3. HVAC hydronic piping.
 - 4. Items penetrating finished ceiling include the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. **<Insert item>**.
 - 5. **<Insert item>**.
- E. Qualification Data: For qualified Installer[**and professional engineer**].
- F. Installer's Qualifications: Firms qualified to install and alter fire protection piping, equipment, specialties, and accessories, and repair and service equipment. A qualified firm is one that is experienced in such work, with minimum of five (5) previous projects similar in size and scope to this Project, is familiar with precautions required, and in compliance with the requirements of the authority having jurisdiction. The firm shall be in possession of City and County of Denver Fire Protection License Class A or B. Refer to Division 01 Section Reference Standards and Definitions for definition of Installer.
 - 1. The qualified installer shall be licensed for the design and installation for the

- specific type of system in the City and County of Denver and the State of Colorado and have been in business under the current name for five (5) years.
2. All field personnel must be a current holder of the City & County of Denver Fire Department Fire Protection Installers license.
- G. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five (5) years' documented experience.
- H. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- I. Welding certificates.
- J. Copy of City and County of Denver Fire Protection Contractors License, and Fire protection Supervisor's certificate for class of equipment being installed.
- K. Fire-hydrant flow test report.
- L. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- M. Field quality-control reports.
- 1.10 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.
 1. Maintenance data for each type sprinkler head, valve, piping specialty, fire protection specialty, fire department valve, and hose cabinet specified, for inclusion in operating and maintenance manual specified in Division 01.
 - a. Include written maintenance data on components of system, servicing requirements, and Record Drawings.
 - b. Include pump operation, maintenance, and inspection data, replacement part numbers and availability, and location and telephone numbers and website of service depot.
 - B. Test reports and certificates including "Contractor's Material and Test Certificate for Aboveground Piping" as described in NFPA 13.
 - C. All sprinkler system record drawings shall be submitted in the form of hard copies and electronic format in compliance with DEN requirements.

1.11 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.
- C. The following must be delivered and accepted prior to any testing:
 - 1. Provide a spare parts list. The list is to be provided with material submittal cut sheets.
 - 2. Provide extra sprinkler heads: Furnish each style with its own sprinkler head cabinet under provisions of NFPA 13 and Division 01.
 - 3. Provide suitable wrenches for each head type.
 - 4. Provide metal storage cabinet in location designated.
 - 5. Provide one set of renewable parts and seals for each dry valve installed.
 - 6. Provide DEN representatives all special tools required for installation and maintenance.

1.12 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Firms qualified to install and alter fire protection piping, equipment, specialties, and accessories, and repair and service equipment. A qualified firm is one that is experienced in such work, with minimum of 5 previous projects similar in size and scope to this Project, familiar with precautions required, and in compliance with the requirements of the authority having jurisdiction. The firm shall be in possession of City and County of Denver Fire Protection License Class A or B. Refer to Division 01 Section Reference Standards and Definitions for definition of Installer.
 - 2. The qualified installer shall be licensed for the design and installation for the specific type of system in the City and County of Denver and the State of Colorado and have been in business under the current name for five (5) years.
 - 3. All field personnel must be a current holder of the City & County of Denver Fire Department Fire Protection Installers license.
 - 4. Submit evidence of such qualifications to the DEN Project Manager.
 - 5. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13, "Installation of Sprinkler Systems."
 - 2.
 - 3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."
- E. Design and installation to conform to Denver Fire Department requirements.
- F. Equipment and Components: Bear UL, FM GLOBAL label or marking.
- G. Qualifications for Welding Processes and Operators: Comply with the requirements of AWS B2.1, Specifications for Procedure and Performance Qualifications.
- H. Sprinkler design drawings and hydraulic calculations submitted for approval shall have the signed wet stamp of a Colorado registered Fire Protection Engineer practicing in the fire protection field in the state of the project or a N.I.C.E.T. Level 4, certifying that the fire sprinkler system has been designed and hydraulically calculated in compliance with NFPA and governing authorities requirements.
- I. Obtain DEN Life Safety Team review and stamp prior to submittal for permit.
- J. Fire Proofing: Where hangers require removal of fire proofing, remove minimum amount of fire proofing for hanger attachment. Repair fireproofing per requirements specified in Section 078100 "Applied Fireproofing".
- K. Comply with all requirements of Owner's Insurance Underwriter.

1.13 PROJECT CONDITIONS, SEQUENCE AND SCHEDULING

- A. Comply with DEN Maintenance and Engineering system interruption requirements and provide Denver Fire Department approved Fire Watch during entire time of system interruption.
- B. In no case shall the building structure remain without fire protection for more than ten (10) hours.
- C. Prior to system shut down, Contractor shall certify all equipment and materials are on site for removing, capping, valving, tagging, and reconnection of system.
- D. Schedule rough-in installations with installations of other building components.
- E. Conform to NFPA 13 for sprinkler systems.

1.14 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.15 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store pumps in shipping containers with labeling in place under provisions of Division 01.
- B. Provide temporary inlet and outlet caps to be used throughout system construction until systems are in service.
- C. Maintain caps in place until installation.

1.16 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.
- B. Equipment and components: Bear UL or FM Global label or marking where required.

2.2 STEEL PIPE AND FITTINGS

- A. Threadable lightwall, black and galvanized, for threaded joints is not allowed.
- B. Black steel pipe, ASTM A-53, A-135, Schedule 40. Only pipe identified and conforming to schedule 40 wall thickness shall be used.
 - 1. "Dyna Flow", "Eddy Pipe", "Super Flow" and/or similar products which are not true schedule 40 thickness will NOT be allowed.
- C. Thin Wall pipe:
 - 1. Thin wall pipes shall have grooved fittings only. Threaded thin wall piping shall not be used. Welded outlets are allowed as long as all welding qualifications are met.

- D. Cast Iron Threaded Fittings: ANSI B16.4, Class 125 or 250 as required, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.
- E. Malleable Iron Threaded Fittings: ANSI B16.3, Class 150 or 300 as required, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.
- F. Deluge and exterior dry systems connections must have galvanized fittings
- G. Steel Fittings: ASTM A 234, seamless or welded, for welded joints.
- H. Wrought Copper Fittings: ANSI B16.22, streamlined pattern.
- I. Cast Iron Threaded Flanges: ANSI B16.1, Class 125 or 250 as required. Raised face flanges shall be mated with raised face, and flat face flanges shall be mated with flat face only.
- J. Use of Hooker style fittings and/or any similar rubber gasketed, drill to mount, 2" and smaller clamp on tees will NOT be permitted.
- K. Use of threaded thin wall pipe. Pressfit fittings or similar non-threaded connections of any kind will NOT be permitted.
- L. "EZ-T's" are NOT permitted.
- M. Unions: 150 to 300 psi as required malleable iron for threaded ferrous piping.
- N. Welding Materials: Field welding shall not be permitted; perform only shop welding. Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded. Welded outlets are permitted as long as the welding is done in compliance with NFPA welding requirements and welding requirements of these specifications.
- O. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- P. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Corcoran Piping System Co.
 - c. National Fittings, Inc.
 - d. Shurjoint Piping Products.
 - e. Tyco Fire & Building Products LP.
 - f. Victaulic Company.
 - g. <Insert manufacturer's name>.
 - h. or approved equal.
 - 2. Pressure Rating: [175 psig (1200 kPa)] [250 psig (1725 kPa)] [300 psig (2070 kPa)] minimum.

3. **[Galvanized] [and] [Uncoated]**, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
 - a. Malleable iron housing clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion: "C" shaped composition sealing gasket, steel bolts, nuts, and washers.
- Q. Steel Pressure-Seal Fittings: UL 213, FM-approved, **175-psig** (1200-kPa) pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: **[AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick] [or] [ASME B16.21, nonmetallic and asbestos free]**.
1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
 2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- D. Welding Materials: Field welding shall not be permitted. Perform only shop welding. Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded. Welded outlets are permitted as long as the welding is done in compliance with NFPA welding requirements and Section 059990 "Welding".
- E. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- F. Brazing: ANSI/AWS A5.8.

- G. Gasket Materials: Thickness, material, and type suitable for fluid or gas to be handled, and design temperatures and pressures.
- H. Threaded Joint Compound or “Teflon” tape.

2.4 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

- 1. Valves shall be UL listed or FM approved.
- 2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig (1200 kPa).
- 3. Minimum Pressure Rating for High-Pressure Piping: [250 psig (1725 kPa)] [300 psig (2070 kPa)].

B. Ball Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Victaulic Company.
 - c. <Insert manufacturer's name>.
 - d. or approved equal.
- 2. Standard: UL 1091 except with ball instead of disc.
- 3. Valves NPS 1-1/2 (DN 40) and Smaller: Bronze body with threaded ends.
- 4. Valves NPS 2 and NPS 2-1/2 (DN 50 and DN 65): Bronze body with threaded ends or ductile-iron body with grooved ends.
- 5. Valves NPS 3 (DN 80): Ductile-iron body with grooved ends.

C. Butterfly and grooved end control valves

- 1. Per NFPA 13: UL listed and FM Global approved butterfly control valves for use with tamper switches, flanged or grooved connections. Carbon steel body, 150 lb full ANSI rated bi directional, 316 SS electro-deposit nickel plated eccentric rotating disc, dynamic sealed, TFE seal ring, 17 4 PH stainless steel shaft, teflon chevron stem packing, 316 SS graphite impregnated bearings, and gear operator. Provide Supervisory switches.
- 2. Per NFPA-13 UL-Listed and FM Global approved grooved end control valves for use as zone control and/or sectional valves may be used with appropriate pressure ratings for intended service.
- 3. Supervisory switches are required on all control valves.

D. Check Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.

- c. Anvil International, Inc.
 - d. Clow Valve Company; a division of McWane, Inc.
 - e. Crane Co.; Crane Valve Group; Crane Valves.
 - f. Crane Co.; Crane Valve Group; Jenkins Valves.
 - g. Crane Co.; Crane Valve Group; Stockham Division.
 - h. Fire-End & Croker Corporation.
 - i. Fire Protection Products, Inc.
 - j. Fivalco Inc.
 - k. Globe Fire Sprinkler Corporation.
 - l. Groeniger & Company.
 - m. Kennedy Valve; a division of McWane, Inc.
 - n. Matco-Norca.
 - o. Metraflex, Inc.
 - p. Milwaukee Valve Company.
 - q. Mueller Co.; Water Products Division.
 - r. NIBCO INC.
 - s. Potter Roemer.
 - t. Reliable Automatic Sprinkler Co., Inc.
 - u. Shurjoint Piping Products.
 - v. Tyco Fire & Building Products LP.
 - w. United Brass Works, Inc.
 - x. Venus Fire Protection Ltd.
 - y. Victaulic Company.
 - z. Viking Corporation.
 - aa. Watts Water Technologies, Inc.
 - bb. **<Insert manufacturer's name>**.
 - cc. or approved equal.
2. Standard: UL 312.
 3. Pressure Rating: [250 psig (1725 kPa) **minimum**] [300 psig (2070 kPa)].
 4. Type: Swing check.
 5. Body Material: Cast iron, bronze trim, swing disc, renewable disc, and seat.
 - a. Iron body, bronze trim spring loaded, renewable composition disc, where indicated on drawings.
 6. End Connections: Flanged or grooved.
- E. Bronze OS&Y Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. United Brass Works, Inc.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.

2. Standard: UL 262.
3. Pressure Rating: 175 psig (1200 kPa).
4. Body Material: Bronze.
5. End Connections: Threaded.

F. Iron OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Crane Valves.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. Hammond Valve.
 - h. Milwaukee Valve Company.
 - i. Mueller Co.; Water Products Division.
 - j. NIBCO INC.
 - k. Shurjoint Piping Products.
 - l. Tyco Fire & Building Products LP.
 - m. United Brass Works, Inc.
 - n. Watts Water Technologies, Inc.
 - o. <Insert manufacturer's name>.
 - p. or approved equal.
2. Standard: UL 262.
3. Pressure Rating: [250 psig (1725 kPa) minimum] [300 psig (2070 kPa)].
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

G. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Fivalco Inc.
 - c. Global Safety Products, Inc.
 - d. Kennedy Valve; a division of McWane, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Shurjoint Piping Products.
 - h. Tyco Fire & Building Products LP.
 - i. Victaulic Company.
 - j. <Insert manufacturer's name>.
 - k. or approved equal.
2. Standard: UL 1091.

3. Pressure Rating: **175 psig** (1200 kPa) minimum.
4. Valves **NPS 2** (DN 50) and Smaller:
 - a. Valve Type: Ball or butterfly.
 - b. Body Material: Bronze.
 - c. End Connections: Threaded.
5. Valves **NPS 2-1/2** (DN 65) and Larger:
 - a. Valve Type: Butterfly.
 - b. Body Material: Cast or ductile iron.
 - c. End Connections: Flanged, grooved, or wafer.
6. Valve Operation: Integral [**electrical, 115-V ac, prewired, single-circuit, supervisory switch**] [**electrical, 115-V ac, prewired, two-circuit, supervisory switch**] [**visual**] indicating device.

H. Gate Valves:

1. Gate Valves, 2- Inch and Smaller: Body and bonnet of cast bronze, 175 pound cold water working pressure, nonshock, threaded ends, solid wedge, outside screw and yoke, rising stem, screw-in bonnet, and malleable iron handwheel. Valves shall be capable of being repacked under pressure, with valve wide open. Provide Supervisory switches.
2. Gate Valves, 2-1/2 inch and larger: Iron body, bronze mounted, 175 pound cold water working pressure, nonshock. Valves shall have solid taper wedge, outside screw and yoke, rising stem, flanged bonnet, with body and bonnet conforming to ASTM A 126, Class B; replaceable bronze wedge facing rings, flanged ends, and a packing assembly consisting of a cast iron gland flange, brass gland, packing, bonnet, and bronze bonnet bushing. Valves shall be capable of being repacked under pressure, with valve wide open. Provide Supervisory switches.
3. Iron body, bronze trim, rising stem, OS&Y, solid wedge.
4. Supervisory switches are required.
5. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Kennedy Valve; a division of McWane, Inc.
 - f. Mueller Co.; Water Products Division.
 - g. NIBCO INC.
 - h. Tyco Fire & Building Products LP.
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.

I. NRS Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Kennedy Valve; a division of McWane, Inc.
 - f. Mueller Co.; Water Products Division.
 - g. NIBCO INC.
 - h. Tyco Fire & Building Products LP.
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
2. Standard: UL 262.
3. Pressure Rating: [250 psig (1725 kPa) **minimum**] [300 psig (2070 kPa)].
4. Body Material: Cast iron with indicator post flange.
5. Stem: Nonrising.
6. End Connections: Flanged or grooved.

J. Indicator Posts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Kennedy Valve; a division of McWane, Inc.
 - f. Mueller Co.; Water Products Division.
 - g. NIBCO INC.
 - h. Tyco Fire & Building Products LP.
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
2. Standard: UL 789.
3. Type: Horizontal for wall mounting.
4. Body Material: Cast iron with extension rod and locking device.
5. Operation: [**Wrench**] [**Hand wheel**].

2.5 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig (1200 kPa) minimum.

B. Angle Valves:

1. Brass body with renewable composition disc.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire Protection Products, Inc.
 - b. United Brass Works, Inc.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.

C. Ball Valves:

1. Valves up to 2 Inches: Bronze, two piece body, stainless steel ball, teflon seats and stuffing box ring, lever handle, threaded ends.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Affiliated Distributors.
 - b. Anvil International, Inc.
 - c. Barnett.
 - d. Conbraco Industries, Inc.; Apollo Valves.
 - e. Fire-End & Croker Corporation.
 - f. Fire Protection Products, Inc.
 - g. Flowserve.
 - h. FNW.
 - i. Jomar International, Ltd.
 - j. Kennedy Valve; a division of McWane, Inc.
 - k. Kitz Corporation.
 - l. Legend Valve.
 - m. Metso Automation USA Inc.
 - n. Milwaukee Valve Company.
 - o. NIBCO INC.
 - p. Potter Roemer.
 - q. Red-White Valve Corporation.
 - r. Southern Manufacturing Group.
 - s. Stewart, M. A. and Sons Ltd.
 - t. Tyco Fire & Building Products LP.
 - u. Victaulic Company.
 - v. Watts Water Technologies, Inc.
 - w. **<Insert manufacturer's name>**.
 - x. or approved equal.

D. Globe Valves:

1. Brass body with renewable composition disc.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire Protection Products, Inc.
 - b. United Brass Works, Inc.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.

E. Plug Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Southern Manufacturing Group.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.

2.6 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
 - a. Standard-Pressure Piping Specialty Valves: **175 psig** (1200 kPa) minimum.
 - b. High-Pressure Piping Specialty Valves: **[250 psig (1725 kPa) minimum]** **[300 psig (2070 kPa)]**.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Globe Fire Sprinkler Corporation.
 - c. Reliable Automatic Sprinkler Co., Inc.
 - d. Tyco Fire & Building Products LP.
 - e. Venus Fire Protection Ltd.
 - f. Victaulic Company.
 - g. Viking Corporation.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.
2. Standard: UL 193.
3. Design: For horizontal or vertical installation.

4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, [**retarding chamber**,] and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Deluge Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. BERMAD Control Valves.
 - c. CLA-VAL Automatic Control Valves.
 - d. Globe Fire Sprinkler Corporation.
 - e. OCV Control Valves.
 - f. Reliable Automatic Sprinkler Co., Inc.
 - g. Tyco Fire & Building Products LP.
 - h. Venus Fire Protection Ltd.
 - i. Victaulic Company.
 - j. Viking Corporation.
 - k. **<Insert manufacturer's name>**.
 - l. or approved equal.
2. Standard: UL 260.
3. Design: Hydraulically operated, differential-pressure type.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.
5. Wet, Pilot-Line Trim Set: Include gage to read push-rod chamber pressure, globe valve for manual operation of deluge valve, and connection for actuation device.

D. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
2. Standard: UL 1726.
3. Pressure Rating: **175 psig** (1200 kPa) minimum.
4. Type: Automatic draining, ball check.
5. Size: **NPS 3/4** (DN 20).
6. End Connections: Threaded.

2.7 FIRE-DEPARTMENT CONNECTIONS

- A. Fire Department Connection: Two-Way, flush-mounted wall type, Fire Department Connection, threading as required by Denver Fire Department, with nameplate marked "AUTO SPKR -STP".
1. Finish: polished, chrome plated. Complete with 3/4 inch automatic ball drip.
 2. Provide additional 2.5 inch outlet for each 250 GPM design discharge over 500 GPM per NFPA 13.
 3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Potter Roemer, 5020 series.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.

2.8 SPRINKLER SPECIALTY PIPE FITTINGS

- A. Branch Outlet Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. National Fittings, Inc.
 - c. Shurjoint Piping Products.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
 2. Standard: UL 213.
 3. Pressure Rating: [175 psig (1200 kPa) **minimum**] [300 psig (2070 kPa)].
 4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
 5. Type: Mechanical-T and -cross fittings.
 6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
 7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
 8. Branch Outlets: Grooved, plain-end pipe, or threaded.
- B. Flow Detection and Test Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGF Manufacturing Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.

- e. **<Insert manufacturer's name>**.
 - f. or approved equal.
 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 3. Pressure Rating: [175 psig (1200 kPa) **minimum**] [300 psig (2070 kPa)].
 4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
 5. Size: Same as connected piping.
 6. Inlet and Outlet: Threaded.
- C. Branch Line Testers:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkhart Brass Mfg. Company, Inc.
 - b. Fire-End & Croker Corporation.
 - c. Potter Roemer.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
 2. Standard: UL 199.
 3. Pressure Rating: 175 psig (1200 kPa).
 4. Body Material: Brass.
 5. Size: Same as connected piping.
 6. Inlet: Threaded.
 7. Drain Outlet: Threaded and capped.
 8. Branch Outlet: Threaded, for sprinkler.
- D. Sprinkler Inspector's Test Fittings:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGF Manufacturing Inc.
 - b. Triple R Specialty.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - e. Viking Corporation.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 3. Pressure Rating: [175 psig (1200 kPa) **minimum**] [300 psig (2070 kPa)].
 4. Body Material: Cast- or ductile-iron housing with sight glass.
 5. Size: Same as connected piping.
 6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CECA, LLC.
 - b. Corcoran Piping System Co.
 - c. Merit Manufacturing; a division of Anvil International, Inc.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
2. Standard: UL 1474.
3. Pressure Rating: [250 psig (1725 kPa) **minimum**] [300 psig (2070 kPa)].
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

F. Flexible, Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fivalco Inc.
 - b. FlexHead Industries, Inc.
 - c. Gateway Tubing, Inc.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: [175 psig (1200 kPa) **minimum**] [300 psig (2070 kPa)].
5. Size: Same as connected piping, for sprinkler.

2.9 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFAC Inc.
2. Globe Fire Sprinkler Corporation.
3. Reliable Automatic Sprinkler Co., Inc.
4. Tyco Fire & Building Products LP.
5. Venus Fire Protection Ltd.
6. Victaulic Company.
7. Viking Corporation.
8. **<Insert manufacturer's name>**.
9. or approved equal.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Residential Sprinklers: **175 psig** (1200 kPa) maximum.
3. Pressure Rating for Automatic Sprinklers: **175 psig** (1200 kPa) minimum.
4. Pressure Rating for High-Pressure Automatic Sprinklers: [**250 psig** (1725 kPa) **minimum**] [**300 psig** (2070 kPa)].

C. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: [**UL 1767**] <Insert standard>.
2. Nonresidential Applications: [**UL 199**] <Insert standard>.
3. Residential Applications: [**UL 1626**] <Insert standard>.
4. Characteristics: Nominal **1/2-inch** (12.7-mm) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Open Sprinklers with Heat-Responsive Element Removed: UL 199.

1. Characteristics:
 - a. Nominal [**1/2-inch** (12.7-mm)] <Insert value> Orifice: With Discharge Coefficient K [**between 5.3 and 5.8**] <Insert value>.
 - b. Nominal [**17/32-inch** (13.5-mm)] <Insert value> Orifice: With Discharge Coefficient K [**between 7.4 and 8.2**] <Insert value>.

E. Sprinkler Finishes:

1. Chrome plated.
2. Bronze.
3. Painted.

F. Special Coatings:

1. Wax.
2. Lead.
3. Corrosion-resistant paint.

G. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: [**Chrome-plated steel, one piece, flat**] [**Chrome-plated steel, two piece, with 1-inch** (25-mm) **vertical adjustment**] [**Plastic, white finish, one piece, flat**].
2. Sidewall Mounting: [**Chrome-plated steel**] [**Plastic, white finish**], one piece, flat.

H. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
 - e. **<Insert manufacturer's name>**.
 - f. or approved equal.
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.10 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Globe Fire Sprinkler Corporation.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
 - e. **<Insert manufacturer's name>**.
 - f. or approved equal.
2. Standard: UL 753.
3. Type: Mechanically operated, with Pelton wheel.
4. Alarm Gong: Cast aluminum with red-enamel factory finish.
5. Size: **10-inch** (250-mm) diameter.
6. Components: Shaft length, bearings, and sleeve to suit wall construction.
7. Inlet: **NPS 3/4** (DN 20).
8. Outlet: **NPS 1** (DN 25) drain connection.

C. Electrically Operated Alarm Bell:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Notifier; a Honeywell company.
 - c. Potter Electric Signal Company.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
2. Standard: UL 464.
3. Type: Vibrating, metal alarm bell.

4. Size: [6-inch (150-mm) **minimum-**] [8-inch (200-mm) **minimum-**] [10-inch (250-mm)] diameter.
5. Finish: Red-enamel factory finish, suitable for outdoor use.

D. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ADT Security Services, Inc.
 - b. McDonnell & Miller; ITT Industries.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 - e. Viking Corporation.
 - f. Watts Industries (Canada) Inc.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
2. Vane type waterflow detector, rated to 250 psig: Designed for vertical or horizontal installation; having two (2), spdt circuit switches to provide isolated alarm and auxiliary contacts, 7 ampere, 125 Vac and 0.25 ampere, 24 Vdc; complete with factory-set, field-adjustable tamperproof cover.
 - a. Retard feature must be of the instantly recycling type so that flows less than retard period will not produce a cumulative effect.
 - b. Flow switch shall not be installed in a fitting or within 12 inches of any fitting that changes the direction of water flow.
 - c. Design detector with a sensitivity setting to signal any flow of water that equals or exceeds the discharge from one sprinkler head.
 - d. Provide weatherproof and dust tight flow detector.
 - e. Provide a 3/4 inch conduit entrance per detector.
 - f. Standard: UL 346.

E. Pressure Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Barksdale, Inc.
 - c. Detroit Switch, Inc.
 - d. Potter Electric Signal Company.
 - e. System Sensor; a Honeywell company.
 - f. Tyco Fire & Building Products LP.
 - g. United Electric Controls Co.
 - h. Viking Corporation.
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
2. Rated to 250 psig; designed for vertical installation; having two, spdt circuit

switches to provide isolated alarm and auxiliary contacts, 7 ampere, 125 Vac and 0.25 ampere, 24 Vdc; complete with factory-set, field-adjustable tamperproof cover.

- a. Design detector with a sensitivity setting to signal any flow of water that equals or exceeds the discharge from one sprinkler head.
- b. Provide weatherproof and dust tight flow detector.
- c. Provide a 3/4 inch conduit entrance per detector.
- d. Standard: UL 346.

F. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 - e. **<Insert manufacturer's name>**.
 - f. or approved equal.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

G. Indicator-Post Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Potter Electric Signal Company.
 - b. System Sensor; a Honeywell company.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled indicator-post valve is in other than fully open position.

2.11 MANUAL CONTROL STATIONS

- A. Description: UL listed or FM approved, hydraulic operation, with union, **NPS 1/2** (DN 15) pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.12 CONTROL PANELS

- A. Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.
1. Panels: UL listed and FM approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
 2. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.
 3. Manual Control Stations: Hydraulic operation, with union, **NPS 1/2 (DN 15)** pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.13 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AMETEK; U.S. Gauge Division.
 2. Ashcroft, Inc.
 3. Brecco Corporation.
 4. WIKA Instrument Corporation.
 5. **<Insert manufacturer's name>**.
 6. or approved equal.
- B. Standard: UL 393.
- C. Dial Size: **3-1/2- to 4-1/2-inch** (90- to 115-mm) diameter.
- D. Pressure Gage Range: **[0 to 250 psig (0 to 1725 kPa) minimum] [0 to 300 psig (0 to 2070 kPa)]**.
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include **[retard feature and]** "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends to full inside diameter.
- B. Remove burrs, and bevel plain end ferrous pipe.
- C. Remove scale and foreign material, inside and outside, before assembly.
- D. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- E. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 211100 "Facility Fire-Suppression Water-Service Piping."
- B. Install shutoff valve,[**backflow preventer**,] pressure gage, drain, and other accessories indicated at connection to water-service piping.[**Comply with requirements for backflow preventers in Section 211100 "Facility Fire-Suppression Water-Service Piping."**]
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 WATER-SUPPLY CONNECTIONS

- A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Section 221116 "Domestic Water Piping."
- B. Install shutoff valve,[**backflow preventer**,] pressure gage, drain, and other accessories indicated at connection to water-distribution piping.[**Comply with requirements for backflow preventers in Section 221119 "Domestic Water Piping Specialties."**]
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.4 PIPE APPLICATIONS

- A. Schedule 40 steel pipe with threaded joints and fittings for 2-inch and smaller pipe.

- B. Schedule 40 steel pipe with cut grooved ends and mechanical couplings, flanged or screwed fittings for piping 2-1/2 inches and larger.
- C. Thinwall steel pipe with roll grooved ends and mechanical couplings with flanges or fittings.
- D. Use of threaded Hooker fittings and similar rubber gasketed, drill to mount, 2" and smaller clamp on tees will not be permitted.
- E. Use of threaded thin wall pipe: Pressfit fittings or similar non-threaded connections of any kind will NOT be permitted.

3.5 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with DEN Project Manager before deviating from approved working plans.
 - 2. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
 - 3. Install piping to conserve building space, to not interfere with use of space and other work.
 - 4. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Cleaning:
 - 1. Thoroughly pre-clean internal surfaces of piping sections to be installed; install piping in accordance with NFPA 13.
 - 2. Prepare pipe, fittings, supports, and accessories for finish painting.
 - 3. All work in existing areas shall require daily cleaning, including cleaning and removal of any foreign materials. Final cleaning will require all dust to be recovered and removed.
- D. Penetrations:
 - 1. Do not penetrate building structural members unless indicated. Penetration of structural members requires structural engineer review and approval.
 - 2. X-ray: Provide X-ray of structural walls and floors prior to attempting drilling or saw cutting to guarantee structural or electrical members are not interrupted by process. Comply with DEN Standard X-ray procedures.
- E. Seals and sleeves:

1. Provide sleeves when penetrating footings, floors, partitions, and walls.
2. Seal pipe and sleeve penetration to achieve fire resistance equivalent to fire separation required.
3. Install mechanical sleeve seal at pipe penetrations in basement and foundation walls. Refer to Section 210517 "Sleeves and Sleeve Seals for Fire Suppression Piping".
4. In steel piping, main sized saddle branch connections or direct connection of branch lines to mains is permitted if main is one pipe size larger than the branch for up to 6 inch mains and if main is two pipe sizes larger than branch for 8 inch and larger mains. Do not project branch pipes inside the main pipe.
5. Install sprinkler piping to provide for system drainage in accordance with NFPA 13. Drainage shall be coordinated with locations of floor drains having capacity to receive flow.
6. Use approved fittings to make all changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
7. Install unions in pipes 2 inch and smaller, adjacent to each valve. Unions are not required on flanged devices or in piping installations using grooved mechanical couplings.
8. Install flanges or flange adapters on valves, apparatus, and equipment having a 2-1/2 inch and larger connections.
9. Install test connections sized and located in accordance with NFPA 13 complete with shutoff valve. Test connections may also serve as drainpipes. Victaulic "Test Master" or Engineer approved equal may be used in lieu of test and drainpipe and fittings. Test and drain discharge pipe shall have hose thread connection or discharge as indicated.
10. Install pressure gauge on the riser or feed main at or near each test connection. Provide gauge with a connection not less than 1/4 inch and having a soft metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and where they will not be subject to freezing.

F. Pipe hangers and supports:

1. Reference Section 210529 "Hangers & Supports for Fire Suppression Piping and Equipment".
2. Comply with the requirements of NFPA 13. Hanger and support spacing and locations for piping joined with grooved mechanical couplings shall be in accordance with NFPA 13 and the grooved mechanical coupling manufacturer's written instructions, for rigid systems. Indicate all hangers on shop drawings.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers per NFPA 13.
5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
6. Modifications or additions to system: Provide new independent supports from existing building structural components or walls suitable for the support of the added or modified sprinkler piping system.
7. Added sprinkler piping supports shall not be attached to any part of the existing equipment or its support members.
8. Install new piping, hangers, supports, etc. to avoid interference with existing building systems and operational characteristics of material handling systems.

9. Supports not addressed by NFPA 13: Submit pipe support shop drawings bearing the wet stamp of a Licensed Colorado Professional Structural engineer for approval. All welding and drilling of existing structural components must be reviewed and approved by the DEN Project Manager prior to proceeding.
 10. Support all horizontal piping within 1'0" of end.
- G. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.
 - H. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
 - I. Install unions adjacent to each valve in pipes **NPS 2** (DN 50) and smaller.
 - J. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having **NPS 2-1/2** (DN 65) and larger end connections.
 - K. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
 - L. Install sprinkler piping with drains for complete system drainage.
 - M. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
 - N. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
 - O. Install alarm devices in piping systems.
 - P. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
 - Q. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than **NPS 1/4** (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
 - R. Pressurize and check preaction sprinkler system piping and **[air-pressure maintenance devices] [air compressors]**.
 - S. Fill sprinkler system piping with water.
 - T. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Section 210533 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 210700 "Fire-Suppression Systems Insulation."

- U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.6 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Criteria:
 - 1. Up to and including 2-inch diameter: Screw joint and grooved joint steel piping.
 - 2. 2-1/2 inch diameter and larger: Welded joints (only shop welds), screw joints, or grooved joints.
- C. Welded Joints: AWS D10.9, Level AR-3, and Section 059990 "Welding".
- D. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe, fittings, and valves as follows:
 - 1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - 2. Below grade joints: Die cut screw joints with full cut standard taper pipe threads with red lead and linseed oil or other nontoxic joint compound applied to male threads only.
 - 3. Apply appropriate tape or thread compound to the external pipe threads.
 - 4. Assemble joint to appropriate thread depth. When using a wrench on valves, place the wrench on the valve end into which the pipe is being threaded.
 - 5. Damaged Threads: Do not use pipe with threads that are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.
- E. Flanged Joints: Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.
- F. Mechanical Grooved Joints: Mechanical grooved joints may be used instead of threaded or welded joints at accessible aboveground locations. Cut grooves on pipe ends dimensionally compatible with the couplings.

- G. End Treatment: After cutting pipe lengths, remove burrs and fins from pipe ends.
- H. Dissimilar Materials Piping Joints: Make joints using adapters compatible with both piping materials.
- I. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

3.7 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install valves with stems upright or horizontal, not inverted.
- C. Provide gate valves for shut off or isolating service. Provide double check valve (Back flow preventer) assembly at sprinkler system water source connection.
- D. Gate Valves: Install supervised-open gate valves indicating type so located to control all sources of water supply, except fire department connections. Where there is more than one control valve, provide permanently marked identification signs indicating the portion of the system controlled by each valve. Refer to Section 210553 "Identification for Fire Suppression Piping and Equipment" for valve tags and signs.
- E. Where approved and/or indicated, butterfly valves may be used instead of gate valves.
- F. Provide drain valves at main shut off valves, low points of piping and apparatus.
- G. Valves: Bear UL, FM Global label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- H. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- I. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- J. Specialty Valves:
 - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 - 2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.
 - 3. Deluge Valves: Install in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

3.8 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of [**narrow dimension of**] acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.9 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire-department connections.
- B. Install yard-type, fire-department connections in concrete slab support. Comply with requirements for concrete in Section 033000 "Cast-in-Place Concrete."
 - 1. Install [**two**] [**three**] < **Insert number** > protective pipe bollards [**around**] [**on sides of**] each fire-department connection. Comply with requirements for bollards in Section 055000 "Metal Fabrications."
- C. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.10 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Coordinate with fire-alarm tests. Operate as required.
 - 6. Coordinate with fire-pump tests. Operate as required.

7. Verify that equipment hose threads are same as local fire-department equipment.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.12 CLEANING

- A. Clean dirt and debris from sprinklers and work area.
- B. Remove and replace sprinklers with paint other than factory finish.
- C. Clean exterior of all installation to be painted.

3.13 DEMONSTRATION

- A. **[Engage a factory-authorized service representative to train] [Train]** Owner's maintenance personnel to adjust, operate, and maintain **[specialty valves] [and] [pressure-maintenance pumps]**.

3.14 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
 1. Rooms without Ceilings: **[Upright sprinklers] <Insert type>**.
 2. Rooms with Suspended Ceilings: **[Pendent sprinklers] [Recessed sprinklers] [Flush sprinklers] [Concealed sprinklers] [Pendent, recessed, flush, and concealed sprinklers as indicated]**.
 3. Wall Mounting: Sidewall sprinklers.
 4. Spaces Subject to Freezing: **[Upright sprinklers] [Pendent, dry sprinklers] [Sidewall, dry sprinklers] [Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated] <Insert type>**.
 5. Deluge-Sprinkler Systems: **[Upright] [and] [pendent]**, open sprinklers.
 6. Special Applications: **[Extended-coverage, flow-control, and quick-response sprinklers where indicated] <Insert type>**.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
 1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
 3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
 4. **[Upright] [Pendent] [and] [Sidewall]** Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 211313

SECTION 211316 - DRY-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connections.
4. Sprinkler specialty pipe fittings.
5. Sprinklers.
6. Alarm devices.
7. Manual control stations.
8. Control panels.
9. Pressure gages.

- B. Related Sections:

1. Section 210500 "Common Work Results for Fire Suppression".
2. Section 210517 "Sleeves and Sleeve Seals for Fire Suppression Piping".
3. Section 210518 "Escutcheons for Fire Suppression Piping".
4. Section 210529 "Hangers & Supports for Fire Suppression Piping and Equipment".
5. Section 210533 "Heat Tracing for Fire Suppression Piping".
6. Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment".
7. Section 210553 "Identification for Fire Suppression Piping and Equipment".
8. Section 210700 "Fire Suppression Systems Insulation".
9. Section 211100 "Facility Fire-Suppression Water-Service Piping".
10. Section 211200 "Fire-Suppression Standpipes" for standpipe piping.
11. Section 211313 "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
12. Section 211339 "Foam-Water Systems" for AFFF piping.
13. Section 212200 "Clean-Agent Fire Extinguishing Systems" for clean-agent systems.
14. Section 213113 "Electric-Drive, Centrifugal Fire Pumps" for fire pumps, pressure-maintenance pumps, and fire-pump controllers.
15. Section 283100 "Intelligent Life Safety Fire Management System" for alarm devices not specified in this Section.

- C. Work furnished but installed under other sections:
1. Furnish pipe sleeves, complete with drawing(s) locating all sleeves and indicating sleeve size to Division 03 or 04 contractors for placement.
 2. Fire Proofing Repair.
 3. Fire Sealants.
 4. Painting.
- D. Include all design, pipe and fittings, valves, connections, fabrication, and installation of all dry-pipe fire protection systems for exterior areas, unheated areas, or areas subject to freezing where indicated on the Drawings in accordance with design criteria and requirements indicated herein and on the drawings.
- E. Major bulk runs, standpipe mains and risers, and sprinkler crossmains are shown to assist the contractor where interference with other trades may occur. However, all piping required to complete the fire protection systems shall be designed, fabricated and installed based on approved hydraulic calculations and shop drawings prepared and submitted by the Fire Protection Work Contractor (FPWC).
- F. The FPWC shall provide all special tools required for installation or maintenance for the equipment provided. If conflicts occur in this specification or between this specification and the contract documents, most stringent requirement shall apply.
- G. Work on all systems require DEN Shut Down Requests be completed and filed five (5) days before work is to be done. No system may be shut down for periods longer than ten (10) hours. The FPWC is responsible for the required Fire Watch and must remain ON SITE for the entire period of time that the system is not in service. Failure to comply may be reason for immediate suspension of work privileges.
- H. Install work in association with fire pump installation, wet-pipe sprinkler installation, and all fire and smoke alarm interface in accordance with design criteria and fire/smoke zoning requirements indicated on drawings.
- I. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 REFERENCE STANDARDS

- A. Materials and workmanship shall conform to the latest issue of all industry standards, publications, or regulations referenced in this section and with the following references as applicable. Appendices and/or Annexes referenced by these standards shall apply.
- B. International Building Code (IBC) with the Denver Amendments.
- C. International Fire Code (IFC) with the Denver Amendments.
- D. National Fire Protection Association (NFPA):
1. NFPA 13 - Installation of Sprinkler Systems.
 2. NFPA 415 - Standard on Airport Terminal Buildings, Fueling Ramp Drainage,

And Loading Walkways.

3. The most stringent interpretations shall apply. All appendices and/or Annexes shall apply.

1.4 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure **175 psig** (1200 kPa) maximum.
- B. High-Pressure Piping System: Fire-suppression piping system designed to operate at working pressure higher than standard 175 psig (1200 kPa), but not higher than **[250 psig (1725 kPa)] [300 psig (2070 kPa)]**.
- C. Pipe sizes used in this specification are Nominal Pipe Size (NPS).
- D. "Working Plans" as used in this section means documents, including drawings and calculations, prepared pursuant to the requirements contained in NFPA 13 and City and County of Denver Code agencies for obtaining approval of the authority having jurisdiction.
- E. Other definitions for fire protection systems are included in referenced NFPA standards.

1.5 SYSTEM DESCRIPTIONS

- A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from sprinklers that are open.
- B. Combined Dry-Pipe and Preaction Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Fire-detection system in same area as sprinklers actuates tripping devices that open dry-pipe valve without loss of air pressure and actuates fire alarm. Water discharges from sprinklers that have opened.
- C. Single-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of fire-detection system in same area as sprinklers opens deluge valve, permitting water to flow into piping and to discharge from sprinklers that have opened.
- D. Double-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of a fire-detection system in the same area as sprinklers opens the deluge valve permitting water to flow into the sprinkler piping; a closed solenoid valve in the sprinkler piping is opened by another fire-detection device; then water will discharge from sprinklers that have opened.
- E. System to provide coverage for un-heated building areas or areas subject to freezing as noted.

- F. Interface system with building fire alarm and smoke control system.
- G. Provide supervised compressed air system sized per NFPA 13 and DEN guidelines with Low Air Detection and Air Maintenance Device, for automatic air pressure maintenance and Low Air Alarm interface with building Fire Alarm System. Provide minimum of 20 gallon attached receiver (tank). The compressor shall be sized accordingly, minimum 1.5 HP, 480volt 3 phase, intermediate size 3.0 HP, and large size 5.0 HP shall have 30 gallon tanks.
- H. Design Criteria:
1. Occupancy hazard class: [**ordinary hazard**] [], Group [**2**] [].
 2. Density: [**.15**] [] GPM/SF flowing over [**1,500**] [] of the remote area.
 3. Hose stream allowance: Include [**250**] [] GPM for hose stream at the riser.
 4. Increase Dry-Pipe System calculated area by 30%.
 5. Provide a 10% safety margin in hydraulic calculations.
 6. Velocities in pipes shall be shown on hydraulic calculations. Velocities in overhead piping shall not exceed 20 feet per second. Velocities in underground piping shall not exceed 16 feet per second.
 7. Hydraulic calculation submittal shall clearly define all devices that will cause friction loss with equivalent lengths of pipe. This includes vane type electric water flow switches. Assume 10 feet of equivalent length of pipe unless actual pressure drop data is available from the manufacturer.
 8. Design information shall be permanently affixed to the risers as described in NFPA 13.
 9. Sprinkler shop drawings and hydraulic calculations shall be prepared in accordance with NFPA 13 and FM Global.
 10. Size compressor per NFPA 13. Minimum HP shall be 1-1/2 HP, 480/3 Phase.
 11. All trapped piping shall be provided with a 1" minimum size, 2 valve drum drip style auxiliary drain. Where similar drains are adjacent they shall be tied together as tie-in drains with a standard drum drip. Drain valves shall be located at a distance approximately 7'-0" above the floor.
 12. Current Denver Water Department test reports (less than 6 months old) for the underground supply shall be provided for all new calculations. Where accepted by all AHJ's the most current DEN Fire Pump Test may be used
 13. Provide fire proofing repair damaged by this work.
 14. Provide all required fire sealants and smoke stopping required by this work
 15. Actuation for deluge and clean agent systems shall be included in this sections work.

1.6 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for **175-psig** (1200-kPa) minimum working pressure.
- B. High-Pressure Piping System Component: Listed for [**250-psig** (1725-kPa) **minimum**] [**300-psig** (2070-kPa)] working pressure.

- C. Design and obtain approval from authority having jurisdiction for fire protection systems specified.
- D. Minimum Pipe Sizes: Not smaller than existing pipe sizes of sprinklers being relocated.
- E. Should the relocation of sprinkler heads cause the calculated remote zone to change, hydraulic calculations shall be performed and approved by the authority having jurisdiction.
- F. Sprinkler system zone shall not serve multiple smoke control zones. Verify that the no conflict exists between the design drawings and this requirement.
- G. System modifications, remodeling:
 - 1. Minimum Pipe Sizes: Not smaller than existing pipe sizes of sprinklers being relocated.
 - 2. Should the relocation of sprinkler heads cause the calculated remote zone to change, hydraulic calculations shall be performed and approved by the authority having jurisdiction.
- H. Systems shall not serve multiple smoke zone areas.
- I. Identify all drain valves per DEN Life Safety Team's Fire Zone number scheme. Numbers and letters shall be permanently applied to the wall within 1 foot of the drain valves in nonpublic areas. Letters and numbers shall be red paint and 3" tall. The identification shall be visible from a distance of 30'. In public areas, signs of at least 3" x 6" shall be attached to the drain valves with the same information. All materials shall be waterproof.
- J. Work on existing systems can be done during normal hours unless it effects the operation of the facility, tenants, or the support staff.
- K. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - 1. Available fire-hydrant flow test records indicate the following conditions:
 - a. Date: **<Insert test date>**.
 - b. Time: **<Insert time> [a.m.] [p.m.]**
 - c. Performed by: **<Insert operator's name>** of **<Insert firm>**.
 - d. Location of Residual Fire Hydrant R: **<Insert location>**.
 - e. Location of Flow Fire Hydrant F: **<Insert location>**.
 - f. Static Pressure at Residual Fire Hydrant R: **<Insert psig (kPa)>**.
 - g. Measured Flow at Flow Fire Hydrant F: **<Insert gpm (L/s)>**.
 - h. Residual Pressure at Residual Fire Hydrant R: **<Insert psig (kPa)>**.
- L. Sprinkler system design shall be approved by authorities having jurisdiction.
 - 1. Margin of Safety for Available Water Flow and Pressure: **[10] [20] <Insert number>** percent, including losses through water-service piping, valves, and

- backflow preventers.
2. Sprinkler Occupancy Hazard Classifications:
 - a. Automobile Parking Areas: [Ordinary Hazard, Group 1] <Insert classification>.
 - b. Building Service Areas: [Ordinary Hazard, Group 1] <Insert classification>.
 - c. Electrical Equipment Rooms: [Ordinary Hazard, Group 1] <Insert classification>.
 - d. General Storage Areas: [Ordinary Hazard, Group 1] <Insert classification>.
 - e. Laundries: [Ordinary Hazard, Group 1] <Insert classification>.
 - f. Machine Shops: [Ordinary Hazard, Group 2] <Insert classification>.
 - g. Mechanical Equipment Rooms: [Ordinary Hazard, Group 1] <Insert classification>.
 - h. Office and Public Areas: [Light Hazard] <Insert classification>.
 - i. Repair Garages: [Ordinary Hazard, Group 2] <Insert classification>.
 - j. Restaurant Service Areas: [Ordinary Hazard, Group 1] <Insert classification>.
 - k. Solvent Cleaning Areas: [Extra Hazard, Group 2] <Insert classification>.
 - l. <Insert classification>.
 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: [0.10 gpm over 1500-sq. ft. (4.1 mm/min. over 139-sq. m)] <Insert value> area.
 - b. Ordinary-Hazard, Group 1 Occupancy: [0.15 gpm over 1500-sq. ft. (6.1 mm/min. over 139-sq. m)] <Insert value> area.
 - c. Ordinary-Hazard, Group 2 Occupancy: [0.20 gpm over 1500-sq. ft. (8.1 mm/min. over 139-sq. m)] <Insert value> area.
 - d. Extra-Hazard, Group 1 Occupancy: [0.30 gpm over 2500-sq. ft. (12.2 mm/min. over 232-sq. m)] <Insert value> area.
 - e. Extra-Hazard, Group 2 Occupancy: [0.40 gpm over 2500-sq. ft. (16.3 mm/min. over 232-sq. m)] <Insert value> area.
 - f. Special Occupancy Hazard: As determined by authorities having jurisdiction.
 4. Maximum Protection Area per Sprinkler: Per UL listing.
 5. Maximum Protection Area per Sprinkler: [_____]
 - a. Office Spaces: [120 sq. ft. (11.1 sq. m)] [225 sq. ft. (20.9 sq. m)] <Insert dimension>.
 - b. Storage Areas: [130 sq. ft. (12.1 sq. m)] <Insert dimension>.
 - c. Mechanical Equipment Rooms: [130 sq. ft. (12.1 sq. m)] <Insert dimension>.
 - d. Electrical Equipment Rooms: [130 sq. ft. (12.1 sq. m)] <Insert dimension>.
 - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
 6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13

unless otherwise indicated:

- a. Light-Hazard Occupancies: [**100 gpm (6.3 L/s) for 30 minutes**] <Insert requirement>.
 - b. Ordinary-Hazard Occupancies: [**250 gpm (15.75 L/s) for 60 to 90 minutes**] <Insert requirement>.
 - c. Extra-Hazard Occupancies: [**500 gpm (31.5 L/s) for 90 to 120 minutes**] <Insert requirement>.
 - d. <Insert requirement>.
- M. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and [**ASCE/SEI 7**] <Insert requirement>.

1.7 REGULATORY REQUIREMENTS

- A. Comply with NFPA 13 - Standard for the Installation of Sprinkler Systems, latest edition.
- B. Comply with NFPA 72 - Installation, Maintenance, and Use of Protective Signaling Systems.
- C. Comply with City and County of Denver Code Agency requirements.
- D. UL and FM Global Compliance: Fire protection system materials and components shall be UL listed and labeled, and FM Global approved.
- E. Hydraulic Calculations, Product Data, Shop Drawings, Dry Pipe System Equipment, and Low Air Switch, Air Maintenance Device: Bear stamp of approval of Designer of Record, DEN Life Safety Team and Owner's Representative and Denver Fire Department.
- F. All applicable insurance authorities underwriting requirements.

1.8 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. [**Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.**]
 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For dry-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

- D. Submit working plans and product data under provisions of Division 01. Submittal shall include drawings, hydraulic calculations, hydraulic reference points, detailed pipe layout, hangers and supports, components and accessories and other items as defined by NFPA 13. Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
 - E. Verify that all formats noted below are most currently used by DEN. Working Plans drawings shall be submitted in Revit format in hard copy and on Compact Disk. Two(2) sets of full size drawings (34 x 44) and (1) Compact Disk containing all drawing files shall be submitted to the DEN Life Safety Team as part of each submittal.
 - F. Working Plan drawings for remodel areas shall include as built depiction of all sprinkler work within at least a 50 foot radius of the work proposed. Risers and main supply pipes shall also be indicated by size and location.
 - G. Final Submittal: Working plans submitted for approval shall have the signed wet stamp of a registered Fire Protection Engineer licensed in the State of Colorado (or N.I.C.E.T. 4), certifying that the fire sprinkler system has been designed and hydraulically calculated in compliance with NFPA and governing authorities requirements.
 - H. Obtain DEN Life Safety Team review and stamp prior to submittal for permit.
 - I. Submit working plans and product data to Denver Fire Department for approval. Subject to approval, submit copy of approved submittal and permit to the DEN Project Manager.
 - J. Submit additional non-returnable copies of current permits and agency approved working plan drawings with System Interruption Request.
 - K. Contractor shall submit fully dimensioned spool drawings for all welded piping work. Drawings shall indicate all weld types, sizes, and materials to be used. The spool drawing size shall match the full size contract documents of either 24 x 36 or 34 x 44. Spool drawings shall be submitted in either the latest version of Revit or the latest version of Adobe Acrobat (pdf). Adobe Acrobat files shall not contain security. Other file formats will not be accepted.
 - L. Supports not addressed by NFPA 13 or 14: Submit pipe support shop drawings bearing the wet stamp of a Licensed Colorado Professional Structural Engineer for approval. All welding and drilling of existing structural components must be reviewed and approved by the DEN Project Manager prior to proceeding.
- 1.9 INFORMATIONAL SUBMITTALS
- A. Subject to approval, submit copy of permit and submittal approved by Denver Fire Department to the DEN Project Manager.
 - B. Current Welders' qualification certificates and procedures. Reference Section 059990 "Welding".

- C. Test reports and certificates including "Contractor's Material and Test Certificate for Aboveground Piping" as described in NFPA 13.
- D. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Domestic water piping.
 - 2. Compressed air piping.
 - 3. HVAC hydronic piping.
 - 4. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. <Insert item>.
 - 5. <Insert item>.
- E. Qualification Data: For qualified Installer[**and professional engineer**].
- F. Installer's Qualifications: Firms qualified to install and alter fire protection piping, equipment, specialties, and accessories, and repair and service equipment. A qualified firm is one that is experienced in such work, with minimum of five (5) previous projects similar in size and scope to this Project, is familiar with precautions required, and in compliance with the requirements of the authority having jurisdiction. The firm shall be in possession of City and County of Denver Fire Protection License Class A or B. Refer to Division 01 Section Reference Standards and Definitions for definition of Installer.
 - 1. The qualified installer shall be licensed for the design and installation for the specific type of system in the City and County of Denver and the State of Colorado and have been in business under the current name for five (5) years.
 - 2. All field personnel must be a current holder of the City & County of Denver Fire Department Fire Protection Installers license.
- G. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five (5) years' documented experience.
- H. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- I. Welding certificates.
- J. Copy of City and County of Denver Fire Protection Contractors License, and Fire protection Supervisor's certificate for class of equipment being installed.
- K. Fire-hydrant flow test report.

- L. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- M. Field quality-control reports.

1.10 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, servicing requirements, and maintenance manuals.
 - 1. Maintenance data for each type sprinkler head, valve, piping specialty, fire protection specialty, fire department valve, and hose cabinet specified, for inclusion in operating and maintenance manual specified in Division 01.
 - a. Include written maintenance data on components of system, servicing requirements, and Record Drawings.
 - b. Include pump operation, maintenance, and inspection data, replacement part numbers and availability, and location and telephone numbers and website of service depot.
- B. Test reports and certificates including "Contractor's Material and Test Certificate for Aboveground Piping" as described in NFPA 13.
- C. All sprinkler system record drawings shall be submitted in the form of hard copies and electronic (CD) AutoDesk (release 14 minimum).

1.11 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.
- C. The following must be delivered and accepted prior to any testing:
 - 1. Provide a spare parts list. The list is to be provided with material submittal cut sheets.
 - 2. Provide extra sprinkler heads: Furnish each style with its own sprinkler head cabinet under provisions of NFPA 13 and Division 01.
 - 3. Provide suitable wrenches for each head type.
 - 4. Provide metal storage cabinet in location designated.
 - 5. Provide one set of renewable parts and seals for each dry valve installed.
 - 6. Provide DEN representatives all special tools required for installation and maintenance.

1.12 QUALITY ASSURANCE

A. Installer Qualifications:

1. Firms qualified to install and alter fire protection piping, equipment, specialties, and accessories, and repair and service equipment. A qualified firm is one that is experienced in such work, with minimum of 5 previous projects similar in size and scope to this Project, familiar with precautions required, and in compliance with the requirements of the authority having jurisdiction. The firm shall be in possession of City and County of Denver Fire Protection License Class A or B. Refer to Division 01 Section Reference Standards and Definitions for definition of Installer.
2. The qualified installer shall be licensed for the design and installation for the specific type of system in the City and County of Denver and the State of Colorado and have been in business under the current name for five (5) years.
3. All field personnel must be a current holder of the City & County of Denver Fire Department Fire Protection Installers license.
4. Submit evidence of such qualifications to the DEN Project Manager.
5. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

E. Design and installation to conform to Denver Fire Department requirements.

F. Equipment and Components: Bear UL, FM GLOBAL label or marking.

G. Qualifications for Welding Processes and Operators: Comply with the requirements of AWS B2.1, Specifications for Procedure and Performance Qualifications.

H. Sprinkler design drawings and hydraulic calculations submitted for approval shall have the signed wet stamp of a Colorado registered Fire Protection Engineer practicing in the fire protection field in the state of the project or a N.I.C.E.T. Level 4, certifying that

the fire sprinkler system has been designed and hydraulically calculated in compliance with NFPA and governing authorities requirements.

- I. Obtain DEN Life Safety Team review and stamp prior to submittal for permit.
- J. Fire Proofing: Where hangers require removal of fire proofing, remove minimum amount of fire proofing for hanger attachment. Repair fireproofing per requirements specified in Section 078100 "Applied Fireproofing".
- K. Comply with all requirements of Owner's Insurance Underwriter.

1.13 PROJECT CONDITIONS, SEQUENCE AND SCHEDULING

- A. Comply with DEN Maintenance and Engineering system interruption requirements and provide Denver Fire Department approved Fire Watch during entire time of system interruption.
- B. In no case shall the building structure remain without fire protection for more than ten (10) hours.
- C. Prior to system shut down, Contractor shall certify all equipment and materials are on site for removing, capping, valving, tagging, and reconnection of system.
- D. Schedule rough-in installations with installations of other building components.
- E. Conform to NFPA 13 for sprinkler systems.
- F. Environmental Conditions:
 - 1. The equipment shall be designed and constructed to operate successfully at the rated values under the following environmental conditions:
 - a. Location: Indoors and Outdoors.
 - b. Altitude: 5,500 feet (1677 m) above sea level.
 - c. Ambient temperature range: Minus 30 deg F (minus 35 deg C) to 120 deg F (49 deg C)
 - d. Wind Load: 115 mph with gust factor of 1.3

1.14 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.15 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store pumps in shipping containers with labeling in place under provisions of Division 01.

- B. Provide temporary inlet and outlet caps to be used throughout system construction until systems are in service.
- C. Maintain caps in place until installation.

1.16 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Equipment and components: Bear UL or FM Global label or marking where required.

2.2 STEEL PIPE AND FITTINGS

- A. Threaded thin wall piping, black and galvanized, for threaded joints, is NOT allowed on Dry-Pipe Sprinkler Systems.
 - 1. Exception: Thin wall pipe with approved joints and fittings may be used only on piping 2-1/2 inches and larger, if approved by DEN Project Manager.
- B. Galvanized-Steel Pipe: ASTM A 53/A 53M, ASTM A-135, Schedule 40 [**Type E**] <Insert type>, [**Grade B**] <Insert grade>. Pipe ends may be factory or field formed to match joining method.
 - 1. Only pipe identified and conforming to Schedule 40 wall thickness shall be used. In example, "Dyna Flow", "Eddy Pipe", "Super Flow" and / or similar products which are not true Schedule 40 thickness will not be allowed.
- C. Thinwall Galvanized-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.
 - 1. Thin wall pipe shall not be used in sizes less than NPS 2-1/2 inches.
 - a. Exception: Thin wall pipes may be used if approved by DEN Project Manager, but shall have grooved fittings only.
 - b. Threaded thin wall piping shall not be used.

- D. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- E. Galvanized, Steel Couplings: ASTM A 865, threaded.
- F. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; "C" shaped composition sealing gasket, steel bolts, nuts, and washers.
- G. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- H. Malleable- or Ductile-Iron Unions: UL 860.
- I. Cast-Iron Flanges: ASME B16.1, Class 125.
- J. Flanges: 150 psi forged steel slip on or weld-neck flanges for ferrous piping. Raised face flanges shall be mated with raised face, and flat face flanges shall be mated with flat face only.
- K. Plain-End-Pipe Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn or screwed retainer pin to secure pipe in fitting.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Shurjoint Piping Products.
 - c. **<Insert manufacturer's name>**
 - d. or approved equal.
- L. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Corcoran Piping System Co.
 - c. National Fittings, Inc.
 - d. Shurjoint Piping Products.
 - e. Tyco Fire & Building Products LP.
 - f. Victaulic Company.
 - g. **<Insert manufacturer's name>**
 - h. or approved equal.
 - 2. Pressure Rating: **[175 psig (1200 kPa)] [250 psig (1725 kPa)] [300 psig (2070 kPa)]** minimum.
 - 3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.

4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: **[AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick] [or] [ASME B16.21, nonmetallic and asbestos free]**.
 1. Class 125, Cast-Iron and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
 2. Class 250, Cast-Iron and Class 300, Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- D. Welding Materials: Field welding shall not be permitted; perform only shop welding. Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded. Welded outlets are permitted as long as the welding is done in compliance with NFPA welding requirements and Division 05 of these specifications.
- E. Gasket Materials: Thickness, material, and type suitable for fluid or gas to be handled, and design temperatures and pressures.
- F. Threaded Joint Compound or "Teflon" tape.

2.4 PIPE HANGERS AND SUPPORTS

- A. Reference Section 220529 "Hangers and Supports for Plumbing Piping and Equipment". Conform to NFPA 13.
- B. Hangers for Pipe Sizes 1/2 to 12 Inch: Malleable iron, adjustable swivel, split ring.
- C. All beam clamp type hangers shall be provided with retaining straps or surge restrainers.
- D. All hangers attached to metal grated mezzanines or floors and conveyor systems shall be provided with vibration spring isolators.
- E. All hangers support under the AGTS Tunnel must be only clevis style with double nuts for locking purposes.
- F. All hangers supported by attachment to the concrete structure shall be provided with fender washers and double nuts against the washer to assure locking.

- G. Earthquake bracing shall be added to the risers, supply mains both horizontal and vertical and crossmains. These braces shall be in accordance to NFPA 13. Bracing is to be Installed at each change in direction, tees in the mains, securing the risers and at the end of the crossmains. Long crossmains shall have bracing at intervals of 40' along their length.

2.5 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: **175 psig** (1200 kPa).

B. VALVE OPERATORS

1. Provide hand wheels for gate, globe [**or angle,**] and drain valves.
2. Butterfly valves provide gear operators for all sizes.
3. For valves located with a centerline more than 7 feet above finish floor, provide endless chain operated sheaves. Extend chains to 5 feet above floor and secure clear of walkways, as applicable.

C. VALVE CONNECTIONS

1. Provide valve connections to match pipe joints. Use valves of pipe size.
2. Provide butterfly valve for isolating service.

D. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Victaulic Company.
 - c. **<Insert manufacturer's name>**
 - d. or approved equal.
2. Standard: UL 1091 except with ball instead of disc.
3. Valves **NPS 2 (DN 50) and smaller: Bronze, two piece body, stainless steel ball, teflon seats and stuffing box ring, lever handle, threaded ends.**
4. **Valves NPS 2-1/2 (DN 65): Bronze body with threaded ends or ductile-iron body with grooved ends.**
5. **Valves NPS 3 (DN 80): Ductile-iron body with grooved ends.**

E. Butterfly and Grooved End Control Valves:

1. Per NFPA 13: UL listed and FM Global approved butterfly control valves for use with tamper switches, flanged or grooved connections. Carbon steel body, 150 lb full ANSI rated bi directional, 316 SS electrodeposit nickel plated eccentric rotating disc, dynamic sealed, TFE seal ring, 17 4 PH stainless steel shaft, Teflon chevron stem packing, 316 SS graphite impregnated bearings, and gear

- operator. Provide Supervisory switches.
2. Per NFPA-13 UL-Listed and FM Global approved grooved end control valves for use as zone control and/or sectional valves may be used with appropriate pressure ratings for intended service.
 3. Supervisory switches are required on all control valves.

F. Bronze Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fivalco Inc.
 - b. Global Safety Products, Inc.
 - c. Milwaukee Valve Company.
 - d. **<Insert manufacturer's name>**
 - e. or approved equal.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig (1200 kPa).
4. Body Material: Bronze.
5. End Connections: Threaded.

G. Iron Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Fivalco Inc.
 - c. Global Safety Products, Inc.
 - d. Kennedy Valve; a division of McWane, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Pratt, Henry Company.
 - h. Shurjoint Piping Products.
 - i. Tyco Fire & Building Products LP.
 - j. Victaulic Company.
 - k. **<Insert manufacturer's name>**
 - l. or approved equal.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig (1200 kPa).
4. Body Material: Cast or ductile iron.
5. Style: Lug or wafer.
6. End Connections: Grooved.

H. Check Valves:

1. UL listed and FM Global approved wafer check valves, flanged or grooved connections.

- a. Iron body, bronze trim, swing disc, renewable disc, and seat.
 - b. Iron body, bronze trim spring loaded, renewable composition disc, where indicated on drawings.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. AFAC Inc.
 - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - c. Anvil International, Inc.
 - d. Clow Valve Company; a division of McWane, Inc.
 - e. Crane Co.; Crane Valve Group; Crane Valves.
 - f. Crane Co.; Crane Valve Group; Jenkins Valves.
 - g. Crane Co.; Crane Valve Group; Stockham Division.
 - h. Fire-End & Croker Corporation.
 - i. Fire Protection Products, Inc.
 - j. Fivalco Inc.
 - k. Globe Fire Sprinkler Corporation.
 - l. Groeniger & Company.
 - m. Kennedy Valve; a division of McWane, Inc.
 - n. Matco-Norca.
 - o. Metraflex, Inc.
 - p. Milwaukee Valve Company.
 - q. Mueller Co.; Water Products Division.
 - r. NIBCO INC.
 - s. Potter Roemer.
 - t. Reliable Automatic Sprinkler Co., Inc.
 - u. Shurjoint Piping Products.
 - v. Tyco Fire & Building Products LP.
 - w. United Brass Works, Inc.
 - x. Venus Fire Protection Ltd.
 - y. Victaulic Company.
 - z. Viking Corporation.
 - aa. Watts Water Technologies, Inc.
 - bb. <Insert manufacturer's name>
 - cc. or approved equal.
3. Standard: UL 312
4. Pressure Rating: **[250 psig (1725 kPa) minimum] [300 psig (2070 kPa)]**.
5. Type: Swing check.
6. Body Material: Cast iron.
7. End Connections: Flanged or grooved.
- I. Bronze OS&Y Gate Valves:
1. Gate Valves - 2 inch and Smaller: Body and bonnet of cast bronze, 175 pound cold water working pressure, nonshock, threaded ends, solid wedge, outside screw and yoke, rising stem, screw-in bonnet, and malleable iron handwheel. Valves shall be capable of being repacked under pressure, with valve wide open. Provide Supervisory switches.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. United Brass Works, Inc.
 - f. **<Insert manufacturer's name>**
 - g. or approved equal.
 3. Standard: UL 262.
 4. Pressure Rating: **175 psig** (1200 kPa).
 5. Body Material: Bronze.
 6. End Connections: Threaded.
- J. Iron OS&Y Gate Valves:
1. Gate Valves - 2-1/2 inch and Larger: Iron body, bronze mounted, 175 pound cold water working pressure, nonshock. Valves shall have solid taper wedge, outside screw and yoke, rising stem, flanged bonnet, with body and bonnet conforming to ASTM A 126, Class B; replaceable bronze wedge facing rings, flanged ends, and a packing assembly consisting of a cast iron gland flange, brass gland, packing, bonnet, and bronze bonnet bushing.
 - a. Valves shall be capable of being repacked under pressure, with valve wide open. Provide Supervisory switches.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Crane Valves.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. Hammond Valve.
 - h. Milwaukee Valve Company.
 - i. Mueller Co.; Water Products Division.
 - j. NIBCO INC.
 - k. Shurjoint Piping Products.
 - l. Tyco Fire & Building Products LP.
 - m. United Brass Works, Inc.
 - n. Watts Water Technologies, Inc.
 - o. **<Insert manufacturer's name>**
 - p. or approved equal.
 3. Standard: UL 262.
 4. Pressure Rating: **[250 psig (1725 kPa) minimum] [300 psig (2070 kPa)]**.

5. Body Material: Cast or ductile iron.
6. End Connections: Flanged or grooved.

K. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Fivalco Inc.
 - c. Global Safety Products, Inc.
 - d. Kennedy Valve; a division of McWane, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Shurjoint Piping Products.
 - h. Tyco Fire & Building Products LP.
 - i. Victaulic Company.
 - j. **<Insert manufacturer's name>**
 - k. or approved equal.
2. Standard: UL 1091.
3. Pressure Rating: **175 psig** (1200 kPa) minimum.
4. Valves **NPS 2** (DN 50) and Smaller:
 - a. Valve Type: Ball or butterfly.
 - b. Body Material: Bronze.
 - c. End Connections: Threaded.
5. Valves **NPS 2-1/2** (DN 65) and Larger:
 - a. Valve Type: Butterfly.
 - b. Body Material: Cast or ductile iron.
 - c. End Connections: Flanged, grooved, or wafer.
6. Valve Operation: Integral [**electrical, 115-V ac, prewired, single-circuit, supervisory switch**] [**electrical, 115-V ac, prewired, two-circuit, supervisory switch**] [**visual**] indicating device.

L. NRS Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Kennedy Valve; a division of McWane, Inc.
 - f. Mueller Co.; Water Products Division.
 - g. NIBCO INC.

- h. Tyco Fire & Building Products LP.
 - i. **<Insert manufacturer's name>**
 - j. or approved equal.
- 2. Standard: UL 262.
 - 3. Pressure Rating: **[250 psig (1725 kPa) minimum] [300 psig (2070 kPa)]**.
 - 4. Body Material: Cast iron with indicator post flange.
 - 5. Stem: Nonrising.
 - 6. End Connections: Flanged or grooved.

M. Indicator Posts:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Kennedy Valve; a division of McWane, Inc.
 - f. Mueller Co.; Water Products Division.
 - g. NIBCO INC.
 - h. Tyco Fire & Building Products LP.
 - i. **<Insert manufacturer's name>**
 - j. or approved equal.
- 2. Standard: UL 789.
- 3. Type: Horizontal for wall mounting.
- 4. Body Material: Cast iron with extension rod and locking device.
- 5. Operation: **[Wrench] [Hand wheel]**.

2.6 TRIM AND DRAIN VALVES

A. General Requirements:

- 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
- 2. Pressure Rating: **175 psig** (1200 kPa) minimum.
- 3. Ball valves are required for all dry system auxiliary drum drip drains.

B. Angle Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire Protection Products, Inc.
 - b. United Brass Works, Inc.
 - c. **<Insert manufacturer's name>**
 - d. or approved equal.

C. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Affiliated Distributors.
 - b. Anvil International, Inc.
 - c. Barnett.
 - d. Conbraco Industries, Inc.; Apollo Valves.
 - e. Fire-End & Croker Corporation.
 - f. Fire Protection Products, Inc.
 - g. Flowserve.
 - h. FNW.
 - i. Jomar International, Ltd.
 - j. Kennedy Valve; a division of McWane, Inc.
 - k. Kitz Corporation.
 - l. Legend Valve.
 - m. Metso Automation USA Inc.
 - n. Milwaukee Valve Company.
 - o. NIBCO INC.
 - p. Potter Roemer.
 - q. Red-White Valve Corporation.
 - r. Southern Manufacturing Group.
 - s. Stewart, M. A. and Sons Ltd.
 - t. Tyco Fire & Building Products LP.
 - u. Victaulic Company.
 - v. Watts Water Technologies, Inc.
 - w. **<Insert manufacturer's name>**
 - x. or approved equal.

D. Globe Valves:

1. Brass body with renewable composition disc.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire Protection Products, Inc.
 - b. United Brass Works, Inc.
 - c. **<Insert manufacturer's name>**
 - d. or approved equal.

E. Plug Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Southern Manufacturing Group.
 - b. **<Insert manufacturer's name>**
 - c. or approved equal.

2.7 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
 - a. Standard-Pressure Piping Specialty Valves: **175 psig** (1200 kPa) minimum.
 - b. High-Pressure Piping Specialty Valves: [**250 psig** (1725 kPa) **minimum**] [**300 psig** (2070 kPa)].
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

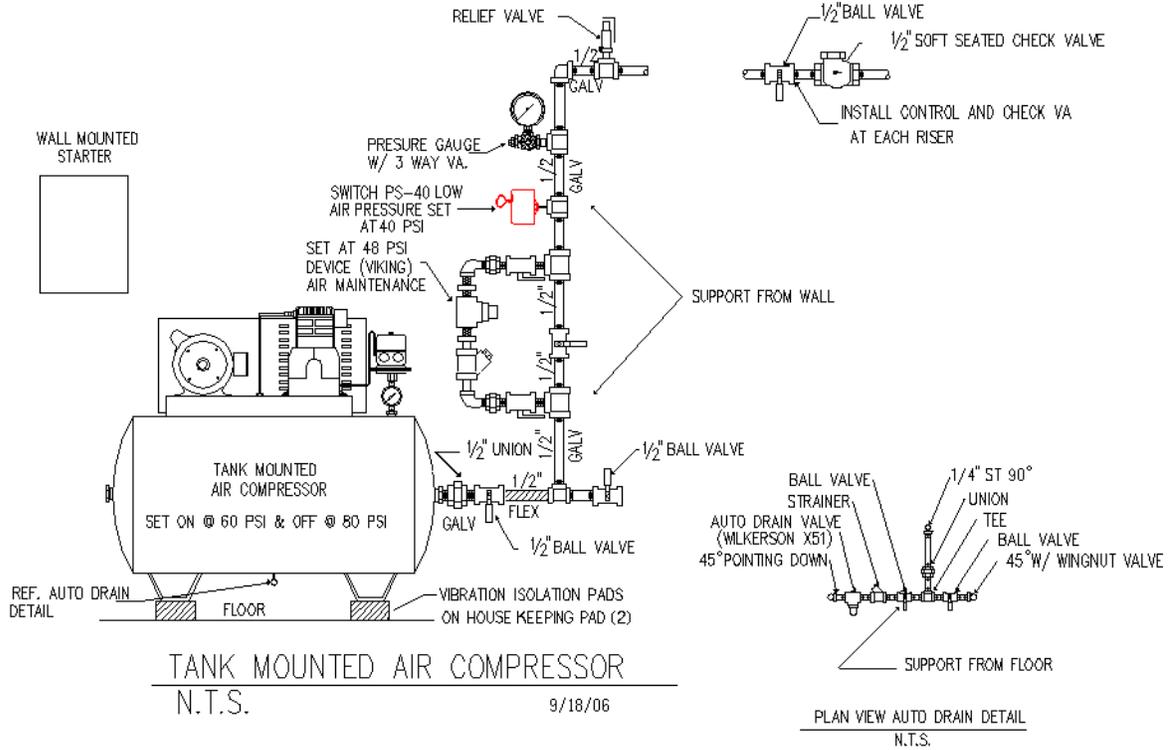
B. Automatic Dry-Pipe Valves: Each Automatic Dry Pipe Valve shall be provided with necessary trim, including but not limited to: accelerator as required, pressure alarm switch, low air switch, air maintenance device per NFPA 13, and drain.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Firematic Sprinkler Devices, Inc.
 - b. Globe Fire Sprinkler Corporation.
 - c. Grinnell Fire Protection
 - d. Reliable Automatic Sprinkler Co., Inc.
 - e. Star Sprinkler, Inc.
 - f. Victaulic Company.
 - g. Viking Corporation.
 - h. **<Insert manufacturer's name>**
 - i. or approved equal.
2. Standard: UL 260
3. Design: Differential-pressure type.
4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
5. Air-Pressure Maintenance Device:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) AFAC Inc.
 - 2) Globe Fire Sprinkler Corporation.
 - 3) Reliable Automatic Sprinkler Co., Inc.
 - 4) Tyco Fire & Building Products LP.
 - 5) Venus Fire Protection Ltd.
 - 6) Victaulic Company.
 - 7) Viking Corporation.

- 8) **<Insert manufacturer's name>**
 - 9) or approved equal.
 - b. Standard: UL 260.
 - c. Type: Automatic device to maintain minimum air pressure in piping.
6. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with **14- to 60-psig** (95- to 410-kPa) adjustable range, and [**175-psig** (1200-kPa)] [**300-psig** (2070-kPa)] outlet pressure.
7. Air Compressor:
- a. Electric motor driven, with ASME rated horizontal receiver tank, low air pressure operated electric switch, motor, motor starter, safety valves, check valves, automatic tank drain, muffler-filter, belt guard, and controls. Automatic drain shall have stop valve and manual valve upstream of stop valve for alternate service. Automatic air pressure maintenance shall be provided with dry pipe valves. Drains shall be piped to suitable location.
 - b. Provide 20 gallon tank mounted centrifugal electric motor driven compressor (1.5 HP, 480V 3 Phase, 60HZ.) with Automatic Air Maintenance Device, electric pressure switches, low air switch, motor starter, safety valves, and trimmings. As necessary provide intermediate size 3.0 HP, and large size 5.0 HP equipped with 30 gallon tanks.
 - c. Small Systems: Systems with total capacity of less than 40 gallons may use riser mounted centrifugal electric motor driven compressor, (1/2 HP, 120 VAC, 60 HZ) with Automatic Air Maintenance Device, electric pressure switch(s), low-air switch, motor starter, safety valves and trimmings.
 - d. Submit calculations substantiating total capacity of system if this option is to be proposed.
 - e. Air-Pressure Maintenance Device: UL 260, automatic device to maintain correct air pressure in piping. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig maximum inlet pressure.
 - f. Provide vibration isolation for system connection and compressor mounting.
 - g. Mount motor starter on structure. Motor starter shall not be mounted on compressor.
 - h. Provide 4" thick minimum housekeeping pad poured in place and attached to existing structure.
 - i. Refer to detail provided:

GENERAL NOTES

- * ALL GALV MATL
- * 1/2" DIA. FOR SINGLE RISERS
- * 3/4" DIA. FOR MULTIPLE RISERS



- j. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Gast Manufacturing Inc.
 - 2) General Air Products, Inc,
 - 3) Viking Corporation.
 - 4) <Insert manufacturer's name>
 - 5) or approved equal.
- k. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
- l. Motor Horsepower: Fractional.
- m. Power: 120-V ac, 60 Hz, single phase.

C. Deluge Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. BERMAD Control Valves.
 - c. CLA-VAL Automatic Control Valves.

- d. Globe Fire Sprinkler Corporation.
 - e. OCV Control Valves.
 - f. Reliable Automatic Sprinkler Co., Inc.
 - g. Tyco Fire & Building Products LP.
 - h. Venus Fire Protection Ltd.
 - i. Victaulic Company.
 - j. Viking Corporation.
 - k. **<Insert manufacturer's name>**
 - l. or approved equal.
2. Standard: UL 260.
 3. Design: Hydraulically operated, differential-pressure type.
 4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.
 5. Dry, Pilot-Line Trim Set: Include dry, pilot-line actuator; air- and water-pressure gages; low-air-pressure warning switch; air relief valve; and actuation device. Dry, pilot-line actuator includes cast-iron, operated, diaphragm-type valve with resilient facing plate, resilient diaphragm, and replaceable bronze seat. Valve includes threaded water and air inlets and water outlet. Loss of air pressure on dry, pilot-line side allows pilot-line actuator to open and causes deluge valve to open immediately.
 6. Air-Pressure Maintenance Device:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) AFAC Inc.
 - 2) Globe Fire Sprinkler Corporation.
 - 3) Reliable Automatic Sprinkler Co., Inc.
 - 4) Tyco Fire & Building Products LP.
 - 5) Venus Fire Protection Ltd.
 - 6) Victaulic Company.
 - 7) Viking Corporation.
 - 8) **<Insert manufacturer's name>**
 - 9) or approved equal.
 - b. Standard: UL 260.
 - c. Type: Automatic device to maintain minimum air pressure in piping.
 - d. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with **14- to 60-psig** (95- to 410-kPa) adjustable range, and **[175-psig (1200-kPa)] [300-psig (2070-kPa)]** outlet pressure.
 7. Air Compressor:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Gast Manufacturing Inc.
- 2) General Air Products, Inc,
- 3) Viking Corporation.
- 4) **<Insert manufacturer's name>**
- 5) or approved equal.

- b. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
- c. Motor Horsepower: Fractional.
- d. Power: 120-V ac, 60 Hz, single phase.

D. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
 - d. **<Insert manufacturer's name>**
 - e. or approved equal.
2. Standard: UL 1726.
3. Pressure Rating: **175 psig** (1200 kPa) minimum.
4. Type: Automatic draining, ball check.
5. Size: **NPS 3/4** (DN 20).
6. End Connections: Threaded.

2.8 DOUBLE CHECK VALVE ASSEMBLY (BACK FLOW PREVENTER)

- A. Provide UL/FM Global approved, double check valve assembly, in fire pump room or at service entry points, between flange spigot piece and fire pump suction.
 1. Subject to compliance with requirements, provide products by one of the following:
 - a. Febco Master Series 850
 - b. Watts
 - c. **<Insert manufacturer's name>**
 - d. or approved equal.
- B. At every backflow preventer there shall be displayed, on the assembly a permanent placard with the greatest total flow anticipated by the hydraulic calculations and the corresponding net pressure lose utilized for the device in the hydraulic data. This information must be substantiated by means of a full flow discharge test during system acceptance to assure proper valve operation per NFPA. The placard shall be a standard red background, white letters, a minimum of $\frac{3}{4}$ " tall. A ball valve shall be provided on each end of the device and a common liquid filled gauge cross connected to achieve a net differential reading for comparison to the hydraulic calculations.

2.9 FIRE-DEPARTMENT CONNECTIONS

A. Flush-Type, Fire-Department Connection:

1. Fire Department Connection: Two-Way [2], flush mounted wall type, Fire Department Connection (threading as required by Denver Fire Department), with nameplate marked "AUTO SPKR -STP", finish; polished, chromeplated. Complete with 3/4 inch automatic ball drip.
2. Provide additional 2.5 inch outlet for each 250 GPM design discharge over 500 GPM per NFPA 13.
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Potter Roemer 5020 Series.
 - b. <Insert manufacturer's name>
 - c. or approved equal.
4. Standard: UL 405.
5. Type: Flush, for wall mounting.
6. Pressure Rating: 175 psig (1200 kPa) minimum.
7. Body Material: Corrosion-resistant metal.
8. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
9. Caps: Brass, lugged type, with gasket and chain.
10. Escutcheon Plate: Rectangular, brass, wall type.
11. Outlet: With pipe threads.
12. Body Style: [Horizontal] [Square] [Vertical].
13. Number of Inlets: [Two] [Three] [Four] [Six].
14. Outlet Location: [Back] [Bottom] [Left side] [Right side] [Top].
15. Escutcheon Plate Marking: Similar to "AUTO SPKR - STP"]
16. Finish: Polished chrome plated.
17. Outlet Size: [NPS 4 (DN 100)] [NPS 5 (DN 125)] [NPS 6 (DN 150)] [NPS 8 (DN 200)].

B. Yard-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Elkhart Brass Mfg. Company, Inc.
 - c. Fire-End & Croker Corporation.
 - d. Fire Protection Products, Inc.
 - e. GMR International Equipment Corporation.
 - f. Guardian Fire Equipment, Inc.
 - g. Wilson & Cousins Inc.
 - h. <Insert manufacturer's name>
 - i. or approved equal.

2. Standard: UL 405.
3. Type: Exposed, freestanding.
4. Pressure Rating: [**175 psig (1200 kPa) minimum**] [**300 psig (2070 kPa)**].
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, floor type.
9. Outlet: Bottom, with pipe threads.
10. Number of Inlets: [**Two**] [**Three**] [**Four**].
11. Sleeve: [**Brass**] [**Not required**].
12. Sleeve Height: **18 inches** (460 mm).
13. Escutcheon Plate Marking: Similar to "[**AUTO SPKR & STP**] [**AUTO SPKR**]."
14. Finish[, **Including Sleeve**]: [**Polished chrome plated**] .
15. Outlet Size: [**NPS 4 (DN 100)**] [**NPS 5 (DN 125)**] [**NPS 6 (DN 150)**].

2.10 FITTINGS

- A. Cast Iron Threaded Fittings: ANSI B16.4, Class 125 or 250 as required, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.
- B. Malleable Iron Threaded Fittings: ANSI B16.3, Class 150 or 300 as required, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.
- C. Deluge and exterior dry systems connections must have galvanized fittings
- D. Steel Fittings: ASTM A 234, seamless or welded, for welded joints.
- E. Wrought Copper Fittings: ANSI B16.22, streamlined pattern.
- F. Cast Iron Threaded Flanges: ANSI B16.1, Class 125 or 250 as required. Raised face flanges shall be mated with raised face, and flat face flanges shall be mated with flat face only.
- G. Use of Hooker style fittings and/or any similar rubber gasketed, drill to mount, 2" and smaller clamp on tees are NOT permitted.
- H. Use of threaded thin wall pipe: Pressfit fittings or similar non-threaded connections of any kind will NOT be permitted.
- I. "EZ-T's" are NOT permitted.
- J. Unions: 150 to 300psi as required malleable iron for threaded ferrous piping.

2.11 SPRINKLER SPECIALTY PIPE FITTINGS

- A. General Requirements for Dry-Pipe-System Fittings: [**UL listed**] <Insert standard> for dry-pipe service.

B. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. National Fittings, Inc.
 - c. Shurjoint Piping Products.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
 - f. **<Insert manufacturer's name>**
 - g. or approved equal.
2. Standard: UL 213.
3. Pressure Rating: **[175 psig (1200 kPa) minimum] [300 psig (2070 kPa)]**.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

C. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGF Manufacturing Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - e. **<Insert manufacturer's name>**
 - f. or approved equal.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: **[175 psig (1200 kPa) minimum] [300 psig (2070 kPa)]**.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

D. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkhart Brass Mfg. Company, Inc.
 - b. Fire-End & Croker Corporation.
 - c. Potter Roemer.

- d. **<Insert manufacturer's name>**
 - e. or approved equal.
 2. Standard: UL 199.
 3. Pressure Rating: **175 psig** (1200 kPa) minimum.
 4. Body Material: Brass.
 5. Size: Same as connected piping.
 6. Inlet: Threaded.
 7. Drain Outlet: Threaded and capped.
 8. Branch Outlet: Threaded, for sprinkler.
- E. Sprinkler Inspector's Test Fittings:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGF Manufacturing Inc.
 - b. Triple R Specialty.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - e. Viking Corporation.
 - f. **<Insert manufacturer's name>**
 - g. or approved equal.
 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 3. Pressure Rating: **[175 psig (1200 kPa) minimum] [300 psig (2070 kPa)]**.
 4. Body Material: Cast- or ductile-iron housing with sight glass.
 5. Size: Same as connected piping.
 6. Inlet and Outlet: Threaded.
- F. Adjustable Drop Nipples:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CECA, LLC.
 - b. Corcoran Piping System Co.
 - c. Merit Manufacturing; a division of Anvil International, Inc.
 - d. **<Insert manufacturer's name>**
 - e. or approved equal.
 2. Standard: UL 1474.
 3. Pressure Rating: **[250 psig (1725 kPa) minimum] [300 psig (2070 kPa)]**.
 4. Body Material: Steel pipe with EPDM O-ring seals.
 5. Size: Same as connected piping.
 6. Length: Adjustable.
 7. Inlet and Outlet: Threaded.
- G. Flexible, Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fivalco Inc.
 - b. FlexHead Industries, Inc.
 - c. Gateway Tubing, Inc.
 - d. **<Insert manufacturer's name>**
 - e. or approved equal.
2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: **[175 psig (1200 kPa) minimum] [300 psig (2070 kPa)]**.
5. Size: Same as connected piping, for sprinkler.

2.12 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFAC Inc.
 2. Globe Fire Sprinkler Corporation.
 3. Reliable Automatic Sprinkler Co., Inc.
 4. Tyco Fire & Building Products LP.
 5. Venus Fire Protection Ltd.
 6. Victaulic Company.
 7. Viking Corporation.
 8. **<Insert manufacturer's name>**
 9. or approved equal.
- B. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 2. Pressure Rating for Automatic Sprinklers: **175 psig (1200 kPa) minimum**.
 3. Pressure Rating for High-Pressure Automatic Sprinklers: **[250 psig (1725 kPa) minimum] [300 psig (2070 kPa)]**.
- C. Automatic Sprinklers with Heat-Responsive Element:
1. Fusible link type, and style as indicated or required by the application.
 2. Nonresidential Applications: **[UL 199] <Insert standard>**.
 3. Characteristics: Nominal **1/2-inch (12.7-mm)** orifice with discharge coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
 4. Exposed Area Type: Standard upright, pendent or sidewall type with brass finish.
 5. Dry Pendent Sprinklers: Flush type with escutcheon. Finish to be as indicated on Architectural Reflected Ceiling Plans or Ceiling Finish Schedules.

6. Provide corrosion proof sprinkler heads in areas subject to corrosive atmosphere or exposure to weather.
 7. Orifice: All sprinklers to be minimum 1/2 inch orifice unless noted otherwise.
 8. Temperature: All sprinklers to be temperature rated with manufacturer's color code, to correspond with hazard requirements, location, and proximity to heat producing media. Provide sprinklers with temperature ratings based on area conditions and heat producing equipment. Sprinkler temperature ratings shall conform to the requirements of the NFPA 13.
 9. Finished Ceilings: Flush type, semi-recessed, standard pendent or sidewall type sprinklers with escutcheon. Finishes and type of sprinkler to install to be as indicated on Architectural Reflected Ceiling Plans or Ceiling Finish Schedules.
- D. Sprinkler Heads to Match Existing:
1. Where new work is performed in an area of the existing building, the new heads must match the existing. If the existing heads cannot be matched, an area defined by walls may be replaced entirely so that all heads within the room are the same style and finish.
- E. Dry Pendent Heads:
1. Where dry pendent sprinklers are used to protect an unheated area, the minimum length for the dry barrel must be 12".
- F. Sprinkler Finishes:
1. Completely concealed sprinkler heads, GEM Concealed or approved equal, shall be installed in all public areas with suspended ceilings and concealed piping.
 2. Ceiling plate color shall match DEN Project Manager's color sample.
 3. Ceiling plate paint shall be applied by the manufacturer.
 4. Ceiling plates shall not be painted after installation.
 5. Use chrome finish recessed sprinklers, GEM or approved equal, with chrome recessed escutcheon in nonpublic areas with suspended ceilings and concealed piping.
 6. Use chrome horizontal type sidewall sprinklers where indicated and specified.
- G. Special Coatings:
1. Wax.
 2. Corrosion-resistant paint.
- H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
1. Ceiling Mounting: [**Chrome-plated steel, one piece, flat**] [**Chrome-plated steel, two piece, with 1-inch (25-mm) vertical adjustment**] [**Plastic, white finish, one piece, flat**].
 2. Sidewall Mounting: [**Chrome-plated steel**] [**Plastic, white finish**], one piece, flat.

I. Sprinkler Guards:

1. Head Guards: Provide sprinkler head guards where the Sprinkler Deflector is located 7'-0" or less above finish floor, or is otherwise subject to damage or injury. Head Guard finish to match applicable sprinkler head finish requirements, except brass sprinkler heads, which shall be "Red Enamel".
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Viking Corporation.
 - c. Automatic Sprinkler Corporation of America.
 - d. Central Sprinkler Corporation.
 - e. Firematic Sprinkler Devices, Inc.
 - f. Globe Fire Equipment Co.
 - g. Guardian Automatic Sprinkler Co., Inc.
 - h. GEM
 - i. Star Sprinkler Corporation.
 - j. **<Insert manufacturer's name>**
 - k. or approved equal.
3. Standard: UL 199.
4. Type: Wire cage with fastening device for attaching to sprinkler.

2.13 PIPE HANGERS AND SUPPORTS

- A. Reference Section 220529 "Hangers and Supports for Plumbing Piping and Equipment". All supports shall conform to the requirements of NFPA 13.
- B. Hangers for Pipe Sizes 1/2 to 12 inch: Adjustable band hanger or malleable iron split ring in accordance with NFPA 13.
- C. All beam clamp type hangers shall be provided with retaining straps and surge restrainers.
- D. All hangers attached to metal grated mezzanines or floors and conveyor systems shall be provided with vibration spring isolators.
- E. All hangers support under the AGTS Tunnel must be only clevis style with double nuts for locking purposes.
- F. All hangers supported by attachment to the concrete structure shall be provided with fender washers and double nuts against the washer to assure locking.

2.14 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Water Flow Detectors: Vane type waterflow detector, rated to 250 psig; designed for

vertical or horizontal installation; having two, spdt circuit switches to provide isolated alarm and auxiliary contacts, 7 ampere, 125 Vac and 0.25 ampere, 24 Vdc; complete with factory-set, field-adjustable tamperproof cover.

1. Retard feature must be of the instantly recycling type so that flows less than retard period will not produce a cumulative effect.
2. Flow switch shall not be installed in a fitting or within 12 inches of any fitting that changes the direction of water flow.
3. Design detector with a sensitivity setting to signal any flow of water that equals or exceeds the discharge from one sprinkler head.
4. Provide weatherproof and dust tight flow detector.
5. Provide a 3/4 inch conduit entrance per detector.

C. Water-Motor-Operated Alarm:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Globe Fire Sprinkler Corporation.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
 - e. **<Insert manufacturer's name>**
 - f. or approved equal.
2. Standard: UL 753.
3. Type: Mechanically operated, with Pelton wheel.
4. Alarm Gong: Cast aluminum with red-enamel factory finish.
5. Size: **10-inch** (250-mm) diameter.
6. Components: Shaft length, bearings, and sleeve to suit wall construction.
7. Inlet: **NPS 3/4** (DN 20).
8. Outlet: **NPS 1** (DN 25) drain connection.

D. Electrically Operated Alarm Bell:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-Lite Alarms; a Honeywell company.
 - b. Notifier; a Honeywell company.
 - c. Potter Electric Signal Company.
 - d. **<Insert manufacturer's name>**
 - e. or approved equal.
2. Standard: UL 464.
3. Type: Vibrating, metal alarm bell.
4. Size: **[6-inch (150-mm) minimum] [8-inch (200-mm) minimum] [10-inch (250-mm)]** diameter.
5. Finish: Red-enamel factory finish, suitable for outdoor use.

E. Pressure Switches:

1. Pressure Alarm Switches: Rated to 250 psig; designed for vertical installation; having two, spdt circuit switches to provide isolated alarm and auxiliary contacts, 7 ampere, 125 Vac and 0.25 ampere, 24 Vdc; complete with factory-set, field-adjustable tamperproof cover.
 - a. Design detector with a sensitivity setting to signal any flow of water that equals or exceeds the discharge from one sprinkler head.
 - b. Provide weatherproof and dust tight flow detector.
 - c. Provide a 3/4 inch conduit entrance per detector.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Barksdale, Inc.
 - c. Detroit Switch, Inc.
 - d. Potter Electric Signal Company.
 - e. System Sensor; a Honeywell company.
 - f. Tyco Fire & Building Products LP.
 - g. United Electric Controls Co.
 - h. Viking Corporation.
 - i. **<Insert manufacturer's name>**
 - j. or approved equal.
3. Standard: UL 346.
4. Type: Electrically supervised water-flow switch with retard feature.
5. Components: Single-pole, double-throw switch with normally closed contacts.
6. Design Operation: Rising pressure signals water flow.

F. Valve Supervisory Switches:

1. Supervisory Tamper Switches: SPDT, normally closed contacts, designed to signal valve in other than full open position.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-Lite Alarms; a Honeywell company.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 - e. **<Insert manufacturer's name>**
 - f. or approved equal.
3. Standard: UL 346.
4. Type: Electrically supervised.
5. Components: Single-pole, double-throw switch with normally closed contacts.
6. Design: Signals that controlled valve is in other than fully open position.

G. Indicator-Post Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Potter Electric Signal Company.
 - b. System Sensor; a Honeywell company.
 - c. <Insert manufacturer's name>
 - d. or approved equal.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled indicator-post valve is in other than fully open position.

2.15 MANUAL CONTROL STATIONS

- A. Description: UL listed or FM Global approved, hydraulic operation, with union, [NPS 1/2 \(DN 15\)](#) pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.16 CONTROL PANELS

- A. Description: Single-area, two-area, or single-area cross-zoned type control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.
1. Panels: UL listed and FM Global approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
 2. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.
 3. Manual Control Stations: Hydraulic operation, with union, [NPS 1/2 \(DN 15\)](#) pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.17 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AMETEK, Inc.; U.S. Gauge Division.
 2. Ashcroft, Inc.
 3. Brecco Corporation.
 4. WIKA Instrument Corporation.
 5. **<Insert manufacturer's name>**
 6. or approved equal.
- B. Standard: UL 393.
- C. Dial Size: **3-1/2- to 4-1/2-inch** (90- to 115-mm) diameter.
- D. Pressure Gage Range: [**0 to 250 psig (0 to 1725 kPa) minimum**] [**0 to 300 psig (0 to 2070 kPa)**].
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include[**retard feature and**] "AIR" or "AIR/WATER" label on dial face.

2.18 SIGNAGE AND LABELING

- A. Signage shall be per the requirements of NFPA 13, FM Global, and any applicable Insurance underwriter.
1. Signs shall be pre-manufactured metal, approximately 2" x 6", located at all valves, main drains, auxiliary drains, air, alarm, and similar devices.
 2. Every drain and control valve shall be permanently labeled with the DEN designated system I.D. number and a consecutive number indicating quantity of drains on the system, i.e. T-4-43 / 3 of 7 in the terminal or FZ – 03 / 2 of 2 .
- B. Hydraulic Plaques shall be provided at all risers with the appropriate information.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE AND HANDLING

- A. Deliver and store valves, compressors and other equipment in shipping containers, with labeling in place, under provisions of Division 01.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures. Maintain in place until installation.

3.2 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

1. Report test results promptly and in writing.
- B. Coordinate work of this Section with other affected work.
- C. Comply with coordination drawings requirements.
- D. Comply with DEN System Interruption Request requirements.
- E. Ream pipe and tube ends to full inside diameter.
- F. Remove burrs, and bevel plain end ferrous pipe.
- G. Remove scale and foreign material, inside and outside, before assembly.
- H. Cleaning:
 1. Thoroughly pre-clean internal surfaces of piping sections to be installed; install piping in accordance with NFPA 13.
 2. Prepare pipe, fittings, supports, and accessories for finish painting.
 3. All work in existing areas shall require daily cleaning, including cleaning and removal of any foreign materials. Final cleaning will require all dust to be recovered and removed.

3.3 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements in Section 211100 "Facility Fire-Suppression Water-Service Piping" for exterior piping.
- B. Install shutoff valve,[**backflow preventer**,] pressure gage, drain, and other accessories indicated at connection to water-service piping.[**Comply with requirements in Section 211100 "Facility Fire-Suppression Water-Service Piping" for backflow preventers.**]
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.4 WATER-SUPPLY CONNECTIONS

- A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements in Section 221116 "Domestic Water Piping" for interior piping.
- B. Install shutoff valve,[**backflow preventer**,] pressure gage, drain, and other accessories indicated at connection to water-distribution piping.[**Comply with requirements in Section 221119 "Domestic Water Piping Specialties" for backflow preventers.**]
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.5 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with DEN Project Manager before deviating from approved working plans.
- B. Piping Standard: Comply with requirements in NFPA 13 for installation of sprinkler piping.
- C. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- D. Install piping to conserve building space, to not interfere with use of space and other work.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.
- G. In steel piping, main sized saddle branch connections or direct connection of branch lines to mains is permitted if main is one pipe size larger than the branch for up to 6 inch mains and if main is two pipe sizes larger than branch for 8 inch and larger mains. Do not project branch pipes inside the main pipe.
- H. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- I. Install unions adjacent to each valve in pipes **NPS 2 (DN 50)** and smaller. Unions are not required on flanged devices or in piping installations using grooved mechanical couplings.
- J. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having **NPS 2-1/2 (DN 65)** and larger end connections.
- K. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
 - 1. Install test connections sized and located in accordance with NFPA 13 complete with shutoff valve. Test connections may also serve as drainpipes.
 - 2. Victaulic "Test Master" or DEN Project Manager approved equal may be used in lieu of test and drainpipe and fittings. Test and drain discharge pipe shall have hose thread connection or discharge as indicated.
- L. Install sprinkler piping with drains for complete system drainage. Install sprinkler piping to provide for system drainage in accordance with NFPA 13. Drainage shall be

coordinated with locations of floor drains having capacity to receive flow.

- M. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- N. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or to outside building.
- O. Connect compressed-air supply to dry-pipe sprinkler piping.
- P. Connect air compressor to the following piping and wiring:
 - 1. Pressure gages and controls.
 - 2. Electrical power system.
 - 3. Fire-alarm devices, including low-pressure alarm.
- Q. Install alarm devices in piping systems.
- R. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- S. Drain dry-pipe sprinkler piping. Piping must be sloped to drain points per NFPA requirements.
- T. Pressurize and check dry-pipe sprinkler system piping and **[air-pressure maintenance devices] [air compressors]**.
- U. Penetrations:
 - 1. Do not penetrate building structural members unless indicated. Penetration of structural members requires structural engineer review and approval.
 - 2. X-RAY: Provide X-ray of Structural walls and Floors prior to attempting drilling or saw cutting to guarantee structural or electrical members are not interrupted by process. Comply with DEN Standard X-ray procedures.
- V. Seals and Sleeves:
 - 1. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
 - 2. Seal pipe and sleeve penetration to achieve fire resistance equivalent to fire separation required.
 - 3. Install mechanical sleeve seal at pipe penetrations in basement and foundation walls.
 - 4. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
 - 5. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply

with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.6 PIPE HANGERS AND SUPPORTS

- A. Reference Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for more information on pipe hangers and supports.
- B. Comply with the requirements of NFPA 13 and NFPA 14. Comply with requirements in NFPA 13 for hanger materials. Hanger and support spacing and locations for piping joined with grooved mechanical couplings shall be in accordance with NFPA 13 and the grooved mechanical coupling manufacturer's written instructions, for rigid systems. Indicate all hangers on shop drawings.
 - 1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 2. Place hangers per NFPA 13.
 - 3. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
- C. Modifications or additions to system: Provide new independent supports from existing building structural components or walls suitable for the support of the added or modified sprinkler piping system.
 - 1. Added sprinkler piping supports shall not be attached to any part of the existing equipment or its support members.
 - 2. Install new piping, hangers, supports, etc., to avoid interference with existing building systems and operational characteristics of material handling systems.
- D. Supports not addressed by NFPA 13 or 14: Submit pipe support shop drawings bearing the wet stamp of a Licensed Colorado Professional Structural engineer for approval. All welding and drilling of existing structural components must be reviewed and approved by the DEN Project Manager prior to proceeding.
- E. Support all horizontal piping within 1'-0" of end.

3.7 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Criteria:
 - 1. Up to and including 2 inch diameter: Screw joint and grooved joint steel piping
 - 2. 2- 1/2 inch diameter and larger: Welded joints (only shop welds), screw joints, or grooved joints.
- C. Install unions adjacent to each valve in pipes **NPS 2** (DN 50) and smaller.

- D. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- E. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- F. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- G. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9. Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.
- H. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - 3. Below grade joints: Die-cut screw joints with full cut standard taper pipe threads with red lead and linseed oil or other nontoxic joint compound applied to male threads only.
 - 4. Assemble joint to appropriate thread depth. When using a wrench on valves, place the wrench on the valve end into which the pipe is being threaded.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.
- I. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- J. Steel-Piping, Cut-Grooved Joints: Mechanical grooved joints may be used instead of threaded or welded joints at accessible aboveground locations. Cut grooves on pipe ends dimensionally compatible with the couplings. Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- K. Welded Joints: AWS D10.9, Level AR-3
- L. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.8 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim,

controls, and specialties according to NFPA 13 and authorities having jurisdiction.

- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Install valves with stems upright or horizontal, not inverted.
- E. Provide gate valves for shut off or isolating service. Provide double check valve (backflow preventer) assembly at sprinkler system water source connection.
- F. Gate Valves: Install supervised-open gate valves indicating type so located to control all sources of water supply, except fire department connections. Where there is more than one control valve, provide permanently marked identification signs indicating the portion of the system controlled by each valve. Refer to Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and signs.
- G. Where approved and/or indicated, butterfly valves may be used instead of gate valves.
- H. Provide drain valves at main shut off valves, low points of piping and apparatus.
- I. Valves: Bear UL, FM Global label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- J. Specialty Valves:
 - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 - 2. **[Dry-Pipe] [and] [Deluge]** Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
 - a. Install air compressor and compressed-air supply piping.
 - b. Air-Pressure Maintenance Device: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with **[14- to 60-psig (95- to 410-kPa)] <Insert value>** adjustable range; and **[175-psig (1200-kPa)] <Insert value>** maximum inlet pressure.
 - c. Install compressed-air supply piping from building's compressed-air piping system.

3.9 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of **[narrow dimension of]** acoustical ceiling panels.

- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.10 AIR COMPRESSOR INSTALLATION

- A. Install air compressor on vibration isolators specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment".
- B. Install air compressor on 4" minimum concrete housekeeping pad.
- C. Installation shall maintain clearances conforming to manufacturer's recommendations.
- D. Pipe automatic receiver tank drain to drain. In cases where drain is remote from compressor location, mount compressor in elevated location to allow positive flow and piping to floor drain. Do not drain system in areas of foot traffic, office or in areas subject to freezing.
- E. Field adjust low air pressure switch, start / stop points for the air compressor air and maintenance devise regulator per instruction of DEN Project Manager at pre-check jobsite meeting and record settings on the as built plans.
- F. Installation to comply with Standard Tank Mounted Air Compressor Detail drawing.
- G. Work effecting existing dry system compressors, either adding of new zones or modifying existing, will require that the existing components be changed to fully and completely upgrade the old systems, to match the Standard Tank Mounted Air Compressor Detail drawing.
- H. All air compressors shall be equipped with a magnetic starter mounted on the wall adjacent to the electrical disconnect, within sight of the unit less than 30' travel distance.

3.11 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire-department connections.
- B. Install yard-type, fire-department connections in concrete slab support. Comply with requirements for concrete in Section 033000 "Cast-in-Place Concrete."
 - 1. Install **[two] [three] <Insert number>** protective pipe bollards **[around] [on sides of]** each fire-department connection. Comply with requirements for bollards in Section 055000 "Metal Fabrications."
- C. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.12 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.13 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. General Requirements: All System Function tests shall be performed during evening hours between 10:00 P.M. and 6:00 A.M. Sunday night through Friday morning.
 - 1. Prior to the time of test observation, the Contractor shall provide written verification that:
 - a. All equipment involved in the test is functioning and is placed as required by contract documents and approved submittals.
 - b. Piping shall have been flushed, as required by NFPA 13, to remove any foreign matter that could have entered the system during installation.
 - 2. Contractor shall submit a system shutdown request form a minimum of five working days prior to testing. The shutdown request shall include at least two alternate times and dates for requested testing. Testing dates will be established in cooperation with all DEN Divisions and the Contractor. Night Testing will be required. An additional fee shall be assessed by the Denver Fire Department. The Contractor shall coordinate and fund these fees prior to the time of the requested test.
 - 3. For cancellation of a test, at least 48 hours notice is required, or it shall be considered a re-test. The Contractor shall be responsible for costs of re-tests incurred by all parties involved.
 - 4. Perform final system testing in conjunction with the fire alarm and detection system specified under Division 28. Test control sequence for operation.
 - 5. Re-tests:
 - a. If a system fails any test, the same scheduling procedure shall be as listed above shall be followed.
 - b. Replace piping system components that do not pass test procedures specified, and then retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
 - c. For the re-scheduled test(s), the Contractor shall be responsible for any added costs incurred by all parties affected.
 - 6. The Contractor shall supply all necessary equipment such as ladders and special tools.
 - 7. Signing of certificate by Owner shall in no way prejudice any claim against Contractor for faulty material, poor workmanship, or failure to comply with the

construction documents.

C. Acceptance Tests:

1. The Contractor shall conduct the following tests for acceptance of the system installation. Contractor shall record the test results on a copy of Material and Test Certificate shown in NFPA 13. Test report(s) information shall be completed by the Contractor prior to final observation.
 - a. A separate test record shall be completed for each observation by the installing Contractor.
 - b. Functional tests shall be performed on all valves and manual operating devices.

D. Specific System Tests for Dry-Pipe Systems:

1. All hydrostatic testing requirements listed for wet pipe system above in this Section shall be conducted. If weather prevents these tests, the optional air tests can be done to facilitate system commissioning, with hydrostatic testing being completed as weather permits.
2. Optional air test may be performed as follows when weather conditions prevent the hydrostatic test prior to placing the system in service.
 - a. Air pressure of 40 psi shall be maintained for 24 hours without losing more than 1.5 psi during the test period.
3. A functional test shall be conducted on all detection devices, valves, and drainage facilities for Dry Pipe systems.

- E. Maximum water delivery time to the inspector's test connection is 60 seconds from when the inspector's test valve is completely open.
- a. The system must be totally drained and placed back in service by the contractor. This includes all additional trips necessary to assure that all the lines are dry.
 2. Coordinate all tests with the DEN Project Manager and authorities having jurisdiction.

F. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

3.14 WATER DAMAGE

- A. The Fire Protection Work Contractor shall be responsible for any damage to the work of others, to building and property/materials of others caused by leaks in automatic sprinkler equipment, unplugged or disconnected pipes or fittings, and shall pay for necessary replacement or repair of work or items so damaged during the installation and testing periods of the automatic sprinkler work.

3.15 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Flush entire piping system of foreign matter.
- C. Apply strippable tape or paper bag covers to ensure concealed sprinkler head cover plates do not receive field paint finish. Remove covers after painting.
- D. Clean exterior of all installation to be painted. Reference Section 230553 "Identification for HVAC Piping and Equipment".
- E. Remove and replace sprinklers with paint other than factory finish.

3.16 DEMONSTRATION

- A. **Engage a factory-authorized service representative to assist Contractor and** train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.
- B. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.
- C. The Fire Protection Work Contractor shall conduct two (2) training sessions to familiarize the Owner's Maintenance personnel with the features, operation and maintenance and related emergency actions or repairs for the sprinkler systems. The amount of time required for training sessions will be based on the complexity of the system, but in no case should it be less than four (4) hours for each session.

3.17 WARRANTY

- A. All work and equipment shall be warranted to be free from defects in workmanship and material for a period of twelve (12) months from the date of Substantial Completion. Any material or equipment found to be defective or malfunctioning during this period shall be repaired or replaced by Contractor without expense to the Owner.

3.18 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with **[threaded ends; cast-iron threaded fittings; and threaded] [grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved]** joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Standard-pressure, dry-pipe sprinkler system, **[NPS 2 (DN 50) and smaller]** **<Insert pipe size range>**, shall be **[one of]** the following:

1. **Schedule 40** , galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
- D. Standard-pressure, dry-pipe sprinkler system, [**NPS 2-1/2 and larger**] (DN 65 and larger) <Insert pipe size range>, shall be[**one of**] the following:
1. **Schedule 40** , galvanized-steel pipe with cut-grooved ends and mechanical couplings, flanged or screwed fittings.
 2. Thinwall galvanized steel pipe, with roll grooved ends and mechanical couplings with flanges or fittings, may be used if approved by DEN Project Manager.
 - a. Threaded thinwall piping shall not be used.
 - b. Pressfit fittings or similar non-threaded connections of any kind will not be permitted.
 3. Use of threaded Hooker fittings and similar rubber gasketed, drill to mount, 2" and smaller clamp on tees will not be permitted.

3.19 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
1. Rooms without Ceilings: [**Upright sprinklers**] <Insert type>.
 2. Rooms with Suspended Ceilings: [**Dry pendent sprinklers**] [**Dry recessed sprinklers**] [**Dry flush sprinklers**] [**Dry concealed sprinklers**] [**Dry pendent, recessed, flush, and concealed sprinklers as indicated**].
 3. Wall Mounting: Dry sidewall sprinklers.
 4. Spaces Subject to Freezing: [**Upright sprinklers**] [**Dry pendent sprinklers**] [**Dry sidewall sprinklers**] [**Upright, dry pendent sprinklers; and dry sidewall sprinklers as indicated**] <Insert type>.
 5. Special Applications: [**Extended-coverage and quick-response sprinklers where indicated**] <Insert type>.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
 3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
 4. [**Upright,**] [**Pendent,**] [**and**] [**Sidewall**] Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 211316

SECTION 211339 - FOAM-WATER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concentrate piping and piping specialties.
2. Bladder tanks and proportioning devices.
3. Foam concentrate.
4. Discharge devices.
5. Monitoring and alarm devices.

B. Related Sections:

1. Section 211200 "Fire-Suppression Standpipes" for standpipe systems. .
2. Section 211313 "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler systems.
3. Section 211316 "Dry-Pipe Sprinkler Systems" for dry-pipe sprinkler systems.
4. Section 212200 "Clean-Agent Fire Extinguishing Systems" for clean-agent systems.
5. Section 213113 "Electric-Drive, Centrifugal Fire Pumps" [**Section 213213 "Electric-Drive, Vertical-Turbine Fire Pumps"**] for fire pumps, pressure-maintenance pumps, and fire-pump controllers.
6. Section 283111 "Digital, Addressable Fire-Alarm System" [**Section 283112 "Zoned (DC Loop) Fire-Alarm System"**] for alarm devices not specified in this Section.

C. Work furnished but installed under other sections:

1. Furnish pipe sleeves, complete with drawings locating all sleeves and indicating sleeve size to Division 03 or 04 contractors for placement.
2. Fireproofing repair.
3. Fire sealants.
4. Painting.

D. Include all design, pipe and fittings, valves, connections, fabrication, and installation of all fire protection systems in accordance with design criteria and requirements indicated herein and on the drawings.

E. Major bulk runs, standpipe mains and risers, and sprinkler crossmains are shown to

assist the contractor where interference with other trades may occur. However, all piping required to complete the fire protection systems shall be designed, fabricated and installed based on approved hydraulic calculations and shop drawings prepared and submitted by the Fire Protection Work Contractor (FPWC). The FPWC shall provide all special tools required for installation or maintenance for the equipment provided. If conflicts occur in this specification or between this specification and the contract documents, most stringent requirement shall apply.

- F. Work on all systems require DEN Shut Down Requests be completed and filed five (5) days before work is to be done. Work on wet systems must be done during offhour periods, 10:00 p.m. to 6:00 a.m., Sunday night through Friday morning. No system may be shut down for periods longer than ten (10) hours. The FPWC is responsible for the required Fire Watch and must remain ON SITE for the entire period of time that the system is not in service. Failure to comply may be reason for immediate suspension of work privileges.
- G. Work on existing systems can be done during normal hours unless it effects the operation of the facility, its tenants, or the support staff.
- H. Install work in association with fire pump installation, wet-pipe and/or dry-pipe sprinkler installation, and all fire and smoke alarm interface in accordance with design criteria and fire/smoke zoning requirements indicated on drawings.
- I. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. AFFF: Aqueous film-forming foam.
- B. AR-AFFF: Alcohol-resistant aqueous film-forming foam.
- C. Standard-Pressure Sprinkler Piping: Sprinkler system piping designed to operate at working pressure 175 psig (1200 kPa) maximum.
- D. High-Pressure Piping System: Sprinkler system piping system designed to operate at working pressure higher than standard 175 psig (1200 kPa)
- E. Pipe sizes used in this specification are Nominal Pipe Size (NPS).
- F. Other definitions for fire protection systems are listed in NFPA 13 and 16.
- G. "Working Plans" as used in this section means those documents (including drawings and calculations) prepared pursuant to the requirements contained in NFPA 13 and NFPA 16 for obtaining approval of the authority having jurisdiction.

1.4 REFERENCE STANDARDS

- A. Materials and workmanship shall conform to the latest issue of all industry standards,

publications, or regulations referenced in this section and with the following references as applicable. Appendices and/or Annexes referenced by these standards shall apply.

B. National Fire Protection Association (NFPA):

1. NFPA 13 - Installation of Sprinkler Systems.
2. NFPA 16 - Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems.
3. NFPA 415 - Standard on Airport Terminal Buildings, Fueling Ramp Drainage, And Loading Walkways.

1.5 REGULATORY REQUIREMENTS

A. Comply with the requirements of the latest editions of following codes:

1. Comply with City and County of Denver Code Agency requirements.
2. UL and FM Global Compliance: Fire protection system materials and components shall be UL listed and labeled, and FM Global approved.
3. Hydraulic Calculations, Product Data, Shop Drawings, Dry Pipe System Equipment, and Low Air Switch, Air Maintenance Device: Bear stamp of approval of Designer of Record, DEN Life Safety Team and Owner's Representative and Denver Fire Department.
4. All applicable insurance authorities underwriting requirements.

1.6 SYSTEM DESCRIPTION

- A. Description: Engineered, fixed, **[wet-pipe] [dry-pipe] [preaction] [deluge]**, automatically actuated, low-expansion, **[AR-]AFFF** fire-extinguishing system for flammable-liquid fires. System includes diaphragm proportioning tanks and devices as described in NFPA 16.
- B. Coordinate all work of this Section with the work of Section 211313 "Wet-Pipe Sprinkler Systems" and Section 211316 "Dry-Pipe Sprinkler Systems".
- C. Interface system with building fire alarm and smoke control system.
- D. System to provide coverage for the specified building area.

1.7 PERFORMANCE REQUIREMENTS

- A. Standard Working Pressure of Piping-System Component: Listed for at least **175 psig** (1200 kPa).
- B. Unless authorities having jurisdiction have stricter requirements, minimum design parameters are as follows:
 1. Solution: **[3] <Insert number>** percent foam-water solution.

2. Sprinkler Spacing: Maximum of [100 sq. ft. (9.5 sq. m)] <Insert area> per sprinkler, and maximum [12-foot (3.7-m)] <Insert dimension> spacing.
 3. Design Density: Minimum [0.16 gpm/sq. ft. (0.108 L/s per sq. m)].
 4. Foam Supply: Minimum [10] <Insert number>-minute discharge time.
 5. Water Supply: Minimum [60] <Insert number> minutes.
 6. Remote Area: Minimum [5000-sq. ft. (476-sq. m)] <Insert area> design area for closed-sprinkler systems. Open-sprinkler systems shall discharge over the entire system area.
 7. Sprinkler Temperature Rating: Maximum 250 to 300 deg F (121 to 149 deg C) at a roof or ceiling, and 135 to 170 deg F (57 to 77 deg C) for intermediate sprinklers.
- C. Seismic Performance: Fire-suppression piping shall withstand the effects of earthquake motions determined according to NFPA 13.
1. Comply with requirements for Seismic Zone 1.
- D. Design and obtain approval from authorities having jurisdiction for fire protection systems specified.
- E. System modifications and remodeling:
1. Minimum Pipe Sizes: Not smaller than existing pipe sizes of sprinklers being relocated.
 2. Should the relocation of sprinklers cause the calculated remote zone to change, hydraulic calculations shall be performed and approved by the authorities having jurisdiction.
- F. Systems shall not serve multiple smoke zone areas.
- 1.8 ACTION SUBMITTALS
- A. Submit working plans and product data under provisions of Division 01.
- B. Product Data: For each type of product indicated. Include the following:
1. Piping, valves, fittings, and hangers.
 2. Seismic restraints for all equipment.
 3. Bladder tanks and proportioning devices.
 4. Foam concentrate.
 5. Discharge devices. Include flow characteristics.
 6. Monitoring and alarm devices. Include electrical data and supervision method.
 7. Foam-concentrate pumps. Include power supply and controller.
 8. Foam-concentrate storage tanks.
 9. Strainers.
 10. Test connections.
 11. Include data substantiating that materials comply with requirements.
- C. Shop Drawings: For each hazard area, drawn to scale, and signed and sealed by a qualified professional engineer. Include plans, elevations, sections, details, and

attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Submittal shall include drawings, hydraulic calculations, hydraulic reference points, detailed pipe layout, hangers and supports, components and accessories and other items as defined by NFPA 13 and NFPA 16.
 3. Indicate pipe materials used, connections, jointing methods, supports, floor and wall penetration seals.
 4. Wiring Diagrams: For power, signal, and control wiring.
 5. Design Calculations: For amount of foam concentrate required for each hazard area.
 6. Plans: Show the following:
 - a. Foam-solution proportioning tanks and devices, piping, discharge devices, monitoring and alarm devices, and accessories.
 - b. Method of attaching hangers to building structure.
 - c. Fire-alarm panel.
 - d. Equipment and furnishings.
 7. Working Plans drawings shall be submitted in hard copy and on recordable digital media. Electronic format to be as approved by DEN Project Manager. Two (2) sets of full size drawings (34"x44") and one (1) copy recordable digital media containing all drawing files shall be submitted to the DEN Life Safety Team as part of each submittal.
 8. Working Plan drawings for remodel areas shall include as built depiction of all sprinkler work within at least a 50 foot radius of the work proposed. Risers and main supply pipes shall also be indicated by size and location.
 9. Final Submittal: Working plans submitted for approval shall have the signed wet stamp of a Professional Engineer, licensed in the State of Colorado with experience in Fire Protection Engineering or the name, certificate number and expiration date for a technician with certification as NICET IV in Water-Based Fire Protection Systems Layout or demonstrable equivalent, certifying that the fire sprinkler system has been designed and hydraulically calculated in compliance with NFPA and governing authorities requirements.
- D. Permit-Approved Drawings: Working plans prepared according to NFPA 16 and approved by authorities having jurisdiction. Include hydraulic calculations complying with NFPA 13.
- E. Submit working plans and product data to Denver Fire Department for approval. Subject to approval, submit copy of approved submittal and permit to the DEN Project Manager.
- F. Submit additional non-returnable copies of current permits and agency approved working plan drawings with System Interruption Request.
- G. Obtain DEN Life Safety Team review and stamp prior to submittal for permit.

1.9 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Domestic water piping.
 2. Compressed air piping.
 3. HVAC hydronic piping.
 4. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. **<Insert item>**.
- B. Qualification Data: For qualified Installer and professional engineer.
- C. Installer's Qualifications: Firms qualified to install and alter fire protection piping, equipment, specialties, and accessories, and repair and service equipment. A qualified firm is one that is experienced in such work, with minimum of five (5) previous projects similar in size and scope to this Project, is familiar with precautions required, and is in compliance with the requirements of the authority having jurisdiction. The firm shall be in possession of City and County of Denver Fire Protection License Class A or B. Refer to Division 01 Section Reference Standards and Definitions for definition of Installer.
1. The qualified installer shall be licensed for the design and installation for the specific type of system in the City and County of Denver and the State of Colorado and have been in business under the current name for five (5) years.
 2. All field personnel must be a current holder of the City & County of Denver Fire Department Fire Protection Installers license.
- D. Manufacturers Qualifications: Company specializing in manufacturing the products specified in this section with minimum five (5) years of documented experience.
- E. Welding certificates: Current welder's qualification certificates and procedures. Reference Division 05.
- F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13 and NFPA 16. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- G. Field quality-control reports.

1.10 CLOSEOUT SUBMITTALS

- A. Submit manufacturer's operation and maintenance data under provisions of Division 01.
- B. Include written maintenance data on components of system, servicing requirements,

and Record Drawings.

- C. Operation and Maintenance Data: For foam fire extinguishing to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. Valves and specialties.
 2. Bladder tanks and proportioning devices.
 3. Foam concentrate.
 4. Discharge devices. Include flow characteristics.
 5. Monitoring and alarm devices. Include supervision method.
 6. Foam-concentrate pumps. Include controller.
 7. Foam-concentrate storage tanks.
 8. Strainers.
 9. Test connections.
- D. "As-Built" Plans shall be provided in the same format and manner as described above. Each set shall be equipped with a plan holder equal to "Stacor Plan Clamps" for the appropriate size drawings.
- E. In addition, all sprinkler system record drawings shall be submitted in the form of hard copies and recordable digital media in format as approved by DEN Project Manager.

1.11 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Discharge Devices: Not less than 20 percent of amount of each type installed.
 2. Foam Concentrate: Not less than 200 percent of amount installed.
- B. The following must be delivered and accepted prior to any testing:
1. Provide a spare parts list. The list is to be provided with material submittal cut sheets.
 2. Provide one set of renewable parts and seals for each dry valve installed.
 3. Provide DEN Representatives all special tools required for installation and maintenance.

1.12 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- C. FM Global Compliance: Provide components that are FM Approved and that are listed in FM's "Approval Guide."
- D. UL Compliance: Provide equipment listed in UL's "Fire Protection Equipment Directory."
- E. Obtain DEN Life Safety Team review and stamp prior to submittal for permit.
- F. Fireproofing: Where hangers require removal of fireproofing, remove minimum amount of fireproofing for hanger attachment. Repair fireproofing per requirements specified in Section 078100 "Applied Fireproofing".
- G. Comply with all requirements of Owner's Insurance Underwriter.

1.13 PROJECT CONDITIONS

- A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary sprinkler service according to requirements indicated:
 - 1. Notify DEN Project Manager no fewer than five (5) days in advance of proposed interruption of sprinkler service.
 - 2. Do not proceed with interruption of sprinkler service without DEN Project Manager's written permission.
 - 3. Comply with DEN Maintenance and Engineering system interruption requirements and provide Denver Fire Department approved Fire Watch during entire time of system interruption.
 - 4. In no case shall the building structure remain without fire protection for more than ten (10) hours.
- B. Schedule rough-in installations with installations of other building components.
- C. Environmental Conditions:
 - 1. The equipment shall be designed and constructed to operate successfully at the rated values under the following environmental conditions:
 - a. Location: Indoors and Outdoors.
 - b. Altitude: 5,500 feet (1677 m) above sea level.
 - c. Ambient temperature range: Minus 30 deg F (minus 35 deg C) to 120 deg F (49 deg C)
 - d. Wind Load: 115 mph with gust factor of 1.3

1.14 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 CONCENTRATE PIPING MATERIALS

- A. Comply with requirements specified in Section 211313 "Wet-Pipe Sprinkler Systems" or Section 211316 "Dry-Pipe Sprinkler Systems" for pipes, fittings, joining materials, hangers, valves, and any other required items for a complete system.
- B. Threaded thinwall piping, black and galvanized, is NOT ALLOWED..
 - 1. Exception: Thinwall piping with approved joints and fittings may be used only on piping 2-1/2 inches and larger, if approved by DEN Project Manager.
- C. Schedule 40, Black Steel Pipe: ASTM A 53/A 53M, [**Type E**] <Insert type>, [**Grade B**] <Insert grade> or ASTM A 795/A 795M, [**Type E**] <Insert type>. Pipe ends may be factory or field formed to match joining method.
 - 1. Gray Iron Threaded Fittings, Classes 125 and 250: ASME B16.4.
 - 2. Gray Iron Pipe Flanges and Flanged Fittings: ASME B16.1.
 - 3. Malleable Iron Threaded Fittings, Classes 150 and 300: ASME B16.3.
- D. Stainless-Steel Pipe: ASTM A 312/A 312M, Schedule 40, [**Grade 304**] [or] [**Grade 316**], with factory-formed threaded or beveled ends; ASTM A 376/A 376M for seamless pipe; or ASTM A 213/A 213M, ASTM A 249/A 249M, and ASTM A 269 for seamless and welded tubing.
 - 1. Class 150 Threaded Fittings: ASME B16.3 and MSS SP 114.
 - 2. Butt-Weld Fittings: ASTM A 403/A 403M.
 - 3. Flanges, Forged Fittings and Flanges, and Socket-Weld Fittings: ASTM A 182/A 182M.
 - 4. Bar Stock and Compression Fittings: ASTM A 276 and ASTM A 479/A 479M.
- E. Red Brass Pipe: ASTM B 43, Schedule 40, with factory- or field-formed threaded ends.
 - 1. Threaded Fittings: ASME B16.11.

2.2 VALVES

- A. General Valve Requirements:
 - 1. UL listed or FM Approved for use in fire-protection systems.
 - 2. Compatible with type of foam concentrate used.
- B. Ball Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International.

- b. Crane Co.; Crane Valve Group; Stockham Division.
- c. Milwaukee Valve Company.
- d. NIBCO INC.
- e. Victaulic Company.
- f. Watts Water Technologies, Inc.
- g. **<Insert manufacturer's name>**
- h. or approved equal.

2. Description:

- a. Standard: UL 258.
- b. For trim and drain functions.
- c. Valves **NPS 1-1/2 (DN 40)** and Smaller: Bronze body with threaded ends.
- d. Valves **NPS 2 and NPS 2-1/2 (DN 50 and DN 65)**: Bronze body with threaded ends or ductile-iron body with grooved ends.
- e. Valves **NPS 3 (DN 80)**: Ductile-iron body with grooved ends.

C. OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Stockham Division.
- c. Milwaukee Valve Company.
- d. NIBCO INC.
- e. United Brass Works, Inc.
- f. Watts Water Technologies, Inc.
- g. **<Insert manufacturer's name>**
- h. or approved equal.

2. Description:

- a. Standard: UL 262.
- b. Accessories: Pregrooved stem for mounting tamper switch for monitoring by fire-alarm panel.
- c. Body Material: Cast or ductile iron.
- d. Ends: Flanged or mechanical.
- e. Packing: Asbestos free.

D. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Anvil International.
- b. Fivalco Inc.
- c. Kennedy Valve; a division of McWane, Inc.
- d. Milwaukee Valve Company.
- e. NIBCO INC.

- f. Shurjoint Piping Products.
- g. Tyco Fire Products LP.
- h. Victaulic Company.
- i. **<Insert manufacturer's name>**
- j. or approved equal.

2. Description:

- a. Standard: UL 1091.
- b. Pressure Rating: **175 psig** (1200 kPa) minimum.
- c. Valves **NPS 2** (DN 50) and Smaller:
 - 1) Body Material: Bronze.
 - 2) End Connections: Threaded.
- d. Valves **NPS 2-1/2** (DN 65) and Larger:
 - 1) Body Material: Cast or ductile iron.
 - 2) End Connections: Flanged, grooved, or wafer.
 - 3) Ends: Flanged or mechanical.
- e. Accessories: Tamper switch for monitoring by fire-alarm panel.

E. Swing Check Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International.
 - b. Clow Valve Company; a division of McWane, Inc.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Crane Co.; Crane Valve Group; Jenkins Valves.
 - e. Crane Co.; Crane Valve Group; Stockham Division.
 - f. Fire-End & Croker Corporation.
 - g. Fire Protection Products, Inc.
 - h. Globe Fire Sprinkler Corporation.
 - i. Kennedy Valve; a division of McWane, Inc.
 - j. Kidde Fire Fighting; a UTC business unit.
 - k. Milwaukee Valve Company.
 - l. Mueller Co. Ltd.; Water Products Division.
 - m. NIBCO INC.
 - n. Potter Roemer; a division of Acorn Engineering Company.
 - o. Reliable Automatic Sprinkler Co., Inc. (The).
 - p. Tyco Fire Products LP.
 - q. United Brass Works, Inc.
 - r. Victaulic Company.
 - s. Viking Group Inc.
 - t. Waterous Company.
 - u. Watts Water Technologies, Inc.
 - v. **<Insert manufacturer's name>**

w. or approved equal.

2. Description:

- a. Standard: UL 312.
- b. Pressure Rating: **[250 psig (1725 kPa) minimum] [300 psig (2070 kPa)]**.
- c. Body Material: Cast iron.
- d. End Connections: Flanged or grooved.

F. Trim and Drain Valves:

1. General Requirements:

- a. Compatible with type of foam concentrate used.
- b. Pressure Rating: **175 psig (1200 kPa) minimum**.

2. Angle Valves:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Fire Protection Products, Inc.
 - 2) United Brass Works, Inc.
 - 3) **<Insert manufacturer's name>**
 - 4) or approved equal.

3. Globe Valves:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Fire Protection Products, Inc.
 - 2) United Brass Works, Inc.
 - 3) **<Insert manufacturer's name>**
 - 4) or approved equal.

4. Plug Valves:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Southern Manufacturing Group.
 - 2) **<Insert manufacturer's name>**
 - 3) or approved equal.

2.3 SPECIALTIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ansul Incorporated.
 2. Chemguard Inc.
 3. National Foam; part of the Kidde Fire Fighting organization.
 4. Viking Group Inc.
 5. **<Insert manufacturer's name>**
 6. or approved equal.
- B. Specialties shall comply with NFPA 16, be compatible with the foam concentrate, and be designed to be drained and cleaned.
- C. Foam-Concentrate Storage Tanks: Buna-N, bladder-type proportioning tank complying with UL 162 and ASME Boiler and Pressure Vessel Code: Section VIII; designed for use with foam-concentrate pumps and for specific type of foam concentrate used. Include bladder, internal piping, fill and drain, glass sight gage, piping, and valves. Contain concentrate in the bladder.
1. Orientation: **[Horizontal design with saddle] [Vertical design with skirt]** support.
- D. Foam-Concentrate Storage Tanks: Atmospheric type, complying with UL 162 and ASME Boiler and Pressure Vessel Code: Section VIII; designed for use with foam-concentrate pumps and for specific type of foam concentrate used. Include pressure-vacuum vent, fill and drain, glass sight gage, piping, and valves.
- E. Foam-Concentrate Pumps: Listed for use in foam-water systems according to NFPA 20. Include supply side pressure relief valve and drain cock or valve.
- F. Proportioning Controllers: Venturi type complying with UL 162 and of capacity to match design at minimum and maximum flow.
- G. Concentrate Control Valves: Water-operated ball or deluge valve designed to open with flow through the proportioning controller.
- H. Concentrate Strainers: Bronze body and stainless-steel mesh strainer with minimum **0.125-inch (3.2-mm)** perforations to remove solids that would block system components.
- I. Pressure Gages: Comply with UL 393; with **3-1/2-inch (90-mm)** minimum-diameter dial, **0- to 300-psig (0- to 2070-kPa)** dial range, and caption "WATER" or "CONCENTRATE" on dial face.
- 2.4 FOAM CONCENTRATE
- A. Description: **[AR-]AFFF** liquid concentrate, complying with NFPA 11 and UL 162, for making foam-water fire-extinguishing foam solution.
- 2.5 DISCHARGE DEVICES
- A. Discharge devices shall be UL listed or FM Approved.

- B. Sprinklers: [**Closed,**] [**Open,**] [**non-**]air-aspirating type; UL listed or FM Approved and listed for use with type of foam concentrate used.
- C. Spray Nozzles: For foam water; include foam generator and distributing deflector to distribute foam or water.

2.6 MONITORING DEVICES

- A. Valve Supervisory Switches: Single pole, double throw, with normally closed contacts complying with UL 753. Switch shall signal fire-alarm panel or releasing panel when valve is in other than fully open position.
- B. Pressure Switches: Single pole, double throw, UL listed or FM Approved and complying with UL 753. Switch shall signal an alarm condition at the fire-alarm panel or releasing panel when switch is in other than fully open position.
- C. Flow Switches: Single pole, double throw, UL listed or FM Approved and complying with UL 753. Switch shall signal an alarm condition at the fire-alarm panel or releasing panel when switch is in other than fully open position.

2.7 ALARM DEVICES

- A. Description: UL listed or FM Approved, low voltage, and surface mounting. Alarm and monitoring devices are specified in Section 283111 "Digital, Addressable Fire-Alarm System" or Section 283112 "Zoned (DC Loop) Fire-Alarm System."

2.8 SIGNAGE AND LABELING

- A. Signage shall be per the requirements of NFPA 13, NFPA 16, FM Global, and any applicable Insurance underwriter.
 - 1. Signs shall be pre-manufactured metal, approximately 3" x 6", located at all valves, main drains, auxiliary drains, air, alarm, and similar devices.
 - 2. Letters and numbers shall be red paint. The identification shall be visible from a distance of 30'.
 - 3. Every drain and control valve shall be permanently labeled with the DEN designated system I.D. number and a consecutive number indicating quantity of drains on the system, i.e. T-4-43 / 3 of 7 in the terminal or FZ – 03 / 2 of 2 .
 - 4. Hydraulic Plaques shall be provided at all risers with the appropriate information
 - 5. All materials shall be waterproof.

PART 3 - EXECUTION

3.1 CONCENTRATE STORAGE TANK INSTALLATION

- A. Equipment Mounting: Install concentrate storage tanks on cast-in-place concrete

equipment bases. Comply with requirements for equipment bases specified in **[Section 033000 "Cast-in-Place Concrete."]** **[Section 033053 "Miscellaneous Cast-in-Place Concrete."]**

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 2. Construct bases to withstand, without damage to equipment, seismic force required by code.
 3. Construct concrete bases **[4 inches (100 mm)] [6 inches (150 mm)] [8 inches (200 mm)]** <Insert dimension> high and extend base not less than **6 inches (150 mm)** in all directions beyond the maximum dimensions of concentrate storage tank unless otherwise indicated or unless required for seismic anchor support.
 4. Minimum Compressive Strength: **[5000 psi (34.5 MPa)] [4500 psi (31 MPa)] [4000 psi (27.6 MPa)] [3500 psi (24.1 MPa)] [3000 psi (20.7 MPa)]** <Insert value> at 28 days.
 5. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around the full perimeter of concrete base.
 6. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
 7. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 8. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Install concentrate storage tanks anchored to substrate according to tank manufacturer's written instructions.
- C. Install tanks level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- D. Install seismic restraints for tanks in compliance with requirements for Seismic Zone 1. Anchor tanks to substrate.
- ### 3.2 PIPING INSTALLATION
- A. Install piping and other components level and plumb.
- B. Install pipe and fittings, valves, and discharge devices according to requirements listed in NFPA 16, "Installation of Foam-Water Sprinkler and Foam-Water Spray Systems."
1. Support piping using supports and methods according to NFPA 13.
 2. Install seismic restraints for concentrate storage tanks and piping systems.
 3. Install monitoring and alarm devices according to NFPA 16 and NFPA 72.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on piping, valves, apparatus, and equipment having **NPS 2-1/2 (DN 65)** and larger end connections.

- D. Ream ends of pipes and tubes and remove burrs.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for foam concentrate. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated.
- K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems and with foam concentrate.

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in Section 211313 "Wet-Pipe Sprinkler Systems" or Section 211316 "Dry-Pipe Sprinkler Systems." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Provide concentrate control and drain valves with piping to permit maintenance of the foam concentrate with continuous sprinkler-system service.
- C. Install proportioning controller in fire-suppression piping to provide coverage to area indicated on Drawings.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

- E. Connect electrical devices to building's fire-alarm system. Comply with requirements for wiring and connections in Section 283111 "Digital, Addressable Fire-Alarm System" or Section 283112 "Zoned (DC Loop) Fire-Alarm System."
- F. Install a fire department connection on the supply side of the proportioning controller when required.

3.4 LABELING

- A. Install labeling on piping, equipment, and panels as per DEN requirements, and according to Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Identify all drain valves per DEN Life Safety Team's Fire Zone number scheme.

3.5 CHARGING SYSTEM

- A. Fill proportioning tanks with foam concentrate after field quality-control testing is complete and satisfactory results have been achieved.

3.6 FIELD QUALITY CONTROL

- A. Coordinate all testing requirements of this Section with testing requirements of Section 211313 "Wet-Pipe Sprinkler Systems" and Section 211316 "Dry-Pipe Sprinkler Systems".
- B. Inspection: Engage the services of a qualified professional engineer to inspect installed fire-extinguishing systems, prepare installation report, and certify that installation complies with the Contract Documents, calculations, and requirements of authorities having jurisdiction.
- C. Comply with operating instructions and procedures in NFPA 16, "Acceptance Tests" Chapter. Include the following tests and inspections to demonstrate compliance with requirements:
 - 1. Check mechanical items.
 - 2. Inspect equipment and check mountings for adequate anchoring to substrate.
 - 3. Check electrical systems.
 - 4. Flush supply piping.
 - 5. Perform hydrostatic pressure test.
 - 6. Perform acceptance test.
 - 7. Perform proportioning system test.
 - 8. Perform discharge test.
 - 9. Flush system piping.
 - 10. Correct malfunctioning equipment; retest to demonstrate compliance. Replace equipment that cannot be satisfactorily corrected or does not perform as specified and indicated; retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.

- D. Perform tests and inspections.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations including connections, and to assist Contractor in testing.
- E. General Requirements: All System Function tests shall be performed during evening hours between 10:00 P.M. and 6:00 A.M. Sunday night through Friday morning.
- F. Prior to the time of test observation, the Contractor shall provide written verification that:
1. All equipment involved in the test is functioning and is placed as required by contract documents and approved submittals.
 2. Piping shall have been flushed, as required by NFPA 13, to remove any foreign matter that could have entered the system during installation.
- G. Contractor shall submit a system shutdown request form a minimum of five (5) working days prior to testing. The shutdown request shall include at least two alternate times and dates for requested testing. Testing dates will be established in cooperation with all DEN Divisions and the Contractor. Night Testing will be required. An additional fee shall be assessed by the Denver Fire Department. The Contractor shall coordinate and fund these fees prior to the time of the requested test.
- H. For cancellation of a test, at least 48 hours notice is required, or it shall be considered a re-test. The Contractor shall be responsible for costs of re-tests incurred by all parties involved.
- I. Perform final system testing in conjunction with the fire alarm and detection system specified under Division 28. Test control sequence for operation.
- J. Re-tests:
1. If a system fails any test, the same scheduling procedure shall be as listed above shall be followed.
 2. Replace piping system components that do not pass test procedures specified, then retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
 3. For the re-scheduled test(s), the Contractor shall be responsible for any added costs incurred by all parties affected.
- K. The Contractor shall supply all necessary equipment such as ladders and special tools.
- L. Signing of certificate by Owner shall in no way prejudice any claim against Contractor for faulty material, poor workmanship, or failure to comply with the construction documents.
- M. Tests and Inspections:
1. After installing foam fire-extinguishing piping system and after electrical circuitry

- has been energized, test for compliance with requirements.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 3. Operational Test: After electrical circuitry has been energized, start systems to confirm proper unit operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

N. Acceptance Tests:

1. The Contractor shall conduct the following tests for acceptance of the system installation. Contractor shall record the test results on a copy of Material and Test Certificate shown in NFPA 13. Test report(s) information shall be completed by the Contractor prior to final observation.
 - a. A separate test record shall be completed for each observation by the installing Contractor.
 - b. Functional tests shall be performed on all valves and manual operating devices.

O. Foam fire-extinguishing piping system will be considered defective if it does not pass tests and inspections.

P. Prepare test and inspection reports.

3.7 DAMAGE

- A. The Fire Protection Work Contractor shall be responsible for any damage to the work of others, to building and property/materials of others caused by leaks in automatic sprinkler equipment, unplugged or disconnected pipes or fittings, and shall pay for necessary replacement or repair of work or items so damaged during the installation and testing periods of the automatic sprinkler work.

3.8 TRAINING

- A. The Fire Protection Work Contractor shall conduct two minimum (2) training sessions to familiarize the Owner's Maintenance personnel with the features, operation and maintenance and related emergency actions or repairs for the sprinkler systems. Training sessions shall be scheduled with the DEN Project Manager. The amount of time required for training sessions will be based on the complexity of the system, but in no case should it be less than four (4) hours each session.
- B. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

3.9 WARRANTY

- A. All work and equipment shall be warranted to be free from defects in workmanship and

material for a period of twelve (12) months from the date of Substantial Completion. Any material or equipment found to be defective or malfunctioning during this period shall be repaired or replaced without expense to the Owner.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 211339

SECTION 211340 - FOAM EXTINGUISHING SYSTEMS FOR AIRCRAFT HANGARS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. This Section includes criteria for the supply, installation and testing of low expansion foam fire suppression systems for aircraft hangars. Materials and equipment specified in this Section include:
 - a. Pipe, fittings, valves, and specialties.
 - b. Sprinklers, foam-water hose racks, and monitor nozzles.
 - c. Low-expansion (AFFF) foam concentrate, foam concentrate storage tanks, and foam concentrate pumps.
2. Products furnished but not installed include sprinkler cabinet with spare sprinklers. Furnish to the DEN's maintenance personnel.
3. Related Work:
 - a. Section 210517 "Sleeves and Sleeve Seals for Fire Suppression Piping" for materials and methods for sealing pipe penetrations through walls and fire/smoke barriers.
 - b. Section 210553 "Identification for Fire Suppression Piping and Equipment" for labeling and identification of fire protection piping system and components.
 - c. Section 213113 "Electric-Drive Centrifugal Fire Pumps" for fire water pumps, motors, controllers, and accessories.

1.3 REFERENCES

- A. Applicable Standards:

1. American National Standards Institute (ANSI):
 - a. B16.5 - Pipe Flanges and Flanged Fittings.
 - b. B16.9 - Factory-made Wrought Steel Buttweld Fittings.
 - c. B16.11 - Forged Steel Fittings, Socket Welded and Threaded.

2. ASME International (ASME):
 - a. B1.20.1 - Pipe Threads, General Purpose.
 - b. B16.3 - Malleable-Iron Threaded Fittings, Classes 150 and 300.
 - c. B16.4 - Cast-Iron Threaded Fittings, Class 125 and 250.
3. American Society for Testing and Materials (ASTM):
 - a. A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
 - b. A105 - Forgings, Carbon Steel, for Piping Components.
 - c. A126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - d. A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate Elevated Temperatures.
 - e. A312/312M – Seamless and Welded Austenitic Stainless Steel Pipes.
 - f. A403/403M – Wrought Austenitic Stainless Steel Piping Fittings.
 - g. A536 - Ductile Iron Castings.
4. American Welding Society (AWS):
 - a. D10.9 - Qualifications of Welding Procedures and Welders for Piping and Tubing.
5. Factory Mutual (FM).
6. National Electrical Manufacturers' Association (NEMA).
7. National Fire Protection Association (NFPA):
 - a. 11 - Foam Extinguishing Systems, Low Expansion, and Combined Agent.
 - b. 13 - Installation of Sprinkler Systems.
 - c. 16 - Installation of Deluge Foam-Water Sprinkler Systems and Foam-Water Spray Systems.
 - d. 20 - Stationary Pumps for Fire Protection.
 - e. 70 - National Electrical Code (NEC).
 - f. 72E - Automatic Fire Detectors.
 - g. 409 - Aircraft Hangars.
8. International Fire Code (UFC).
9. Underwriters Laboratories (UL).

1.4 DEFINITIONS

- A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).
- B. Other definitions for fire protection systems are listed in NFPA 11, 13, 16, and 409.
- C. Working Plans as used in this Section means those documents, including drawings and calculations, prepared pursuant to the requirements contained in NFPA 11, 13, 16, and 409 for obtaining approval of the authority having jurisdiction.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include catalog data sheets and technical information for each major component and/or device specified.
 - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings with Engineer stamp, prepared in accordance with NFPA 13, identified as "Working Plans," including hydraulic calculations where applicable, and which have been approved by the authority having jurisdiction.
- C. Welders' qualification certificates.
- D. Test Reports and Certificates as described in NFPA 11 and NFPA 16.
- E. Foam Pumps:
 - 1. Product Data: Submit manufacturer's technical product data, UL listing and FM approval, including current accurate pump characteristic performance curves with selection points clearly indicated; weights, furnished specialties and accessories; and installation and start-up instructions.
 - 2. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.
 - 3. Wiring Diagrams: Submit foam pump controller manufacturer's electrical requirements for power supply wiring to foam pumps. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed. Foam pump controller shall be furnished by the foam pump manufacturer to comply with listing.

1.6 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For fire pumps, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Product Certificates: For each fire pump, from manufacturer.
- C. Source quality-control reports.
- D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit maintenance data and parts lists for each foam pump, driver, control, and accessory; include "troubleshooting" maintenance guide. Include this data, product data, shop drawings, and wiring diagrams in Operating and Maintenance Manual in accordance with requirements of Division 01.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Design system under the direct supervision of a Professional Engineer who is a member of the Society of Fire Protection Engineers, experienced in design of this type of work and licensed in the State of Colorado using an approved calculation method as determined by the Denver Fire Department.
- B. Qualifications for Welding Processes and Operators: Comply with the requirements of AWS D10.9, Level AR 3.
- C. Regulatory Requirements: Comply with the most current requirements of the following codes: (Note: All NFPA Standards listed shall include applicable Appendix requirements).
 - 1. NEC Compliance: Install foam pumps in accordance with NFPA 70.
 - 2. NEMA Compliance: Provide electrical motors and devices in accordance with NEMA standards.
 - 3. NFPA 11.
 - 4. NFPA 13.
 - 5. NFPA 16.
 - 6. NFPA 20.
 - 7. NFPA 72E.
 - 8. NFPA 409.
 - 9. UL and FM Compliance: Fire protection system materials, pumps, and components shall be UL listed and labeled, or FM approved for the application anticipated.
 - 10. International Fire Code.

1.9 SEQUENCING AND SCHEDULING

- A. Schedule rough-in installations with installations of other building components.

1.10 EXTRA MATERIALS

- A. Sprinkler Wrenches: Furnish to DEN Project Manager with two (2) sprinkler wrenches for each type of sprinkler installed.

- B. Sprinklers and Cabinets: Furnish six (6) extra sprinklers of each style included in the project. Furnish each style with its own sprinkler cabinet and special wrenches as specified in this Section.

1.11 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Handle foam pumps, controllers, and components carefully to prevent damage, breaking, denting, and scoring. Do not install damaged foam pumps or components; replace with new.
- B. Store foam pumps, controllers, and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.
- C. Comply with manufacturer's rigging and installation instructions for unloading foam pumps and moving them to final location.

1.12 HYDRAULIC CALCULATIONS

- A. General: Hydraulic calculations shall be performed in accordance with the requirements of NFPA, FM, IRI, the authority having jurisdiction, and as specified herein.
- B. Velocity: Velocities in excess of 20 feet per second will not be allowed.
- C. Friction Losses: Calculate friction losses in water and foam-water piping in accordance with the Hazen-Williams formula using a "c" value of 120 for steel piping (and 140 for cement-lined ductile iron piping).
- D. Discharge Rate: Uniform discharge rate of sprinkler heads shall be based upon a maximum variation of 15% above the indicated discharge rate. Variation below the indicated discharge rates will not be permitted. Perform both supply and demand calculations.
- E. Foam Concentrate Friction Losses: Calculate friction losses in foam concentrate piping in accordance with the Darcy Formula (a.k.a. Fanning Formula) as indicated in NFPA 16 and NFPA 20. Consideration shall be given to the foam concentrate viscosity.

1.13 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

A. MANUFACTURERS

1. Subject to compliance with requirements, provide fire protection system products from one of the following:
 - a. Gate Valves:
 - 1) Jenkins.
 - 2) Kennedy Valve, Div. of McWane, Inc.
 - 3) Mueller Co.
 - 4) Stockham.
 - 5) **<Insert manufacturer's name>**
 - 6) or approved equal.
 - b. Ball Valves:
 - 1) Victaulic Company of America.
 - 2) **<Insert manufacturer's name>**
 - 3) or approved equal.
 - c. Check Valves:
 - 1) Flomatic Corp.
 - 2) The Metraflex Co.
 - 3) Val-Matic Valve & Manufacturing Corp.
 - 4) Victaulic Company of America.
 - 5) **<Insert manufacturer's name>**
 - 6) or approved equal.
 - d. Grooved Mechanical Couplings:
 - 1) Stockham.
 - 2) Victaulic Company of America.
 - 3) **<Insert manufacturer's name>**
 - 4) or approved equal.
 - e. Flow Control/Deluge Valves:
 - 1) Cla-Val Co.
 - 2) Reliable Automatic Sprinkler Co., Inc.
 - 3) Star Sprinkler Corp.
 - 4) Viking Corp.
 - f. In-Line Balanced Pressure Proportioner Module:
 - 1) National Foam Systems, Inc.
 - 2) Ansul Fire Protection.
 - 3) Spectrum Mfg. Inc.
 - 4) Viking Corp.
 - 5) **<Insert manufacturer's name>**
 - 6) or approved equal.

- g. Low Expansion Foam:
- 1) Ansul Fire Protection.
 - 2) National Foam Systems, Inc.
 - 3) Viking Corp.
 - 4) **<Insert manufacturer's name>**
 - 5) or approved equal.
- h. Foam Concentrate Tanks:
- 1) National Foam Systems, Inc.
 - 2) Wishert-Thompson, Inc.
 - 3) **<Insert manufacturer's name>**
 - 4) or approved equal.
- i. Oscillating Monitor Nozzles:
- 1) Ansul Fire Protection.
 - 2) National Foam Systems, Inc.
 - 3) Spectrum Mfg. Inc.
 - 4) Viking Corp.
 - 5) **<Insert manufacturer's name>**
 - 6) or approved equal.
- j. 1Foam-Water Hose Reel Stations:
- 1) Allenco, J. W. Moore, Inc.
 - 2) National Foam Systems, Inc.
 - 3) Sierra Fire Equipment Co.
 - 4) **<Insert manufacturer's name>**
 - 5) or approved equal.
- k. Water Pressure Regulating Valve:
- 1) Fisher Controls Co.
 - 2) **<Insert manufacturer's name>**
 - 3) or approved equal.
- l. Flow Meters:
- 1) Dieterich Standard, A Dover Industries Co.
 - 2) Taco, Inc.
 - 3) **<Insert manufacturer's name>**
 - 4) or approved equal.
- m. Sprinklers:
- 1) ITT Grinnell.
 - 2) Reliable Automatic Sprinkler Co., Inc.
 - 3) Star Sprinkler Corp.

- 4) Viking Corp.
- 5) **<Insert manufacturer's name>**
- 6) or approved equal.

n. Refractometer:

- 1) American Optical.
- 2) **<Insert manufacturer's name>**
- 3) or approved equal.

o. Foam Concentrate Pump:

- 1) Edwards Manufacturing, Inc.
- 2) Viking Corp.
- 3) **<Insert manufacturer's name>**
- 4) or approved equal.

p. Foam Jockey Pump:

- 1) Edwards Manufacturing, Inc.
- 2) MTH Pump Co.
- 3) **<Insert manufacturer's name>**
- 4) or approved equal.

2.2 PIPE MATERIALS

- A. General: Refer to Part 3 Article "PIPE APPLICATIONS" for identification of systems where the below specified pipe and fitting materials are used.
- B. Steel Pipe: ASTM A53, Grade B, seamless, black steel pipe with Schedule as listed in PART 3.
- C. Stainless Steel Pipe: ASTM A312, Schedule 409, Grade TP304L.

2.3 FITTINGS

- A. Cast-Iron Threaded Fittings: ASME B16.4, Class 250, standard pattern, for threaded joints. Threads shall conform to ASME B1.20.1.
- B. Malleable-Iron Threaded Fittings: ASME B16.3, Class 300, standard pattern, for threaded joints. Threads shall conform to ASME B1.20.1.
- C. Steel Fittings: ANSI B16.9, wall thickness equal to attached pipe, ASTM A234, seamless or welded, for welded joints.
- D. Socket Weld Fittings: ANSI B16.11, Schedule 80, Class 3000, ASTM A105.
- E. Steel Flanges and Flanged Fittings: ANSI B16.5, including bolts, nuts, and gaskets of

the following material group, end connections, facing, and Class.

1. Material Group: 1.1.
2. End Connections: Weld neck or slip on.
3. Facing: Raised face.
4. Class: 150 or 300.

F. Stainless Steel Fittings: Seamless socket weld or buttweld type, conforming to ASTM 403, Grade WP304L.

G. Grooved Mechanical Fittings: ASTM A536, Grade 65-45-12 ductile iron with grooves or shoulders designed to accept grooved end couplings.

1. Subject to compliance with requirements, provide products from one of the following:
 - a. Victaulic Style 741 for Class 150, Style 743 for Class 300.
 - b. **<Insert manufacturer's name>**
 - c. or approved equal.

H. Grooved Mechanical Couplings: Consist of ductile iron housing, a synthetic rubber gasket of central cavity pressure-responsive design with nuts and bolts to secure grooved pipe and fittings. Grooved mechanical couplings including gaskets used on dry-pipe systems shall be of the flush seal type.

1. Subject to compliance with requirements, provide products from one of the following:
 - a. Victaulic Style 77, 07, 005.
 - b. **<Insert manufacturer's name>**
 - c. or approved equal.

2.4 JOINING MATERIALS

- A. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.
- B. Gasket Materials: Thickness, material, and type suitable for AFFF foam concentrate to be handled and design temperatures and pressures.
- C. Pipe Thread Compound: Loctite pipe sealant with Teflon.

2.5 GENERAL DUTY VALVES

- A. Drain and Trim Valves: Sprinkler system drain and trim valves shall be cast bronze or brass, globe or gate valves. These valves shall be rated for a minimum of 300 psi and suitable for sprinkler system applications.

- B. Gate Valves - 2-inch and Smaller: Body and bonnet of cast bronze, 175 pound cold water working pressure - nonshock, threaded ends, solid wedge, outside screw and yoke, rising stem, screw-in bonnet, and malleable iron handwheel. Valves shall be capable of being repacked under pressure, with valve wide open.
- C. Gate Valves - 2-1/2-inch and Larger: Iron body, bronze mounted, 175-pound cold water working pressure - nonshock. Valves shall have solid taper wedge, outside screw and yoke, rising stem, flanged bonnet, with body and bonnet conforming to ASTM A126, Class B; replaceable bronze wedge facing rings; flanged ends; and a packing assembly consisting of a cast-iron gland flange, brass gland, packing, bonnet and bronze bonnet bushing. Valves shall be capable of being repacked under pressure, with valve wide open. Gate valves isolating sprinkler systems shall be provided with FM approved or UL listed valve tamper switches.
- D. Ball Valves: Ductile iron body, stainless steel ball and stem and TFE seats. Valve shall be rated for 300 psi service. Valve shall be provided with hand wheel and gear operator and grooved end connections.
- E. Check Valves: Double disc, spring loaded, normally closed, anti-water hammer design. Seat shall be resilient and water tight. Valve shall be rated for minimum 175 psi working pressure. Body shall be ductile iron with stainless steel shaft and spring(s). Discs and sealing element material shall be suitable for use with foam concentrate supplied. Valve shall be suitable for installation in horizontal or vertical position between ANSI flanges. When installed in piping systems with grooved mechanical joints, valve may be supplied with grooved end connections.

2.6 SPECIALTY VALVES

- A. Deluge Valves:
 - 1. General:
 - a. Construction: Hydraulically operated, globe or angle pattern, and size as required or indicated on drawings. Diaphragm and seat shall be field replaceable. End connections shall be threaded for 2-inch valves and flanged for 3-inch and larger.
 - b. Materials: Cast or ductile iron body and cover, bronze and stainless steel internal valve trim, and synthetic rubber diaphragm and disc.
 - c. Pressure Rating: 175-psig working pressure.
 - d. Approvals: UL-listed or FM-approved.
 - e. External Trim: Valve shall be complete with all external trim and accessories required for remote actuation from fire alarm system and remote manual trip. Provide trim sets for bypass, drain, electric sprinkler alarm switch, pressure gauges, and drip cup assembly piped without valves separate from main drain line. Provide fill line attachment with strainer. Provide electric actuation trim including normally closed solenoid. Valve shall remain open after resetting of automatic or manual trip and shall require manual closing.
 - f. Remote manual trip shall function hydraulically with no electrical

connections required. Operation shall be by means of a quick opening 1/4 turn ball valve. Valve shall be brass with chrome-plated brass ball and Teflon seat and seal. Valve shall be housed in stainless steel enclosure of adequate size to allow free operation of the valve. Enclosure shall be painted red and labeled with "Manual Emergency Station."

- 1) Subject to compliance with requirements, provide products from one of the following:
 - a) Viking Model C-1 Emergency Release Valve.
 - b) **<Insert manufacturer's name>**
 - c) or approved equal.
 2. Water Deluge Valve: Valve shall serve as on-off control of water supply to foam/water systems.
 3. Foam Deluge Valve: Valve shall serve as on-off control of foam flow to the proportioner module for foam/water systems.
- B. Water Pressure Control Valve: Valve shall serve to regulate water pressure for the overhead deluge system and monitor nozzle system. The valve shall maintain a constant downstream pressure regardless of varying inlet pressure.
1. Construction: Hydraulically operated, diaphragm actuated, globe or angle pattern, and size as required or indicated on drawings. End connections shall be flanged.
 2. Materials: Cast or ductile iron body and cover, bronze and stainless steel internal valve trim, and synthetic rubber diaphragm and disc.
 3. Pressure Rating: 175-psig working pressure.
 4. Pressure Adjustment Range: 30 to 165 psi.
 5. Approvals: UL-listed or FM-approved.
 6. External Trim: Valve shall be complete with all external trim and accessories required for self-contained operation. Pilot control shall be a direct-acting, adjustable, spring-loaded, normally open, diaphragm valve, designed to permit flow when controlled pressure is less than the spring setting.
 - a. Subject to compliance with requirements, provide products from one of the following:
 - 1) Cla-Val Model No. 90G-01 Series Pressure Reducing Valve.
 - 2) **<Insert manufacturer's name>**
 - 3) or approved equal.
 7. A single UL-listed or FM-approved valve combining the functions of the water Deluge Valve and Water Pressure Control Valve may be used at the Contractor's option.
- C. Aqueous Film-Forming Foam (AFFF) Concentrate Control Valve Assembly: Valve shall serve as off-on control of foam flow to the proportioner for the foam/water system.
1. Construction: Assembly shall consist of a threaded ball valve with hydraulic

- actuator. Actuator shall be provided with a position indicator and shall have capability for manual over-ride.
2. Materials: Provide ball valve with bronze body, stainless steel ball, stem, packing nut, and Teflon valve seats.
 3. Accessories: Provide a normally closed two-way solenoid valve which, when energized, will direct a pressurized water supply to the valve hydraulic actuator. Valve solenoid shall be operable with a 24Vdc power supply.
- D. Aqueous Film-Forming Foam (AFFF) Pressure Regulating Valve: Valve shall serve to relieve excess foam pump discharge pressure and maintain constant foam concentrate system pressure to the foam/water proportioners.
1. Construction: Hydraulically operated, pilot-controlled, diaphragm type, globe or angle pattern, and size as required or indicated on drawings. Diaphragm and seat shall be field replaceable. End connections shall be flanged.
 2. Material: [**Cast or ductile iron body and cover,**] [**All bronze with**] bronze and stainless steel internal valve trim, and synthetic rubber diaphragm and disc. Provide integral coating, or approved alternate material, as required for corrosion resistance and compatibility with AFFF foam concentrate supplied.
 3. Pressure Rating: Class 250.
 4. Approvals: UL-listed or FM-approved.
 5. External Trim: Valve shall be complete with all external trim and accessories required to maintain constant foam pump discharge pressure regardless of demand changes. Pilot control shall be direct acting, adjustable, spring-loaded, diaphragm-type valve designed for modulating service.
 - a. Subject to compliance with requirements, provide products from one of the following:
 - 1) CLA-VAL Model 50G01.
 - 2) **<Insert manufacturer's name>**
 - 3) or approved equal.
- E. In-line Balanced Pressure Proportioner Module: In-line balanced pressure proportioner shall be used for overhead deluge system and monitor nozzle systems.
1. Construction: Module shall consist of all bronze in-line proportioner, pressure balancing valve, duplex pressure gauge, foam concentrate pressure gauge, foam concentrate isolation valve, and interconnecting piping, fittings, and accessories required for a complete functioning unit. The assembly shall have manual override capability.
 2. Material: Provide material suitable for use with AFFF concentrate supplied.
 3. Approvals: UL-listed or FM-approved.

2.7 AUTOMATIC SPRINKLERS

- A. Sprinklers: Nonair-aspirating open head style as indicated or required by the application. Unless otherwise indicated, provide sprinklers with nominal 1/2-inch discharge orifice.

- B. Sprinkler Finishes: Provide sprinklers with the following finishes.
 - 1. Upright, Pendent, and Sidewall Styles, chrome-plated in finish spaces, exposed to view; rough bronze finish for sprinklers in unfinished spaces. Sprinklers shall be wax-coated where installation exposes to acids, chemicals, or other corrosive fumes.
- C. Sprinkler Cabinet and Wrench: Finished steel cabinet, suitable for wall mounting, with hinged cover and space for six spare sprinklers plus two sprinkler wrenches. Provide a separate cabinet for each style sprinkler.

2.8 LOW EXPANSION FOAM

- A. General: Foam shall be 3% AFFF. The AFFF shall be an aqueous concentrate containing fluorocarbon surface active agents in combination with foam and storage life stabilizers and suitable for use in a mixture of 97% water and 3% concentrate.
- B. The foam concentrate shall meet the following:
 - 1. The AFFF shall be biodegradable after dilution and shall be nontoxic and nonirritating.
 - 2. The AFFF liquid concentrate shall have an uncontaminated minimum storage life of 15 years. The foam manufacturer shall have an established laboratory reexamination service available to the DEN Project Manager and shall furnish a supply of sample containers and detailed instructions for procuring the samples.
 - 3. The AFFF concentrate shall meet the requirements of UL for AFFF and shall be listed by UL for use with standard 1/2-inch orifice nonair-aspirating sprinkler heads without limitation.
 - 4. The foam shall meet the requirements of NFPA for use with overhead sprinkler discharge and shall be formulated to produce stable foam from air-aspirating and nonair-aspirating devices.
 - 5. The foam generated by the AFFF concentrate and water shall produce a fluid, fast-flowing, tough foam which yields a vapor-suppressing aqueous film on hydrocarbon fuels. The foam produced shall be so stabilized as to maintain its integrity as a foam to provide prolonged vapor suppression, heat-absorbing capabilities, and burnback resistance.
 - 6. The AFFF shall be completely compatible with dry chemicals.

2.9 FOAM CONCENTRATE TANKS

- A. General: Foam concentrate tanks shall be approved for AFFF storage and shall have usable capacity as indicated on drawings. Reserve foam concentrate tank shall have capacity equal to the primary tank and shall be permanently piped into the system and designed to be manually activated to supply the system through the foam pumps when the primary tank is off line.
- B. Material: Fiberglass or polyethylene.

- C. Construction: Vertical or horizontal as indicated on the drawings. Provide the following accessories:
1. Expansion dome and clean out.
 2. Inspection hatch.
 3. Fill connection with funnel.
 4. Pressure/vacuum vent.
 5. Drain valve.
 6. Supply and return connections.
 7. Tank support structure.
 8. Low level alarm device to signal when tank is approaching empty.
 9. Low level alarm device to signal when tank is not full.

2.10 FOAM CONCENTRATE AND FOAM JOCKEY PUMPS

- A. General: Provide UL listed and FM approved factory-assembled and tested positive displacement rotary pumps of capacity and electrical characteristics as scheduled, and acceptable to the authority having jurisdiction.
- B. Factory Test: Test each pump at rated condition and provide UL/FM performance curve prior to shipment.
- C. Construction: Provide foam concentrate pumps of **[all bronze] [ductile iron, bronze fitted] [stainless steel]** construction. Pump shafts shall be stainless steel and provided with mechanical seal or lip seal. Pump, motor, and accessories shall be factory assembled and mounted on a common base. Foam concentrate pumps shall be per NFPA 20 and UL listed, FM approved.
- D. Accessories: Provide the following accessories as required:
1. Relief Valve: Provide listed and approved external relief to protect the pump and piping system from over pressurization. Install relief valve per NFPA 20.
 2. Pump Speed: Not greater than 1800 rpm.
 3. Shaft/Coupling Guards: Manufacturer's standard.
 4. Mounting Base: Manufacturer's standard.
 5. Suction strainer per NFPA 20.
 6. Inlet and outlet pressure gauges.
- E. Electric motors: Provide horizontal, foot-mounted, ball-bearing, induction motor with open dripproof NEMA enclosure, of scheduled capacity, in accordance with the provisions in SECTION 15170 - MOTORS and NFPA 20.
- F. Motor Controllers: Provide foam pump motor controller, UL-listed or FM-approved for foam pump service.
1. Type: Across the line or part winding.
 2. Rate controller for scheduled horsepower. Provide controller capable of interrupting short circuit current at least equal to short circuit current in controller supply circuit.

3. Mounting: Floor or wall mounted for field electrical connections.
4. Provide foam concentrate pump controller suitable as electrical service entrance.
5. Enclosure shall be NEMA 2 or better, as suited to Site conditions.

2.11 FOAM-WATER MONITOR NOZZLE SYSTEM

- A. General: Monitor nozzles shall provide complete, self-contained, unmanned sweep protection for the areas indicated. The system shall be water powered type with manual override to allow manual control.
- B. Materials: Suitable for use with 3% AFFF.
- C. Construction:
 1. Pressure Rating: 150 psig minimum.
 2. Speed oscillation: Adjustable from 0 to 250 per second.
 3. Arc: Adjustable from 30° below horizontal to 60° above horizontal and 0 to 180° side to side without regard to mounting position.
 4. Monitor shall be capable of being driven by an external water supply for tests.

2.12 FOAM-WATER HOSE REEL STATIONS

- A. General: Provide foam/water hose stations as indicated on the drawings. Each station shall consist of hose, hose nozzle, hose reel, water pressure regulating valve and proportioner.
- B. Hose: 1-1/2-inch, continuous flow, suitable for use with 3% AFFF. Length shall be as indicated on the drawings. Hose shall be constructed of oil resistant braid with neoprene tube and cover. Provide hardware for attachment to hose reel and nozzle specified.
- C. Nozzle: Provide nozzle suitable for use with 3% AFFF with shutoff valve and pistol grip.
 1. Subject to compliance with requirements, provide products from one of the following:
 - a. National Foam Model JS 10.
 - b. **<Insert manufacturer's name>**
 - c. or approved equal.
- D. Hose Reel: Provide hose reel with capacity for 1-1/2-inch hose as indicated on drawings. Reel shall be suitable for use with 3% AFFF and shall have a working pressure of 300 psig. Provide reel with hand crank rewind and brake assembly and red polyurethane finish.
 1. Subject to compliance with requirements, provide products from one of the following:

- a. National Foam Model FD47-1-1/2.
 - b. **<Insert manufacturer's name>**
 - c. or approved equal.
- E. Water Pressure Regulating Valve: Provide pressure regulating valve in the water supply piping to the proportioner to maintain constant hose inlet pressure regardless of fire water supply pressure. Regulator shall have capacity as indicated on the drawings for the hose station. Outlet pressure shall be adjustable from 75 to 125 psig. Valve shall be constructed of cast iron with threaded end connections.
- 1. Subject to compliance with requirements, provide products from one of the following:
 - a. Fisher Controls Co. Model 95H.
 - b. **<Insert manufacturer's name>**
 - c. or approved equal.
- F. Proportioner: Provide in-line balanced pressure proportioner module as specified in this Section.

2.13 FLOW METERS

- A. Provide a UL-listed/FM-approved flow metering system for the foam pumps. Flow rate of elements and meters shall be the same as connected equipment or system. The test header shall return the foam concentrate to the supply tank.
- B. Flow meters shall consist of an annular flow measuring element and portable meter.
- C. Elements:
- 1. Type: Differential-pressure pitot tube-type design with probe for insertion into pipe.
 - 2. Construction: Stainless steel probe of length to span inside of pipe, with brass fittings and attached tag with flow conversion data. Elements shall be pressure rated for 150 psig and 250oF (120oC).
 - 3. Each station shall be complete with safety shutoff valves and quick connect coupling connections.
- D. Portable Meters: Differential-pressure gauge and two 12-foot hoses in carrying case with handle. Meter, hoses, and valves shall be suitable for use with AFFF. Meter shall become the property of DEN.
- 1. Scale: In inches of water unless otherwise indicated.
 - 2. Accuracy: +0.5% to +2% between 20% to 80% of range.

2.14 REFRACTOMETER

- A. Hand held, automatic temperature compensating refractometer for aqueous solutions

with hermetically sealed hollow prism and with a refractive index scale of 1.3330 to 1.3730. Unit shall be capable of refractive index readings to 0.0002.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which foam pumps, tanks, monitor nozzles, and hose stations are to be installed.
- B. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PIPE APPLICATIONS

A. Foam/Water System Piping:

- 1. Two-inch and smaller: Install Schedule 40 steel pipe with threaded, flanged, or mechanical joints and fittings.
 - a. Flanges and flanged fittings: Class 150, slip on flanges.
 - b. Grooved Mechanical Fittings: Straight runs shall use rigid couplings; flexible couplings may be used for change of direction.
- 2. 2-1/2-inch and larger: Install steel pipe with butt welded, flanged or mechanical joints and fittings.
 - a. Pipe schedule shall conform to the following:

Size (NPS) Inches	Schedule Buttwelded	Mechanical Joint
2-1/2 to 6	40	40
8 to 12	20	30
14 to 18	20	Standard Weight
20 to 24	20	XS

- b. Flanges and flanged fittings: Class 150, weld neck or slip on flanges.
- c. Grooved Mechanical Fittings: Straight runs shall use rigid couplings; flexible couplings may be used for change of direction.
 - 1) National Foam (NF) recommends the use of stainless steel or brass pipe for AFFF concentrates. However, National Foam is also noting that black steel can be used, as an alternate to save money on projects. However, NF recommends periodic testing of the foam concentrate in the piping. NF has been testing steel pipe with AFFF concentrate for the last 7 years and has found no corrosion to the steel pipe or changes to the AFFF concentrate itself. NF does note that galvanized pipe cannot be used for foam concentrate piping.

However, galvanized piping can be used for foam/water piping.

B. Foam Pump Suction Piping (Above Grade):

1. Two-inch and smaller: Install (Schedule 40 steel) (Schedule 40S stainless steel) pipe with socket welded joints and fittings, with flanged connections to equipment.
 - a. Flanges: Class 150, slip on flanges.
2. 2-1/2-inch and larger: Install (Schedule 40 steel) (Schedule 40S stainless steel) pipe with butt welded joints and fittings with flanged connection to equipment.
 - a. Flanges: Class 150, weld neck or slip on flanges.

C. Foam Pump Discharge Piping (Above Grade):

1. Two-inch and smaller: Install (Schedule 40 steel) (Schedule 40S stainless steel) pipe with socket welded joints and fittings, with flanged connections to equipment.
 - a. Flanges: Class 300, slip on flanges.
2. 2-1/2-inch and larger: Install (Schedule 40 steel) (Schedule 40S stainless steel) pipe with butt welded joints and fittings, with flanged connections to equipment.
 - a. Flanges: Class 300, weld neck or slip on flanges.

D. Foam Pump Suction Piping (Below Grade):

1. Two-inch and smaller: Install Schedule 40S stainless steel pipe with socket welded joints and fittings. Do not install flanges below grade.
2. 2-1/2-inch and larger: Install Schedule 40S stainless steel pipe with butt welded joints and fittings. Do not install flanges below grade.

E. Foam Pump Discharge Piping (Below Grade):

1. Two-inch and smaller: Install Schedule 40S stainless steel pipe with socket welded joints and fittings. Do not install flanges below grade.
2. 2-1/2-inch and larger: Install Schedule 40S stainless steel pipe with butt welded joints and fittings. Do not install flanges below grade.

3.3 PIPING INSTALLATIONS

A. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. So far as practical, install piping as indicated.

1. Deviations from approved "Working Plans" for sprinkler piping require written

approval of the authority having jurisdiction. Written approval shall be on file with the Engineer of Record and DEN Project Manager prior to deviating from the approved "Working Plans."

- B. Install sprinkler piping to provide for system drainage in accordance with NFPA 13.
- C. Use approved fittings to make all changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions in pipes 2-inch and smaller adjacent to each valve. Unions are not required on flanged devices or in piping installations using grooved mechanical couplings.
- E. Install flanges or flange adapters on valves, apparatus, and equipment having 2-1/2-inch and larger connections.
- F. Hangers and Supports: Comply with the requirements of NFPA 13. Hanger and support spacing and locations for piping joined with grooved mechanical couplings shall be in accordance with the grooved mechanical coupling manufacturer's written instructions for rigid systems. Provide protection from damage where subject to earthquake in accordance with NFPA 13.
- G. Make connections between underground and aboveground piping using an approved transition piece strapped or fastened to prevent separation.
- H. Install mechanical sleeve seal at pipe penetrations in basement and foundation walls.
- I. Install test connections sized and located in accordance with NFPA 13 complete with shutoff valve and sign. Test connections may also serve as drainpipes.
- J. Install pressure gauge on the riser or feed main at or near each test connection. Provide gauge with a connection not less than 1/4-inch and having a soft-metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and where they will not be subject to freezing.

3.4 PIPE JOINT CONSTRUCTION

- A. Welded Joints: AWS D10.9, Level AR-3.
- B. Threaded Joints: Conform to ASME B1.20.1, tapered pipe threads for field cut threads. Join pipe, fittings, and valves as follows:
 - 1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - 2. Align threads at point of assembly.
 - 3. Apply Teflon tape and Loctite pipe sealant with Teflon to the external pipe threads.
 - 4. Assemble joint to appropriate thread depth. When using a wrench on valves, place the wrench on the valve end into which the pipe is being threaded.

5. Damaged Threads: Do not use pipe with threads that are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

C. Flanged Joints: Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.

D. Mechanical Grooved Joints: Cut grooves on pipe ends dimensionally compatible with the couplings. Roll grooves are not allowed.

E. End Treatment: After cutting pipe lengths, remove burrs and fins from pipe ends.

3.5 INSTALLATION OF VALVES

A. General: Install fire protection specialty valves, fittings, and specialties in accordance with the manufacturer's written instructions, NFPA 11, 13, 16, and 409, and the authority having jurisdiction.

B. Gate Valves: Install supervised-open gate valves so located to control all sources of water supply except fire department connections. Where there is more than one control valve, provide permanently marked identification signs indicating the portion of the system controlled by each valve. Refer to Section 10553 "Identification for Fire Suppression Piping and Equipment" for valve tags and signs.

C. Miscellaneous Valves: Installation of gate or globe valves shall be in accordance with NFPA 11, 13, 16, and 409.

D. Flow Control and Deluge Valves: Install in the vertical or horizontal position, in proper direction of flow, in the main supply to the deluge system. Install the basic trim set in accordance with the manufacturer's written instructions. Connect system controls and test valve for proper operation.

3.6 SPRINKLER INSTALLATIONS

A. Use proper tools to prevent damage during installations.

B. INSTALLATION OF FOAM PUMPS

C. Install foam pumps and foam jockey pumps where shown, in accordance with manufacturer's published installation instructions, complying with UL and FM, NFPA 11, 16, 20, and 409, and with recognized industry practices, to ensure that foam pumps comply with requirements and serve intended purposes.

D. Install foam pumps on minimum of 4-inch high concrete base equal or greater than 3 times total weight of pump and motor, with anchor bolts poured in place. Set and level plumb; grout under pump base with nonshrink grout.

- E. Provide piping; accessories; hangers, supports, and anchors; valves; meters and suction and discharge gauges; and equipment supports as indicated for complete installation.
- F. Lubricate pumps before start-up. Start-up in accordance with manufacturer's instructions.
- G. Coordinate with other work including plumbing, standpipe, fire water, and sprinkler piping as necessary to interface installation of foam pumps properly with other components of fire water protection system.
- H. Check alignment and, when necessary (and possible), realign shafts of motors and pumps within tolerances recommended by manufacturer.
- I. Install pumps and pump drives on vibration isolators as indicated; comply with manufacturer's indicated installation method, if any, and with other Division 21 Sections.
- J. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.
 - 1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 Sections. Do not proceed with equipment start-up until wiring installation is acceptable to Equipment Installer.
 - 2. Provide rotational check of pumps to verify proper rotation.

3.7 FIELD QUALITY CONTROL

- A. Flush, test, and inspect piping systems in accordance with NFPA 11, 13, 16, and 409.
- B. Test and inspect all below ground piping before backfilling and covering pipe.
- C. Replace piping system components that do not pass the test procedures specified and retest repaired portion of the system.
- D. Upon completion of installation of foam pumps, perform field acceptance tests of pumps, complying with operating instructions and procedures of NFPA 20 to demonstrate compliance with requirements. Where possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units that cannot be satisfactorily corrected.
- E. Test all alarms, supervisory switches, and detectors for proper operation.
- F. Check foam tanks for leaks and fill with 3% AFFF concentrate.
- G. Clean strainers and check foam concentrate valves' tightness and action.

- H. Place all valves, controllers, proportioners, and other devices in the normal operating position.
- I. Complete all field quality control items before beginning final system testing.

3.8 TESTING

- A. Preliminary: Before beginning final system testing, all field quality control items and all testing of fire water pumps, foam pumps, detection systems, and alarms shall be completed and approved by the authority having jurisdiction and FM.
- B. Protection: Provide protection for all building components in the hangar subject to wetting from the tests.
 - 1. Protection shall include, but not be limited to, the following items:
 - a. Wrap and secure in waterproof material electrical equipment such as switches, outlets, panels, transformers, etc.
 - b. Cover and secure with waterproof material, all building and equipment components subject to damage from water or foam/water such as insulation, painted surfaces, exposed metals or wood.
 - c. Close and seal all doors and openings between hangar and other areas of the facility, such as office and shop areas, to prevent entry of water or foam/water during testing.
 - 2. Upon completion of testing, Contractor shall flush all areas exposed to foam/water with potable water and shall remove and dispose of all protection materials.
 - 3. Contractor shall repair or replace all materials and components damaged as a result of testing at no additional cost to DEN.
- C. Water Test: Perform a full flow automatic test with water only on each foam-water sprinkler system. Test shall be performed by activating an AFFF manual pull station for each system.
 - 1. Test each system individually to verify proper monitor nozzle and sprinkler distribution, installation, and discharge.
 - 2. Test the maximum number of systems specified to operate simultaneously in case of a fire. Systems shall be in full operation simultaneously during testing to verify proper monitor nozzle and sprinkler discharge.
 - 3. Provide suitable gauge connections, gauges, and meters to verify adequacy of water supply and hydraulic calculations.
 - 4. Check and adjust monitor nozzles for oscillation, and adjust deflector setting as required for indicated coverage pattern.
- D. Final System Test: Upon completion of the water only test, perform a foam-water system test using a 3% AFFF solution in accordance with the requirements of NFPA, FM, and the authority having jurisdiction.

1. Contractor shall test each proportion separately to verify proper proportioning of foam.
2. Foam pumps shall be tested through the flow meter to verify performance.
3. During foam system testing, the Contractor shall perform refractometer readings to verify that foam-water solution is within the limits approved by the authority having jurisdiction and FM.
4. Upon completion of testing, Contractor shall flush systems with potable water, arrange and pay for disposal of foam/water solution in a manner suitable to governing environmental agencies and DEN Project Manager, shall furnish AFFF and refill foam storage tanks, and shall completely prepare system for full operation by DEN.
5. Contractor shall arrange and pay for an experienced technician or Engineer from the foam system equipment manufacturer to be present during all testing and to instruct the DEN's personnel in the full system operation.
6. Contractor shall provide all foam, play pipes, meters, gauges, and other devices required for complete system testing and shall submit test results to the DEN Project Manager in accordance with the requirements of DIVISION 1. Refractometer shall become property of DEN upon completion of testing.
7. Contractor shall notify the DEN Project Manager at least ten days prior to testing. All tests may be witnessed by the DEN Project Manager, FM, authority having jurisdiction, and the Engineer of Record.

3.9 SEQUENCE OF OPERATION:

- A. The foam jockey pump shall cycle on and off to maintain pressure in the foam concentrate piping to the foam deluge valves and foam hose reel inlet. Foam jockey pump shall start when foam concentrate line pressure drops to 15 psig above starting pressure of the main foam concentrate pumps.
- B. The deluge valves shall open on a signal from the fire detection system or remote manual trip of the "Manual Emergency Station." The fire alarm signal to the solenoid actuation trim of the deluge valves will be provided by others under Division 26.
- C. The primary selected foam concentrate pump shall start on a decrease in pressure in the foam concentrate piping due to tripping of the foam deluge valve, a start signal from the alarm detection panel, or the operation of a foam hose station. A further decrease in foam concentrate piping pressure due to failure of the primary selected pump shall start the standby selected foam concentrate pump. A manual selector switch shall be provided to alternate selection of primary and standby foam concentrate pump. The foam jockey pump shall be automatically stopped when the foam concentrate pump starts.
- D. The in line balanced pressure proportioner module shall operate automatically to provide the specified foam/water mixture regardless of the inlet water pressure.
- E. The monitor nozzle system shall function automatically to provide the areas of coverage indicated on the Drawings.
- F. The deluge valve shall remain open until manually closed.

- G. The foam concentrate pump shall remain in operation until manually stopped.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to assist Contractor and train Owner's maintenance personnel to adjust, operate, and maintain system.
 - 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 211340

SECTION 212113.13 - HIGH-PRESSURE CARBON-DIOXIDE FIRE-EXTINGUISHING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Carbon dioxide.
 - 2. Piping.
 - 3. Flexible-hose connectors.
 - 4. Carbon-dioxide cylinders.
 - 5. Cylinder valves.
 - 6. Discharge nozzles.
 - 7. Hangers and supports.
 - 8. Control panels.
 - 9. Detection devices.
 - 10. Manual stations.
 - 11. Switches.
 - 12. Alarm devices.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control panels.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 3. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For high-pressure carbon-dioxide fire-extinguishing system signed and sealed by a qualified professional engineer.
 - 1. Include plans, elevations, sections, and **[mounting]** **[attachment]** details.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
- C. Delegated-Design Submittal: For high-pressure carbon-dioxide fire-extinguishing system signed and sealed by a qualified professional engineer.
1. Indicate compliance with performance requirements and design criteria, including analysis data.
 2. Design Calculations: For weight, volume, and concentration of extinguishing agent required for each hazard area.
 3. Reflected Ceiling Plans:
 - a. Show ceiling penetrations.
 - b. Ceiling-mounted carbon-dioxide fire-extinguishing system items.
 - c. Extinguishing-agent containers if mounted above floor.
 - d. Piping, discharge nozzles, detectors, and accessories.
 - e. Hangers and supports, including hanger types and spacing and methods for attaching hangers to building structure.
 - f. Coordination with items mounted in and above ceiling other than carbon-dioxide fire-extinguishing systems, including ceiling construction components.
 4. Occupied Work Area Plans:
 - a. Controls and alarms.
 - b. Extinguishing-agent containers, piping and discharge nozzles, detectors, and accessories.
 - c. Coordination with equipment and furnishings protected by the system.
 5. Access Floor Space Plans:
 - a. Extinguishing-agent containers, piping, discharge nozzles, detectors, and accessories.
 - b. Method of supporting piping.

1.4 INFORMATIONAL SUBMITTALS

- A. Permit-Approved Drawings: Working plans including design calculations, prepared according to NFPA 12, that have been approved by authorities having jurisdiction.
- B. Seismic Qualification Certificates: For container foundations, cylinder racks, supports, hangers, braces, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- C. Welding certificates.
- D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For carbon-dioxide fire-extinguishing system to include in emergency, operation, and maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.
 - 1. Detection Devices: Not less than [20] <Insert number> percent of amount of each type installed.
 - 2. Container Valves: Not less than [10] <Insert number> percent of amount of each size and type installed.
 - 3. Nozzles: Not less than [20] <Insert number> percent of amount of each type installed.
 - 4. Extinguishing Agent: Not less than [100] <Insert number> percent of amount installed in largest hazard area. Include pressure-rated containers with valves.

1.7 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.8 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ansul Incorporated.
 2. Chemetron Fire Systems; a UTC Fire & Security company.
 3. Fike Corporation.
 4. Kidde-Fenwal, Inc.; a UTC Fire & Security company.
 5. **<Insert manufacturer's name>**.
 6. or approved equal.
- B. Total-Flooding System: Pre-engineered carbon-dioxide fire-extinguishing system designed for total flooding of the hazard area including the room cavity above the ceiling, below the ceiling, and below the raised floor.
- C. Local Application: Pre-engineered carbon-dioxide fire-extinguishing system designed for local application directly on indicated hazards and adjacent areas.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. NFPA Compliance: Fire-extinguishing system, equipment, and components shall comply with NFPA 12.
- F. FM Global Compliance: Provide components that are FM Approved and that are listed in FM's "Approval Guide."
- G. UL Compliance: Provide equipment listed in UL's "Fire Protection Equipment Directory."

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design a carbon-dioxide fire-extinguishing system and obtain approval from authorities having jurisdiction.
1. Total-Flooding System Design Criteria:
 - a. Hazard Type: **[Data-processing center] [Manufacturing process] [Power generation] [Telecommunications center] [Electrical equipment room] <Insert hazard type>**.
 - b. Discharge carbon dioxide for **[60 seconds] <Insert time>** and maintain **[34] <Insert number>** percent concentration by volume at **70 deg F** (21 deg C) for **[10-minute] <Insert time>** holding time in hazard areas.

- c. System shall include separate zones above and below the ceiling[**and beneath the raised floor**].
 - d. Operations and Controls: If smoke is detected below the raised floor, extinguishing agent shall be discharged in the underfloor zone only. If smoke is detected below the ceiling, extinguishing agent shall be discharged in zones above and below the ceiling and below the floor. If smoke is detected above the ceiling, extinguishing agent shall be discharged in the zone above the ceiling only.
 2. Local-Application System Design Criteria:
 - a. Single zone with an individual nozzle protecting indicated hazard surface.
 - b. Discharge rate shall be determined by the listing information on the nozzle and as recommended by the fire-extinguishing system manufacturer.
 3. High-Pressure Piping Design Criteria:
 - a. Comply with ASME B31.1
 - b. Internal Pressure: **2800 psig** (19 306 kPa).
 - B. Seismic Performance: Cylinder racks, supports, hangers, and braces shall withstand the effects of earthquake motions determined according to [**ASCE/SEI 7**] **<Insert requirement>**.
 1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified[**and the system will be fully operational after the seismic event**]."
 2. Component Importance Factor is [**1.5**] [**1.0**].
- 2.3 CARBON DIOXIDE
- A. Vapor Phase: Equal to or more than 99.5 percent carbon dioxide.
 - B. Taste and Odor: None detectable.
 - C. Water Content: Comply with CGA G-6.2.
 - D. Oil Content: Equal to or less than 10 ppm by weight.
- 2.4 PIPING MATERIALS
- A. Piping, Valves, and Discharge Nozzles: Comply with types and standards listed in NFPA 12, Section "Distribution," for charging pressure of system.

2.5 PIPES AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, Grade B, Schedule 40, **[Type E] [Type S]** or ASTM A 106/A 106M, **[Grade A] [Grade B] [Grade C]**, **[black] [and] [galvanized]** finish, seamless-steel pipe.
1. Threaded Fittings:
 - a. Malleable-Iron Fittings: ASME B16.3, Class 300.
 - b. Flanges and Flanged Fittings: ASME B16.5, Class 300 unless Class 600 is indicated.
 2. Welding Fittings: ASME B16.9.
 3. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - a. ASME B16.21, nonmetallic, flat, asbestos-free, **1/8-inch** (3.2-mm) maximum thickness unless thickness or specific material is indicated.
 4. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.
 5. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- B. Stainless-Steel Pipe: ASTM A 269/A 269M or ASTM A 312/A 312M, **[Grade TP304] [Grade TP316] [Grade TP304L] [or] [Grade TP316L]**.
1. Stainless-Steel Fittings: ASTM A 182/A 182M, Class 3000.

2.6 FLEXIBLE-HOSE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ansul Incorporated.
 2. Chemetron Fire Systems; a UTC Fire & Security company.
 3. Fike Corporation.
 4. Kidde-Fenwal, Inc.; a UTC Fire & Security company.
 5. **<Insert manufacturer's name>**.
 6. or approved equal.
- B. Description: Teflon-lined, braided hose with stainless-steel wire-braid covering.
1. Burst Pressure: **5000 psi** (34 474 kPa) minimum.
 2. End Connections: Threaded male couplings.

2.7 CARBON-DIOXIDE CYLINDERS

- A. Operating Pressure: Between **2400 psi** (16 547 kPa) and **3000 psi** (20 684 kPa).

1. Pressure Relief Device: Rupture-disk type.
 - a. Sized and fitted according to 49 CFR 178.
- B. Ambient Storage Conditions: Less than **120 deg F** (49 deg C) and more than **32 deg F** (0 deg C).
- C. Wall Storage Racks: Fabricate racks with chain restraints for upright cylinders as indicated or provide equivalent manufactured wall racks.
- D. Freestanding Storage Racks: Fabricate racks as indicated or provide equivalent manufactured storage racks.
- E. Storage Cylinder Nominal Size: **[50 lb (23 kg)] [75 lb (34 kg)] [100 lb (45 kg)] <Insert weight>**.

2.8 CYLINDER VALVES

- A. Bursting Pressure Rating:
 1. Valves under Constant Pressure: **6000 psi** (41 369 kPa).
 2. Valves Not under Constant Pressure: **5000 psi** (34 474 kPa).
- B. Discharge Valves:
 1. Actuation: **[Pneumatic] [Electric] [Manual]**.
 2. Solenoid Actuator: **[12-V dc] [24-V dc]**.
 3. Pilot Hose: **[Rigid] [Flexible]**.
 4. Valve Material: Brass or stainless steel.
 5. Slave Valve Material: Brass.
 6. Lock-Out: Key-operation selector, for prevention of discharge during maintenance.

2.9 DISCHARGE NOZZLES

- A. Equipment manufacturer's standard material of working pressure, size, discharge pattern, and capacity required for application.

2.10 HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

5. Hanger Rods: Continuous-thread rod with compatible nuts and washers.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod with compatible nuts and washers.

2.11 CONTROL PANELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ansul Incorporated.
2. Chemetron Fire Systems; a UTC Fire & Security company.
3. Fike Corporation.
4. Kidde-Fenwal, Inc.; a UTC Fire & Security company.
5. **<Insert manufacturer's name>**.
6. or approved equal.

B. Description: FM Approved or listed and labeled by a nationally recognized testing agency acceptable to authorities having jurisdiction, including equipment and features required for testing, supervising, and operating fire-extinguishing system.

C. Power Requirements: 120/240-V ac; with electrical contacts for connection to system components and fire-alarm system, and transformer or rectifier as needed to produce power at voltage required for accessories and alarm devices.

2.12 DETECTION DEVICES

A. General Requirements for Detection Devices:

1. Comply with NFPA 12, NFPA 72, and UL 268.
2. 24-V dc, nominal.

B. Ionization Detectors: Dual-chamber type, having sampling and referencing chambers, with smoke-sensing element.

C. Photoelectric Detectors: LED light source and silicon photodiode receiving element.

D. Remote Air-Sampling Detector System: Include air-sampling pipe network, laser-based photoelectric detector, sample transport fan, and control unit.

1. Pipe Network: CPVC tubing connects control unit with calibrated sampling holes.
2. Smoke Detector: Particle-counting type with continuous laser beam. Sensitivity adjustable to a minimum of four preset values.

3. Sample Transport Fan: Centrifugal type, creating a minimum static pressure of **0.05 inch wg** (12.5 Pa) at all sampling ports.
4. Control Unit: Multizone unit as indicated on Drawings. Include same system power supply, supervision, and alarm features as specified for the control panel plus separate trouble indication for airflow and detector problems.
5. Signals to the Central Fire-Alarm Control Panel: Local system trouble is reported to the central fire-alarm control panel as a composite "trouble" signal. Alarms on each system zone are individually reported to the central fire-alarm control panel as separately identified zones.

2.13 MANUAL STATIONS

- A. Description: [**Surface**] [**Semirecessed**], FM Approved or listed and labeled by a nationally recognized testing agency acceptable to authorities having jurisdiction, with clear plastic hinged cover, 120-V ac or low voltage compatible with controls. Include contacts for connection to control panel.
- B. Manual Release: "MANUAL RELEASE" caption, with red finish. Unit can manually discharge extinguishing agent with operating device that remains engaged until unlocked.
- C. Abort Switch: "ABORT" caption, momentary contact, with green finish.
- D. EPO Switch: "EPO" caption, with yellow finish.

2.14 SWITCHES

- A. Description: FM Approved or listed and labeled by a nationally recognized testing agency acceptable to authorities having jurisdiction.
 1. Control Voltage: [**120-V ac**] <Insert electrical rating> compatible with controls.
 2. Include contacts for connection to control panel.
 3. Discharge Pressure Switches: Pneumatic operation for shutdown of equipment.
 4. Power Transfer Switches: Key-operation selector for transfer of release circuit signal from main supply to reserve supply.
 5. Door Closers: Magnetic retaining and release device or electrical interlock to cause the door operator to drive the door closed.

2.15 ALARM DEVICES

- A. Description: FM Approved or listed and labeled by a nationally recognized testing agency acceptable to authorities having jurisdiction; low voltage and surface mounting.
- B. Comply with requirements in [**Section 283111 "Digital, Addressable Fire-Alarm System"**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System"**] for alarm and monitoring devices.

- C. Bells: Minimum 6-inch (150-mm) diameter.
- D. Horns: 90 to 94 dBA.
- E. Strobe Lights: Translucent lens, with "FIRE" or similar caption.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with hazard-area leakage requirements, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with requirements in NFPA 12.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of gas piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- F. Install piping adjacent to equipment and specialties to allow service and maintenance.
- G. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating.
- H. Install piping to permit valve servicing.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and for branch connections.

- K. Install pipe and fittings, valves, and discharge nozzles according to requirements listed in NFPA 12, Section "Distribution Systems."
 - 1. Install pressure relief devices in piping systems.
 - 2. Install seismic restraints for carbon-dioxide cylinders and piping systems.
 - 3. Install control panels, detection system components, alarms, and accessories, complying with requirements of NFPA 12, Section "Detection, Actuation, and Control," as required for supervised system application.
- L. Install carbon-dioxide cylinders in racks anchored to substrate.

3.3 HANGERS AND SUPPORTS

- A. Field fabricate hangers and supports from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- B. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- C. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- D. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- E. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, [NPS 2-1/2 (DN 65)] <Insert size> and larger, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- F. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes to facilitate draining moisture and to not exceed maximum pipe deflections allowed by ASME B31.9 for building-services piping.
- H. Install carbon-steel hangers and supports for steel piping and stainless-steel hangers and supports for stainless-steel piping.
- I. Vertical Piping: MSS Type 8 or 42, clamps.
- J. Individual, Straight, Horizontal Piping Runs:
 - 1. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.
 - 2. Longer than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.
- K. Base of Vertical Piping: MSS Type 52, spring hangers.

- L. Support horizontal piping within [12 inches (300 mm)] <Insert dimension> of each fitting and coupling.
- M. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch- (10-mm-) minimum rods.
- N. Install hangers with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/8 to NPS 1/2 (DN 10 to DN 15): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 3/4 to NPS 1-1/4 (DN 20 to DN 32): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 1-1/2 (DN 40): 12 feet (3.7 m) with 3/8-inch (10-mm) rod.
 - 4. NPS 2 (DN 50): 13 feet (4 m) with 3/8-inch (10-mm) rod.
 - 5. NPS 2-1/2 (DN 65): 14 feet (4.3 m) with 1/2-inch (13-mm) rod.
 - 6. NPS 3 (DN 80): 15 feet (4.6 m) with 1/2-inch (13-mm) rod.
 - 7. NPS 3-1/2 (DN 90): 16 feet (4.9 m) with 1/2-inch (13-mm) rod.
 - 8. NPS 4 (DN 100): 17 feet (5.2 m) with 5/8-inch (16-mm) rod.
 - 9. NPS 5 (DN 125): 19 feet (5.8 m) with 5/8-inch (16-mm) rod.
 - 10. NPS 6 (DN 150): 21 feet (6.4 m) with 3/4-inch (19-mm) rod.
 - 11. NPS 8 (DN 200): 24 feet (7.3 m) with 3/4-inch (19-mm) rod.
- O. Install seismic restraints on piping. Comply with requirements in Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."

3.4 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to equipment, allow space for service and maintenance.
- C. Connect electrical devices to control panel and to building's fire-alarm system. Comply with requirements in [Section 283111 "Digital, Addressable Fire-Alarm System"] [Section 283112 "Zoned (DC Loop) Fire-Alarm System"] for fire-alarm system wiring.
- D. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical power wiring.
- E. Piping Connections for NPS 1/4 to 1/2 (DN 6 to DN 12): Braided stainless-steel hose with threaded male couplings.

3.5 IDENTIFICATION

- A. Identify system components and equipment. Comply with requirements for identification specified in Section 210553 "Identification for Fire-Suppression Piping and Equipment."
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- C. Identify piping, extinguishing-agent containers, other equipment, and panels according to NFPA 12.
- D. Install signs at entry doors for protected areas to warn occupants that they are entering a room protected by a carbon-dioxide fire-extinguishing system.
- E. Install signs at entry doors to advise persons outside the room of the meaning of the horn(s), bell(s), and strobe light(s) outside the protected space.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections according to NFPA 12[**with the assistance of a factory-authorized service representative**]:
 - 1. Visual Inspections:
 - a. Inspect piping, equipment, and nozzles for proper size and location.
 - b. Verify that locations of alarms and manual emergency releases comply with approved Drawings.
 - c. Compare actual hazard configuration to original specification.
 - d. Inspect system for openings or other possible leakage paths.
 - e. Inspect labeling of devices and equipment for proper identification and nameplate data.
 - 2. Testing: After installing carbon-dioxide fire-extinguishing piping system and after electrical circuitry has been energized, test for compliance with requirements.
 - a. Perform nondestructive operational tests on all equipment.
 - b. Perform full-discharge test on all hazards.
 - c. Perform each electrical test and visual and mechanical inspection stated in NETA's "Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems," Sections "Inspection and Test Procedures" and "System Function Tests." Certify compliance with test parameters.
 - d. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - e. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

- f. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Carbon-dioxide fire-extinguishing system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.7 SYSTEM FILLING

- A. Preparation:
 - 1. Verify that piping system installation is complete and clean.
 - 2. Check system for complete enclosure integrity.
 - 3. Check operation of ventilation and exhaust systems.
- B. Filling Procedures:
 - 1. Fill extinguishing-agent containers with extinguishing agent, and pressurize to indicated charging pressure.
 - 2. Install filled extinguishing-agent containers.
 - 3. Energize circuits.
- C. Adjust operating controls.

3.8 MAINTENANCE SERVICE

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include **[three] [six] [nine] [12]** months' full maintenance by **[skilled employees of carbon-dioxide system Installer] [manufacturer's authorized service representative]**. Include **[monthly] [quarterly] [semiannual] [annual]** preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper carbon-dioxide fire-extinguishing system operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to assist Contractor and train Owner's maintenance personnel to adjust, operate, and maintain carbon-dioxide fire-extinguishing system.
 - 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 212113.13

SECTION 212113.16 - LOW-PRESSURE CARBON-DIOXIDE FIRE-EXTINGUISHING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Carbon dioxide.
2. Piping.
3. Flexible-hose connectors.
4. Insulated carbon-dioxide containers.
5. Distribution valves.
6. Discharge nozzles.
7. Hangers and supports.
8. Control panels.
9. Detection devices.
10. Manual stations.
11. Switches.
12. Alarm devices.

- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control panels.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Include data substantiating that materials comply with requirements.

- B. Shop Drawings: For low-pressure carbon-dioxide fire-extinguishing system signed and sealed by a qualified professional engineer.

1. Include plans, elevations, sections, and **[mounting]** **[attachment]** details.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
- C. Delegated-Design Submittal: For low-pressure carbon-dioxide fire-extinguishing system signed and sealed by a qualified professional engineer.
1. Indicate compliance with performance requirements and design criteria, including analysis data.
 2. Design Calculations: For weight, volume, and concentration of extinguishing agent required for each hazard area.
 3. Reflected Ceiling Plans:
 - a. Show ceiling penetrations.
 - b. Ceiling-mounted carbon-dioxide fire-extinguishing system items.
 - c. Extinguishing-agent containers if mounted above floor.
 - d. Piping, discharge nozzles, detectors, and accessories.
 - e. Hangers and supports, including hanger types and spacing and methods for attaching hangers to building structure.
 - f. Coordination with items mounted in and above ceiling other than carbon-dioxide fire-extinguishing systems, including ceiling construction components.
 4. Occupied Work Area Plans:
 - a. Controls and alarms.
 - b. Extinguishing-agent containers, piping and discharge nozzles, detectors, and accessories.
 - c. Coordination with equipment and furnishings protected by the system.
 5. Access Floor Space Plans:
 - a. Extinguishing-agent containers, piping, discharge nozzles, detectors, and accessories.
 - b. Method of supporting piping.

1.4 INFORMATIONAL SUBMITTALS

- A. Permit-Approved Drawings: Working plans including design calculations, prepared according to NFPA 12, that have been approved by authorities having jurisdiction.
- B. Seismic Qualification Certificates: For container foundations, container racks, supports, hangers, braces, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- C. Welding certificates.
- D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For carbon-dioxide fire-extinguishing system to include in emergency, operation, and maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.
 - 1. Detection Devices: Not less than [20] <Insert number> percent of amount of each type installed.
 - 2. Container Valves: Not less than [10] <Insert number> percent of amount of each size and type installed.
 - 3. Nozzles: Not less than [20] <Insert number> percent of amount of each type installed.
 - 4. Extinguishing Agent: Not less than [100] <Insert number> percent of amount installed in largest hazard area. Include pressure-rated containers with valves.

1.7 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.8 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ansul Incorporated.
 2. Chemetron Fire Systems; a UTC Fire & Security company.
 3. **<Insert manufacturer's name>**.
 4. or approved equal.
- B. Total-Flooding System: Pre-engineered carbon-dioxide fire-extinguishing system designed for total flooding of the hazard area including the room cavity above the ceiling, below the ceiling, and below the raised floor.
- C. Local Application: Pre-engineered carbon-dioxide fire-extinguishing system designed for local application directly on indicated hazards and adjacent areas.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. NFPA Compliance: Fire-extinguishing system, equipment, and components shall comply with NFPA 12.
- F. FM Global Compliance: Provide components that are FM Approved and that are listed in FM's "Approval Guide."
- G. UL Compliance: Provide equipment listed in UL's "Fire Protection Equipment Directory."

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design a low-pressure carbon-dioxide fire-extinguishing system and obtain approval from authorities having jurisdiction.
1. Total-Flooding System Design Criteria:
 - a. Hazards: **[Printing presses] [Transformer vaults] [Rolling mills] [Open pits] [Dip tanks] [Manufacturing process] [Power generation] [Telecommunications center] [Electrical equipment room] <Insert hazard type>**.
 - b. Discharge carbon dioxide for **[60 seconds] <Insert time>** and maintain **[34] <Insert number>** percent concentration by volume at **70 deg F** (21 deg C) for **[10-minute] <Insert time>** holding time in hazard areas.

- c. System shall include separate zones above and below the ceiling[**and beneath the raised floor**].
 - d. Operations and Controls: If smoke is detected below the raised floor, extinguishing agent shall be discharged in the underfloor zone only. If smoke is detected below the ceiling, extinguishing agent shall be discharged in zones above and below the ceiling and below the floor. If smoke is detected above the ceiling, extinguishing agent shall be discharged in the zone above the ceiling only.
2. Local-Application System Design Criteria:
- a. Single zone with an individual nozzle protecting indicated hazard surface.
 - b. Discharge rate shall be determined by the listing information on the nozzle and as recommended by the fire-extinguishing system manufacturer.
- B. Seismic Performance: Container foundations, supports, hangers, and braces shall withstand the effects of earthquake motions determined according to [**ASCE/SEI 7**] **<Insert requirement>**.
1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified[**and the system will be fully operational after the seismic event**]."
 2. Component Importance Factor is [**1.5**] [**1.0**].
- C. Design low-pressure carbon-dioxide fire-extinguishing system and obtain approval from authorities having jurisdiction. Design system for **<Insert hazard type>** as appropriate for areas being protected and include safety factor.
- 2.3 CARBON DIOXIDE
- A. Vapor Phase: Equal to or more than 99.5 percent carbon dioxide.
 - B. Taste and Odor: None detectable.
 - C. Water Content: Comply with CGA G-6.2.
 - D. Oil Content: Equal to or less than 10 ppm by weight.
- 2.4 PIPING MATERIALS
- A. Piping, Valves, and Discharge Nozzles: Comply with types and standards listed in NFPA 12, Section "Distribution," for charging pressure of system.

2.5 PIPES AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, Schedule 40, Grade B, [**Type E**] [**Type S**] or ASTM A 106/A 106M, [**Grade A**] [**Grade B**] [**Grade C**], [**black**] [**and**] [**galvanized**] finish, seamless-steel pipe.
1. Threaded Fittings:
 - a. Malleable-Iron Fittings: ASME B16.3, Class 300.
 - b. Flanges and Flanged Fittings: ASME B16.5, Class 300.
 2. Welding Fittings: ASME B16.9.
 3. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - a. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
 4. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.
 5. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
 6. Grooved-Joint Couplings and Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Anvil International.
 - 2) Grinnell Mechanical Products; Tyco Fire Products LP.
 - 3) Shurjoint Piping Products.
 - 4) Victaulic Company.
 - 5) **<Insert manufacturer's name>**.
 - 6) or approved equal.
 - b. Specifically listed for carbon-dioxide fire-extinguishing systems.
 - c. Ductile-Iron Fittings for Grooved-End Steel Pipe: ASTM A 536, [**galvanized**] [**or**] [**painted**].
 - d. Malleable-Iron Fittings for Grooved-End Steel Pipe: ASTM A 47/A 47M.
 - e. Forged-Steel Fittings for Grooved-End Steel Pipe: ASTM A 234/A 234M or ASTM A 106/A 106M steel pipes with dimensions matching ASTM A 53/A 53M steel pipe, and complying with AWWA C606 for grooved ends.
 - f. Mechanical Couplings for Grooved-End Steel Piping: ASTM F 1476, Type I, [**Class 1 - rigid**] [**and**] [**Class 2 - flexible**]. Include ferrous housing sections with continuous curved keys, EPDM rubber gasket suitable for hot and cold water, and bolts and nuts.
- B. Stainless-Steel Pipe: ASTM A 269/A 269M or ASTM A 312/A 312M, [**Grade TP304**] [**Grade TP316**] [**Grade TP304L**] [**or**] [**Grade TP316L**].
1. Stainless-Steel Fittings: ASTM A 182/A 182M, Class 2000.

- a. Threaded: [**Type 304**] [or] [**Type 316**].
- b. Welded: [**Type 304**] [**Type 316**] [**Type 304L**] [or] [**Type 316L**].

2.6 FLEXIBLE-HOSE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ansul Incorporated.
 2. Chemetron Fire Systems; a UTC Fire & Security company.
 3. **<Insert manufacturer's name>**.
 4. or approved equal.
- B. Description: Teflon-lined, braided hose with stainless-steel wire-braid covering.
 1. Design Standard: ASME B31.1.
 2. Internal Pressure: **450 psi** (3101 kPa).
 3. Burst Pressure: **1800 psi** (12 411 kPa) minimum.
 4. End Connections: Threaded male couplings.

2.7 INSULATED CARBON-DIOXIDE CONTAINERS

- A. Containers:
 1. Minimum Manufacturing Standard: ASME Boiler & Pressure Vessel Code, Section VIII, Division 1.
 2. Housing: [**Steel**] [or] [**fiberglass**].
 3. Working Pressure: **363 psi** (2503 kPa).
 4. Maintenance Pressure Requirements: **300 psi** (2068 kPa) and **0 deg F** (minus 18 deg C) with a design pressure of **325 psi** (2241 kPa.)
 5. Bulk System Storage Container Nominal Size: [**3/4 ton** (680 kg)] [**2 tons** (1814 kg)] [**10 tons** (9070 kg)] **<Insert weight>**.
 6. Mini-Bulk System Storage Container Nominal Size: [**800 lb** (363 kg)] [**1000 lb** (454 kg)] [**1500 lb** (680 kg)] **<Insert weight>**.
- B. Valves:
 1. Manual shutoff valve.
 2. Bleeder Valve: [**341 psi** (2352 kPa)] **<Insert pressure>**.
 3. Relief Valve: [**357 psi** (2462 kPa)] **<Insert pressure>**.
- C. Gages:
 1. Liquid level.
 2. Pressure.
- D. High- and Low-Pressure Supervisory Alarm:

1. Maximum Pressure Set Point: 90 percent of allowable working pressure.
2. Minimum Pressure Set Point: **250 psi** (1724 kPa).

E. Refrigeration System:

1. Maintenance Pressure: **300 psi** (2068 kPa) at maximum expected temperature.
2. Pressure Switch:
 - a. Start Pressure: **295 psi** (2034 kPa).
 - b. Stop Pressure: **305 psi** (2103 kPa).
3. Compressor: Commercial grade.
4. Refrigeration Coil Location: Lengthwise near top.
5. Motor:
 - a. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 210513 "Common Motor Requirements for Fire Suppression Equipment."
 - b. Efficiency: Premium efficient.
 - c. Electrical Characteristics:
 - 1) Horsepower: **[1] [1-1/2] [3] <Insert horsepower>**.
 - 2) Volts: **[120] [208] [230] [460] <Insert value>**.
 - 3) Phase: **[Single] [Poly]**.
 - 4) Hertz: 60.
 - 5) Full-Load Amperes: **<Insert value>**.
 - 6) Minimum Circuit Ampacity: **<Insert value>**.
 - 7) Maximum Overcurrent Protection: **<Insert amperage>**.

F. Heating System:

1. Maintenance Temperature: **32 deg F** (0 deg C) at minimum expected temperature.

2.8 DISTRIBUTION VALVES

A. Selector Valve:

1. Actuation: Pneumatic, electro pneumatic, or manual.
2. Design: **[Ball] [Butterfly]**, with spring-return actuator.
 - a. Minimum Burst Pressure: **5000 psi** (34 474 kPa).
 - b. Minimum Pressure without Permanent Distortion: **1800 psi** (12 411 kPa).

B. Master Valve:

1. Actuation: Pneumatic, electro pneumatic, or manual.
2. Design: **[Ball] [butterfly]**, with spring-return actuator.

- a. Minimum burst pressure: **5000 psi** (34 474 kPa).
- b. Minimum pressure without permanent distortion: **1800 psi** (12 411 kPa).

2.9 DISCHARGE NOZZLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ansul Incorporated.
 2. Chemetron Fire Systems; a UTC Fire & Security company.
 3. **<Insert manufacturer's name>**.
 4. or approved equal.
- B. Equipment manufacturer's standard material of working pressure, size, discharge pattern, and capacity required for application.
- C. Corrosion-resistant metal.
- D. Stamped with orifice size and type.

2.10 HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 5. Hanger Rods: Continuous-thread rod with compatible nuts and washers.
- B. Stainless-Steel Pipe Hangers and Supports:
 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 3. Hanger Rods: Continuous-thread rod with compatible nuts and washers.

2.11 CONTROL PANELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ansul Incorporated.
 2. Chemetron Fire Systems; a UTC Fire & Security company.
 3. **<Insert manufacturer's name>**.
 4. or approved equal.

- B. Description: FM Approved or listed and labeled by a nationally recognized testing agency acceptable to authorities having jurisdiction, including equipment and features required for testing, supervising, and operating fire-extinguishing system.
- C. Power Requirements: 120/240-V ac; with electrical contacts for connection to system components and fire-alarm system, and transformer or rectifier as needed to produce power at voltage required for accessories and alarm devices.

2.12 DETECTION DEVICES

- A. General Requirements for Detection Devices:
 - 1. Comply with NFPA 12, NFPA 72, and UL 268.
 - 2. 24-V dc, nominal.
- B. Ionization Detectors: Dual-chamber type, having sampling and referencing chambers, with smoke-sensing element.
- C. Photoelectric Detectors: LED light source and silicon photodiode receiving element.
- D. Remote Air-Sampling Detector System: Include air-sampling pipe network, laser-based photoelectric detector, sample transport fan, and control unit.
 - 1. Pipe Network: CPVC tubing connects control unit with calibrated sampling holes.
 - 2. Smoke Detector: Particle-counting type with continuous laser beam. Sensitivity adjustable to a minimum of four preset values.
 - 3. Sample Transport Fan: Centrifugal type, creating a minimum static pressure of **0.05 inch wg** (12.5 Pa) at all sampling ports.
 - 4. Control Unit: Multizone unit as indicated on Drawings. Include same system power supply, supervision, and alarm features as specified for the control panel plus separate trouble indication for airflow and detector problems.
 - 5. Signals to the Central Fire-Alarm Control Panel: Local system trouble is reported to the central fire-alarm control panel as a composite "trouble" signal. Alarms on each system zone are individually reported to the central fire-alarm control panel as separately identified zones.

2.13 MANUAL STATIONS

- A. Description: [**Surface**] [**Semirecessed**], FM Approved or listed and labeled by a nationally recognized testing agency acceptable to authorities having jurisdiction, with clear plastic hinged cover, 120-V ac or low voltage compatible with controls. Include contacts for connection to control panel.
- B. Manual Release: "MANUAL RELEASE" caption, with red finish. Unit can manually discharge extinguishing agent with operating device that remains engaged until unlocked.
- C. Abort Switch: "ABORT" caption, momentary contact, with green finish.

- D. EPO Switch: "EPO" caption, with yellow finish.

2.14 SWITCHES

- A. Description: FM Approved or listed and labeled by a nationally recognized testing agency acceptable to authorities having jurisdiction.
 1. Control Voltage: [**120-V ac**] <Insert electrical rating> compatible with controls.
 2. Include contacts for connection to control panel.
 3. Discharge Pressure Switches: Pneumatic operation for shutdown of equipment.
 4. Power Transfer Switches: Key-operation selector for transfer of release circuit signal from main supply to reserve supply.
 5. Door Closers: Magnetic retaining and release device or electrical interlock to cause the door operator to drive the door closed.

2.15 ALARM DEVICES

- A. Description: FM Approved or listed and labeled by a nationally recognized testing agency acceptable to authorities having jurisdiction; low voltage and surface mounting.
- B. Comply with requirements in [**Section 283111 "Digital, Addressable Fire-Alarm System"**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System"**] for alarm and monitoring devices.
- C. Bells: Minimum 6-inch (150-mm) diameter.
- D. Horns: 90 to 94 dBA.
- E. Strobe Lights: Translucent lens, with "FIRE" or similar caption.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with hazard-area leakage requirements, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with requirements in NFPA 12.

- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of gas piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- F. Install piping adjacent to equipment and specialties to allow service and maintenance.
- G. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating.
- H. Install piping to permit valve servicing.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and for branch connections.
- K. Install pipe and fittings, valves, and discharge nozzles according to requirements listed in NFPA 12, Section "Distribution Systems."
 - 1. Install pressure relief devices in piping systems.
 - 2. Install seismic restraints for carbon-dioxide containers and piping systems.
 - 3. Install control panels, detection system components, alarms, and accessories, complying with requirements of NFPA 12, Section "Detection, Actuation, and Control," as required for supervised system application.
- L. Install dirt trap, minimum **2 inches** (51 mm) long, with capped nipple at end of each pipe run.
- M. Install carbon-dioxide containers in racks anchored to substrate.

3.3 HANGERS AND SUPPORTS

- A. Field fabricate hangers and supports from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- B. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

- C. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- D. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- E. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, [NPS 2-1/2 (DN 65)] <Insert size> and larger, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- F. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes to facilitate draining moisture and to not exceed maximum pipe deflections allowed by ASME B31.9 for building-services piping.
- H. Install carbon-steel hangers and supports for steel piping and stainless-steel hangers and supports for stainless-steel piping.
- I. Vertical Piping: MSS Type 8 or 42, clamps.
- J. Individual, Straight, Horizontal Piping Runs:
1. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.
 2. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.
- K. Base of Vertical Piping: MSS Type 52, spring hangers.
- L. Support horizontal piping within [12 inches (300 mm)] <Insert dimension> of each fitting and coupling.
- M. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch- (10-mm-) minimum rods.
- N. Maximum Span between Hangers and Piping with Threaded or Welded Joints:
1. NPS 1/4 to NPS 1/2 (DN 8 to DN 15): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 2. NPS 3/4 (DN 20): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 3. NPS 1 (DN 25): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 4. NPS 1-1/4 (DN 32): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 5. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 6. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 7. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 3/8-inch (10-mm) rod.
 8. NPS 3 (DN 80): 12 feet (3.6 m) with 1/2-inch (13-mm) rod.
 9. NPS 4 (DN 100): 14 feet (4.3 m) with 1/2-inch (13-mm) rod.

- O. Maximum Span between Hangers and Piping with Mechanical Joints:
 - 1. NPS 3/4 to NPS 2 (DN 20 to DN 50): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 3 to NPS 4 (DN 80 to DN 100): 10 feet (3 m) with 3/8-inch (10-mm) rod.
- P. Install seismic restraints on piping. Comply with requirements in Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."

3.4 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to equipment, allow space for service and maintenance.
- C. Connect electrical devices to control panel and to building's fire-alarm system. Comply with requirements in [**Section 283111 "Digital, Addressable Fire-Alarm System"**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System"**] for fire-alarm system wiring.
- D. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical power wiring.
- E. Piping Connections for NPS 1/4 to 1/2 (DN 6 to DN 12): Braided stainless-steel hose with threaded male couplings.

3.5 IDENTIFICATION

- A. Identify system components and equipment. Comply with requirements for identification specified in Section 210553 "Identification for Fire-Suppression Piping and Equipment."
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- C. Identify piping, extinguishing-agent containers, other equipment, and panels according to NFPA 12.
- D. Install signs at entry doors for protected areas to warn occupants that they are entering a room protected by a carbon-dioxide fire-extinguishing system.
- E. Install signs at entry doors to advise persons outside the room of the meaning of the horn(s), bell(s), and strobe light(s) outside the protected space.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections according to NFPA 12[**with the assistance of a factory-authorized service representative**]:
1. Visual Inspections:
 - a. Inspect piping, equipment, and nozzles for proper size and location.
 - b. Verify that locations of alarms and manual emergency releases comply with approved Drawings.
 - c. Compare actual hazard configuration to original specification.
 - d. Inspect system for openings or other possible leakage paths.
 - e. Inspect labeling of devices and equipment for proper identification and nameplate data.
 2. Testing: After installing carbon-dioxide fire-extinguishing piping system and after electrical circuitry has been energized, test for compliance with requirements.
 - a. Perform nondestructive operational tests on all equipment.
 - b. Perform full-discharge test on all hazards.
 - c. Perform each electrical test and visual and mechanical inspection stated in NETA's "Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems," Sections "Inspection and Test Procedures" and "System Function Tests." Certify compliance with test parameters.
 - d. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - e. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
 - f. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Carbon-dioxide fire-extinguishing system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.7 SYSTEM FILLING

- A. Preparation:
1. Verify that piping system installation is complete and clean.
 2. Check system for complete enclosure integrity.
 3. Check operation of ventilation and exhaust systems.
- B. Filling Procedures:

1. Fill extinguishing-agent containers with extinguishing agent, and pressurize to indicated charging pressure.
2. Install filled extinguishing-agent containers.
3. Energize circuits.

C. Adjust operating controls.

3.8 MAINTENANCE SERVICE

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include **[three] [six] [nine] [12]** months' full maintenance by **[skilled employees of carbon-dioxide system Installer] [manufacturer's authorized service representative]**. Include **[monthly] [quarterly] [semiannual] [annual]** preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper carbon-dioxide fire-extinguishing system operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to assist Contractor and train Owner's maintenance personnel to adjust, operate, and maintain carbon-dioxide fire-extinguishing system.

Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 212113.16

SECTION 212200 - CLEAN-AGENT FIRE-EXTINGUISHING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Piping and piping specialties.
2. Extinguishing-agent containers.
3. Extinguishing agent.
4. Detection and alarm devices.
5. Control and alarm panels.
6. Accessories.
7. Connection devices for and wiring between system components.
8. Connection devices for power and integration into building's fire-alarm system.

B. DESCRIPTION OF WORK

1. Design and installation of an engineered fire detection and clean-agent total flooding, gaseous agent, fire suppression system.
2. The FPWC shall provide all special tools required for installation or maintenance for the equipment provided. Any conflicts in this specification or between this specification and the contract documents will require the most stringent requirement to apply.
3. Drawings: The contract drawings indicate the general arrangements of the areas to receive detection and clean-agent protection. Contractor is to review all drawings so that all items affecting the operation of the fire detection/clean-agent suppression system, such as equipment location, air diffusers, damper closures, and door openings, are considered in the design of the engineered system.
4. Assure design includes adequate dampers and venting to prevent over-pressurization of the space during clean-agent release.
5. If conflicts occur in this specification or between this specification and the contract documents, most stringent requirement shall apply.
6. Furnish all engineering design and materials for a complete fire detection/clean-agent suppression system including charged clean-agent storage cylinders (both active and reserve), nozzles, restorable release head/s, control panel, detectors, wiring, annunciators, project signage, alarm and all other equipment necessary for a complete operational system.
7. Major system components shall be produced by manufacturer's indicated, or

equal. Substitutions shall comply with all specifications requirements. Design, installation, and service of clean-agent suppression systems shall be supervised by an authorized manufacturer distributor.

8. Contractor shall, as a minimum, provide 24-hour emergency service, 7 days a week and shall be able to respond to an emergency situation within two (2) hours of receiving an emergency trouble call. In addition, Contractor shall maintain liability insurance as required by the General Conditions

C. RELATED SECTIONS

1. Section 210500 "Common Work Results for Fire Suppression".
2. Section 210517 "Sleeves and Sleeve Seals for Fire Suppression Piping".
3. Section 210518 "Escutcheons for Fire Suppression Piping".
4. Section 210529 "Hangers & Supports for Fire Suppression Piping and Equipment".
5. Section 210553 "Identification for Fire Suppression Piping and Equipment".
6. Section 210529 "Supports and Hangers for Fire Suppression Piping".
7. Section 210553 "Identification for Fire Suppression Piping and Equipment".
8. Section 283100 "Intelligent Life-Safety Fire-Management System".

- D. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 REFERENCE STANDARDS AND APPLICABLE PUBLICATIONS

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the reference thereto, latest editions:

1. National Fire Protection Association (NFPA):
 - a. No. 2001 Clean Agent Fire Extinguishing Systems.
 - b. No. 70 National Electric Code.
 - c. No. 72 National Fire Alarm Code.
2. FM Global and appropriate data sheets.
3. Underwriters Laboratories, Inc. (UL) Publication.
 - a. Fire Protection Equipment Directory with quarterly supplements.
4. Department of Transportation (DOT).
 - a. Title 49 Code of Federal Regulations Parts 100 to 199.
 - b. Transportation of Hazardous Materials, DOT3AAZ300 or 3AAZI ST.
5. National Electrical Manufacturers Association (NEMA) Publication. Enclosures for Industrial Controls and Systems.
6. Industrial Risk Insurers Interpretive Guide (Detection & Controls).
7. International Building Code (IBC) with the Denver Amendments.
8. International Fire Code (IFC) with the Denver Amendments.

9. U.S. Environmental Protection Agency, Protection of Stratospheric Ozone 59 FR 13044, March 18, 1994 (Final SNAP Ruling).
10. Requirements of the Authority Having Jurisdiction (AHJ).
11. All other appropriate insurance authorities.

1.4 PROJECT REQUIREMENTS

- A. This installation shall be made in strict accordance with the drawings, specifications, and applicable National Fire Protection Association Standards. All equipment and devices used shall be listed in both the UL Fire Equipment Directory and the FM Global data sheets.
- B. Design and installation of the fire detection/clean-agent suppression system shall be in strict accordance with the following guidelines and regulatory agencies:
 1. NFPA 2001 Clean Agent Fire Extinguishing Systems
 2. NFPA 72 National Fire Alarm Code, Latest Edition
 3. NFPA 70 National Electric Codes, Latest Edition
 4. Americans with Disabilities Act, Title 24, Latest Edition

1.5 DEFINITIONS

- A. ATS: Acceptance Testing Specifications.
- B. EPO: Emergency Power Off.

1.6 ACTION SUBMITTALS

- A. The following shall be submitted for approval within 21 days of award and prior to delivery of materials:
 1. Material and equipment information shall include manufacturer's catalog cut sheet and technical data for each component or device used in the system. This shall include, but not be limited to, the following:
 - a. Detectors.
 - b. Manual discharge switches.
 - c. Control panel.
 - d. Release devices.
 - e. Alarm devices.
 - f. Agent storage cylinders.
 - g. Mounting brackets.
 - h. Discharge nozzles.
 - i. Abort stations.
 - j. Piping isometrics.
 - k. Flow calculations.

- B. Provide information outlining the warranty of each component or device used in the

system.

- C. Provide information outlining the operation and maintenance procedures that will be required of the DEN Project Manager. This information shall explain any special knowledge or tools the DEN Project Manager will be required to employ and all spare parts that should be readily available.
- D. Drawings shall indicate locations, installation details, and operation details of all equipment associated with the clean-agent system. Floor plans shall be provided showing equipment locations, piping, point-to-point wiring, and other details as required. Floor plans shall be drawn to a scale of not less than 1/8"=1'-0". Elevations, cross sections, and other details shall be drawn to a larger scale as required. Isometric piping layouts shall be provided with the shop drawings. In addition, point-to-point electrical layout drawings shall be provided.
- E. Sequence of operation, electrical schematics, and connection diagrams shall be provided to completely describe the operation of the clean-agent system controls.
- F. Submit working plans and product data under provisions of Division 01. Submittal shall include drawings, flow calculations, flow reference points, detailed pip layout, hangers and supports, components and accessories and other items as defined by NFPA 13 & 2001. Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Include design calculations.
 - 3. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 4. Wiring Diagrams: For power, signal, and control wiring.
- G. Working plans drawings shall be submitted in Revit format in hard copy and on Compact Disk. (2) sets of full size drawings (34x44) and (1) Compact Disk containing all drawing files shall be submitted to the DEN Life Safety Team as part of each submittal.
- H. Delegated-Design Submittal: For clean-agent fire-extinguishing system signed and sealed by the qualified professional engineer.
 - 1. Indicate compliance with performance requirements and design criteria, including analysis data.
 - 2. Include design calculations for weight, volume, and concentration of extinguishing agent required for each hazard area.
 - 3. Indicate the Following on Reflected Ceiling Plans:
 - a. Ceiling penetrations and ceiling-mounted items.
 - b. Extinguishing-agent containers if mounted above floor, piping and discharge nozzles, detectors, and accessories.
 - c. Method of attaching hangers to building structure.

- d. Other ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.
4. Indicate the Following on Occupied Work Area Plans:
 - a. Controls and alarms.
 - b. Extinguishing-agent containers, piping, and discharge nozzles if mounted in space, detectors, and accessories.
 - c. Equipment and furnishings.
 5. Indicate the Following on Access Floor Space Plans:
 - a. Extinguishing-agent containers, piping and discharge nozzles, detectors, and accessories.
 - b. Method of supporting piping.
 6. Indicate the Following on Ceiling Plans:
 - a. Extinguishing-agent containers, piping and discharge nozzles, detectors, and accessories.
 - b. Method of supporting piping.
 - c. Other equipment located in the ceiling space that is being protected including sprinkler piping, HVAC equipment, raceways, or conduit.
- I. Product data and ratings for each type nozzle, valve, piping specialty, fire protection specialty, detector, manual pull box, control panel graphic panel and all specified items.
 1. Include data substantiating that materials comply with requirements.
 - J. Final Submittal: Working plans submitted for approval shall have the signed wet stamp of registered Fire Protection Engineer licensed in the State of Colorado (or N.I.C.E.T 4), certifying that the fire sprinkler system has been designed and flow calculated in compliance with NFPA and governing authorities requirements.
 - K. Obtain DEN Life Safety Team review and stamp prior to submittal for permit.
 - L. Submit working plans and product data to Denver Fire Department for approval. Subject to approval, submit copy of approved submittal and permit to the DEN Project Manager.
 - M. Submit additional non returnable copies of current permits and agency approved working plan drawings with System Interruption Request.
 - N. Maintenance data for each type nozzle, valve, piping specialty, fire protection specialty, detector, manual pull box, control panel, graphic panel and all specified items shall be included in operating and maintenance manual specified in Division 01 and Division 15 Sections.
 - O. LEED Submittals:

1. Product Data for Credit EA 4: Documentation indicating that clean agents comply.

1.7 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 1. Domestic water piping.
 2. Items Penetrating Finished Ceiling Include the Following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. **<Insert item>**.
 3. **<Insert other items if required>**.
- B. Installer qualifications, as per requirements in Quality Assurance article in this Section.
- C. Current Welders' qualification certificates and procedures. Reference Division 5.
- D. Test reports and certificates including "Contractor's Material and Test Certificate for Aboveground Piping" as described in NFPA 13 and per the requirements of NFPA 2001.
- E. Permit Approved Drawings: Working plans, prepared according to NFPA 2001, that have been approved by authorities having jurisdiction. Include design calculations.
- F. Seismic Qualification Certificates: For extinguishing-agent containers and control panels from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- G. Field quality-control reports.

1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For special agent system to include in emergency, operation, and maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.9 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.
1. Detection Devices: Not less than 20 percent of amount of each type installed.
 2. Container Valves: Not less than 10 percent of amount of each size and type installed.
 3. Nozzles: Not less than 20 percent of amount of each type installed.
 4. Extinguishing Agent: Not less than 100 percent of amount installed in largest hazard area. Include pressure-rated containers with valves.

1.10 QUALITY ASSURANCE

- A. Installer Qualifications:
1. Installer's Qualifications: Firms qualified to install and alter fire protection piping, equipment, specialties, and accessories, and repair and service equipment.
 2. A qualified firm is one that is experienced, with minimum of five (5) previous projects similar in size and scope to this Project, in such work, familiar with precautions required, and in compliance with the requirements of the authority having jurisdiction. The firm shall be in possession of City and County of Denver Fire Protection License Class A. Refer to Section 014225 "Referenced Standards" for definition of Installer.
 - a. The qualified installer shall be licensed for the design and installation for the specific type of system in the City and County of Denver and the State of Colorado and have been in business under the current name for five (5) years.
 - b. Submit evidence of such qualifications to the DEN Project Manager.
- B. Manufacturer's Qualifications:
1. Company specializing in manufacturing the products specified in this section with minimum five (5) years documented experience.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. FM Global Compliance: Provide components that are FM Approved and that are listed in FM Global's "Approval Guide."
- E. UL Compliance: Provide equipment listed in UL's "Fire Protection Equipment Directory."

1.11 SYSTEM DESCRIPTION AND OPERATION

- A. The system shall be an clean-agent total flooding, gaseous, clean agent, fire suppression system designed to provide a uniform concentration of clean-agent for the protected area.
1. The amount of clean-agent to be provided shall be the amount required to obtain a uniform (minimum) concentration of **[37.5] [Insert number]** percent for ten (10) minutes, at an altitude of 5500 feet above sea level. Take into consideration such factors as unclosable openings, if any, "rundown" time of fans, time required for dampers to close, requirements for any additional dampers, and any other feature of the facility that could affect concentration. The design concentration shall be by volume at 70 degrees F.
- B. Cross-zoned or Counting Zone Smoke Detection: The clean-agent system shall be automatically actuated by either counting zone detection circuits or cross-zoned detection circuits. Smoke detectors shall be photoelectric with compatibility listings for use with the control unit. Smoke detectors shall be installed per manufacturer's requirements and applicable codes. The detectors shall be alternated throughout the protected area with the system requiring two (2) detectors in alarm prior to automatic agent release.

1.12 SEQUENCE OF OPERATION

- A. Activation of a single **[verified]** smoke detector in the detection zone shall:
1. Cause a first stage alarm condition.
 2. Transmit a "pre-release alarm" signal from the system control panel to the building fire alarm main panel (FAMP) either directly or via fire alarm remote panel (FARP).
 3. The FAMP shall transmit an alarm condition to the central station monitoring site and start standard building alarm programming for one device.
 4. Light an LED on the activated detector.
 5. Light an LED on the control panel **[and the point lit graphic annunciator]**.
 6. The FAMP shall operate all dampers to contain the room and prepare for agent release. Close any main system dampers and/or establish room tightness to assure that the agent is controlled.
- B. Activation of a second **[verified]** smoke detector in the detection zone shall:
1. Cause a second stage (pre-discharge) alarm condition at the local site.
 2. Activate a pre-discharge audible signal in the detection zone at the local site.
 3. Light an LED on the activated detector.
 4. Light an LED on the control panel **[and the point lit graphic annunciator]**.
 5. Operate auxiliary contacts for HVAC shutdown and damper closure.
 6. Initiate a programmable time delay for Agent release. Upon completion of the Agent release time delay, the system shall:
 - a. Cause a discharge alarm condition.

7. Transmit a "Discharge" signal from the system control panel to the building fire alarm main panel (FAMP) either directly or via fire alarm remote panel (FARP):
 - a. Activate a discharge horn/strobe signal in the detection zone at the local site zone.
 - b. Activate discharge visual signals (strobes) outside the detection zone area entrances.
 - c. Operate auxiliary contacts for emergency power off (EPO) of all electrical equipment (excluding lighting and emergency circuits for life safety).
 - d. Energize the control solenoid for Agent release to the detection zone.

C. Activation of a manual discharge station in the detection zone shall:

1. Cause a first stage alarm condition.
2. Transmit a "pre-release alarm" signal from the system control panel to the building fire alarm main panel (FAMP) either directly or via fire alarm remote panel (FARP).
3. The FAMP shall transmit an alarm condition to the central station monitoring site and start standard building alarm programming for one device.
4. Light an LED on the activated detector.
5. Light an LED at the control panel [**and the point lit graphic annunciator**].
6. The FAMP shall operate all dampers to contain the room and prepare for agent re-release. Close any main system dampers and/or establish room tightness to assure that the agent is contained.
7. Cause a second stage (pre-discharge) alarm condition at the local site.
8. Activate a pre-discharge audible signal in the detection zone at the local site.
9. Light an LED on the activated detector.
10. Light an LED on the control panel [**and the point lit graphic annunciator**].
11. Operate auxiliary contacts for HVAC shutdown and damper closure.
12. Initiate a programmable time delay for Agent release. Upon completion of the Agent release time delay, the system shall:
 - a. Cause a discharge alarm condition.
13. Transmit a "discharge" signal from the system control panel to the building fire alarm main panel (FAMP) either directly or via fire alarm remote panel (FARP):
 - a. Activate a discharge horn/strobe signal in the detection zone at the local site zone.
 - b. Activate discharge visual signals (strobes) outside the detection zone area entrances.
 - c. Operate auxiliary contacts for emergency power off (EPO) of all electrical equipment (excluding lighting and emergency circuits for life safety).
 - d. Energize the control solenoid for Agent release to the detection zone.

1.13 SYSTEM ARRANGEMENT

- A. Fire suppression system shall be of the engineered, permanently piped, fixed nozzle type with all pertinent components provided by Ansul Fire Protection or equal.

- B. All agent storage cylinders shall be centrally located as vertical, free-standing cylinders with wall and/or floor mounted retaining brackets. Where multiple cylinders are required for the same hazard, a common manifold shall be employed. Cylinders shall not be mounted horizontally.
- C. On multiple cylinder arrangement (discharging into a common hazard) one cylinder shall be designated as the pilot cylinder and employ both the restorable/resetable electric and mechanical manual actuators. All remaining cylinders shall be pneumatically operated from the clean-agent discharge of the pilot cylinder into the manifold.
- D. Manifoldded cylinders shall employ a flexible discharge hose to facilitate installation and system maintenance. Each cylinder on a manifold shall also include an agent check valve installed to the manifold inlet. Arrange piping to allow any cylinder to be removed without disrupting service of the system.
- E. Panel location shall be as approved by Denver Fire Department.

1.14 FLOW CALCULATIONS

- A. Computerized verification of flow calculations shall be submitted for each clean-agent fire suppression system and include the following data as a minimum:
 - 1. Quantity of agent per nozzle.
 - 2. Type of nozzle.
 - 3. Pressure at nozzle (psi).
 - 4. Nozzle body nominal pipe size (inch).
 - 5. Number and size of cylinders.
 - 6. Total agent.
 - 7. Pipe size per pipe section.
 - 8. Pipe schedule per pipe section.
 - 9. Number, size and type of fitting per pipe section.
 - 10. Actual length per pipe section (feet).
 - 11. Equivalent length per pipe section (feet).
 - 12. Discharge time (seconds).

1.15 AUXILIARY COMPONENTS

- A. Double action manual releasing stations shall be provided at each exit of the protected area and shall, when activated, immediately release the clean-agent agent and cause all audible/visual alarms to activate. In addition, activation of the manual releasing stations shall cause immediate shutdown of air and power circuits.
- B. Abort stations shall be provided at each exit of the protected area and shall, when operated, interrupt the discharge of clean-agent and emergency power-off functions. The abort stations shall be momentary devices (dead-man) requiring constant pressure to maintain contact closure.
 - 1. Manual Releasing Station activation shall override any abort station. Abort station

operation shall be per FM Global guidelines.

- C. Graphic annunciator (required) shall be provided at the control panel location. The graphic annunciator shall be provided by the equipment manufacturer in an approved NEMA enclosure with keyed face plate. The graphic annunciator shall display the entire clean-agent protected area and shall indicate each smoke detector and its proximity. Smoke detectors, when activated, will individually annunciate at the graphic annunciator as follows:
 - 1. Ceiling Detector: Red LED
 - 2. Subfloor Detector: Amber LED
- D. Provide one (1) set, for each system, of the tools necessary to reset both the control head and booster and all other specified tools.

1.16 WARRANTY

- A. All clean-agent system components furnished under this Contract shall be guaranteed against defect in design, material, and workmanship for the full warranty time which is standard with the manufacturer and/or supplier but not less than one (1) year from the date of system acceptance by Owner.
- B. The installing contractor must guarantee the system against false actuation or leakage due to faulty equipment, design, or workmanship for a period of one (1) year from final acceptance. In the event of clean-agent agent leakage or system discharge from any of the above conditions, the installing contractor shall completely recharge and recondition the system at no cost to the DEN Project Manager. In addition, the installing contractor shall be financially responsible for correcting all damages resulting from agent leakage or system discharge.

1.17 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 CLEAN-AGENT SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ansul Incorporated.
 - 2. Chemetron Fire Systems; a UTC Fire & Security company.
 - 3. Fike Corporation.
 - 4. Pem All Fire Extinguisher Corporation; a division of Pem Systems Inc.

5. Pyro-Chem.
 6. Siemens Building Technologies, Inc.; Fire Safety Division.
 7. **<Insert manufacturer's name>**.
 8. or approved equal.
- B. The name of the manufacturer and the serial numbers shall appear on all major components.
- C. Description: Clean-agent fire-extinguishing system shall be an engineered system for total flooding of the hazard area including the room cavity above the ceiling, below the ceiling, and below the raised floor. System includes separate zones above and below the ceiling and beneath the raised floor. If smoke is detected below the raised floor, extinguishing agent shall be discharged in the underfloor zone only. If smoke is detected below the ceiling, extinguishing agent shall be discharged in zones above and below the ceiling and below the floor. If smoke is detected above the ceiling, extinguishing agent shall be discharged in the zone above the ceiling only.
- D. Delegated Design: Design clean-agent fire-extinguishing system and obtain approval from authorities having jurisdiction. Design system for Class A, B, and C fires as appropriate for areas being protected, and include safety factor. Use clean agent indicated and in concentration suitable for normally occupied areas.
- E. Performance Requirements: Discharge HFC 227ea within 10 seconds and maintain 7.1 percent concentration by volume at **70 deg F** (21 deg C) for 10-minute holding time in hazard areas.
1. HFC 227ea concentration in hazard areas greater than **[9.0] <Insert percent>** percent immediately after discharge or less than **[5.8] <Insert percent>** percent throughout holding time will not be accepted without written authorization from Owner and authorities having jurisdiction.
 2. System Capabilities: Minimum **620-psig** (4278-kPa) calculated working pressure and **360-psig** (2484-kPa) initial charging pressure.
- F. Performance Requirements: Discharge FK-5-1-12 within 10 seconds and maintain 6.6 percent concentration by volume at **70 deg F** (21 deg C) for 10-minute holding time in hazard areas.
1. FK-5-1-12 concentration in hazard areas greater than **[10.0] <Insert percent>** percent immediately after discharge or less than **[6.5] <Insert percent>** percent throughout holding time will not be accepted without written authorization from Owner and authorities having jurisdiction.
 2. System Capabilities: Minimum **620-psig** (4278-kPa) calculated working pressure and **360-psig** (2484-kPa) initial charging pressure.
- G. Performance Requirements: Discharge IG-541 within 60 seconds and maintain 38 percent concentration by volume at **70 deg F** (21 deg C) for 10-minute holding time in hazard areas.
1. IG-541 concentration in hazard areas greater than **[40] <Insert percent>** percent immediately after discharge or less than **[32] <Insert percent>** percent

- throughout holding time will not be accepted without written authorization from Owner and authorities having jurisdiction.
2. System Capabilities: Minimum **2175-psig** (15-MPa) calculated working pressure upstream from orifice union, minimum **1000-psig** (6895-kPa) calculated working pressure downstream from orifice union, and **2175-psig** (15-MPa) initial charging pressure.
- H. Cross-Zoned Detection: Devices located in two separate zones. Sound alarm on activating single-detection device, and discharge extinguishing agent on actuating single-detection device in other zone.
 - I. Verified Detection: Devices located in single zone. Sound alarm on activating single-detection device, and discharge extinguishing agent on actuating second-detection device.
 - J. Manual stations shall immediately discharge extinguishing agent when activated.
 - K. Operating abort switches will delay extinguishing-agent discharge while being activated, and switches must be reset to prevent agent discharge. Release of hand pressure on the switch will cause agent discharge if the time delay has expired.
 - L. EPO: Will terminate power to protected equipment immediately on actuation.
 - M. Low-Agent Pressure Switch: Initiate trouble alarm if sensing less than set pressure.
 - N. Power Transfer Switch: Transfer from normal to stand-by power source.
 - O. Seismic Performance: Fire-suppression piping and containers shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7] <Insert requirement>**.
 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[**and the unit will be fully operational after the seismic event**]."
- ## 2.2 PIPING MATERIALS
- A. See **["HFC 227ea Agent Piping Applications"] ["IG-541 Agent Piping Applications"] ["FK-5-1-12 Agent Piping Applications"]** Article for applications of pipe, tube, fitting, and joining materials.
 - B. Piping, Valves, and Discharge Nozzles: Comply with types and standards listed in NFPA 2001, Section "Distribution," for charging pressure of system.
- ## 2.3 PIPE AND FITTINGS
- A. System piping shall be of non-combustible materials having physical and chemical characteristics such that its integrity under stress can be predicted with reliability.

- B. As a minimum, piping materials shall be black steel pipe conforming to ASTM A-53A ERW or ASTM A-106A seamless.
- C. Under no conditions shall ordinary cast iron pipe, or steel pipe conforming to ASTM A-120 or ASTM A-531A-120 be used.
- D. Piping joints shall be suitable for the design conditions and shall be selected with consideration of joint tightness and mechanical strength.
- E. As a minimum, fittings beyond the orifice union/nipple shall be black, 300 lb. class fittings conforming to ANSI B-16.3. Ordinary cast iron fittings shall not be used.
- F. The system manifold up to the orifice union nipple must be constructed of Schedule 80 piping and 2000 lb. or 3000 lb. forged steel fittings. Distribution piping downstream of the orifice union must be a minimum of Schedule 40 with 300 lb. fittings.
- G. All piping shall comply with NFPA, latest edition.
- H. Piping shall be installed in accordance with good commercial practice to the appropriate codes, securely supported with UL Listed hangers and arranged with close attention to the design layout since deviations may alter the design flow performance as calculated.
- I. Piping shall be bracketed within 12" (.3 m) of all discharge nozzles.
- J. All piping shall be reamed, blown clear and swabbed with appropriate solvent to remove mill varnish and cutting oils before assembly.
- K. Multi-outlet fittings, other than tees, shall NOT be permitted.
- L. Assembly of all joints shall conform to the appropriate standards. Threaded pipe joints shall utilize Teflon tape applied to the male threads only
- M. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
- N. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.
- O. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- P. Steel, Keyed Couplings: UL 213, AWWA C606, approved or listed for clean-agent service, and matching steel-pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gasket, and steel bolts and nuts.

2.4 VALVES

A. General Valve Requirements:

1. UL listed or FM Approved for use in fire-protection systems.
2. Compatible with type of clean agent used.

B. Container Valves: With rupture disc or solenoid and manual-release lever, capable of immediate and total agent discharge and suitable for intended flow capacity.

C. Valves in Sections of Closed Piping and Manifolds: Fabricate to prevent entrapment of liquid, or install valve and separate pressure relief device.

D. Valves in Manifolds: Check valve; installed to prevent loss of extinguishing agent when container is removed from manifold.

2.5 VALVE ACTUATORS

A. Electric valve actuators shall be of brass construction and stackable design with swivel connections to allow removal of actuators for maintenance or testing.

B. Operation of actuators shall not require replacement of components. NO ELECTRO-EXPLOSIVE DEVICES may be used to actuate the valve assembly.

C. Electric actuators shall be the magnetic latch, continuous duty type for 24 VDC operation.

D. Actuation devices shall be UL listed and/or FM Global approved for use with the system.

2.6 DISCHARGE HOSE/CHECK VALVE

A. When manifolding, all cylinder assemblies shall include a flexible discharge hose and check valve for connection to the manifold inlet.

B. All hose/check valves shall be UL listed and/or FM Global approved for use with the CV-90 clean-agent valve as manufactured by Ansul Fire Protection.

2.7 EXTINGUISHING-AGENT CONTAINERS

A. Description: Steel tanks complying with ASME Boiler and Pressure Vessel Code: Section VIII, for unfired pressure vessels. Include minimum working-pressure rating that matches system charging pressure, valve, pressure switch, and pressure gage.

1. Finish: Manufacturer's standard red, epoxy paint.
2. Each cylinder shall be equipped with a pressure seat-type valve and gauge. The system shall utilize Ansul's CV-90 valve assemblies. When the system's capacity

exceeds 40 cylinders, a second pilot valve shall be provided and used for cylinder activation. Each valve shall be constructed of forged brass and shall attach to the cylinder providing a leak tight seal. Each valve shall also include a safety pressure relief device that provides relief at 3000-3360 PSI per CGA test methods.

3. Filling of the cylinder assembly shall be by Ansul Fire Protection or an authorized clean-agent systems distributor in conjunction with a factory authorized clean-agent agent filling station. Initial filling and recharge shall be performed in accordance with the manufacturer's established procedures and shall not require replacement components for normal service
4. Manifold: Fabricate with valves, pressure switches, and connections for multiple storage containers, as indicated.
5. Manifold: Fabricate with valves, pressure switches, selector switch, and connections for main- and reserve-supply banks of multiple storage containers.
6. Storage-Tank Brackets: Factory or field-fabricated retaining brackets consisting of steel straps and channels; suitable for container support, maintenance, and tank refilling or replacement.
 - a. Each cylinder assembly shall be furnished with a bracket made from welded steel. The brackets shall hold the cylinders in a saddle with a front bracket piece that secures the cylinders. The brackets shall be modular in design to allow added bracketing or stacking of cylinders depending on installation requirements.
 - b. Cylinder brackets shall be UL listed and/or FM Global approved for use with the system.

2.8 FIRE-EXTINGUISHING CLEAN AGENT

A. HFC 227ea Clean Agent: Heptafluoropropane.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DuPont.
 - b. Great Lakes Chemical Corporation; a Chemtura company.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.

B. FK-5-1-12 Clean Agent: Dodecafluoro-2-methylpentan-3-one.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.

- C. IG-541 Clean Agent: Mixture of nitrogen, argon, and carbon dioxide inert gases.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ansul Incorporated.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.

2.9 DISCHARGE NOZZLES

- A. Discharge nozzles shall be of two-piece construction and sized to provide flow rates in accordance with system design flow calculations.
- B. A nozzle inlet orifice plate shall be included. The orifice size shall be determined by a computerized UL listed flow calculation program.
- C. Orifice(s) shall be machined in the nozzle body to provide a horizontal discharge pattern based upon the approved coverage arrangements.
- D. Nozzles shall be permanently marked with the manufacturer's part number. The nozzles shall be threaded directly to the discharge piping without the use of special adapters.
- E. Nozzles shall be UL listed and FM Global approved as manufactured by Ansul Fire Protection.

2.10 MANIFOLD AND ORIFICE UNIONS

- A. An orifice union/nipple shall be included in the manifold to reduce pressure in the downstream pipe network.
- B. Orifice union/nipple assemblies shall be rated at 2000 lb. Class minimum.
- C. Orifice union/nipple assemblies shall be permanently marked with the manufacturer's orifice code. The union orifice/nipple shall be threaded directly to the manifold piping without the use of special adapters.
- D. Union orifice/nipple assemblies shall be UL Listed and/or FM Global Approved for use with the system.

2.11 CONTROL SYSTEMS - GENERAL

- A. All control systems shall be UL Listed or FM Global approved and be utilized with listed or approved compatible operating devices and shall be capable of the following features:
 - 1. Ground fault indication.

2. Supervised detection circuit(s).
3. Supervised alarm circuit(s).
4. Supervised release circuit(s).
5. Supervised manual pull circuit (if applicable).
6. Supervised primary power circuit.
7. Alarm overrides trouble logic.
8. Battery standby.
9. Front panel indicating lamps (LEDs).
10. Key lock steel enclosure.
11. Programmable time delay.
12. Programmable detection logic.
13. Prioritized trouble logic.
14. Microprocessor based logic.
15. History buffer.

2.12 CONTROL PANELS - AUTOPULSE FOUR CONTROL SYSTEM

- A. The Fire Alarm Control Panel (FACP) shall include an integral battery standby power supply. The control panel shall be listed as a "Releasing Device" and shall perform all the functions necessary to operate the clean-agent system including detection, actuation, and auxiliary system functions as outlined.
- B. The FACP shall be housed in a wall-mounted enclosure suitable for protecting electrical circuits. It shall be an 18 ga. metal cabinet with a hinged, locked door painted with an attractive finish. Provide six (6) keys for all panel enclosures. All panel enclosures shall be keyed the same.
- C. The FACP shall be capable of operating at either 120 VAC or 240 VAC, 50 or 60 Hz.
- D. The FACP shall provide an internal sounder to provide audible indication of status with distinctively different sounds for initiating circuit alarm, trouble condition and supervisory off-normal condition.
- E. The FACP shall include a self-contained, 24 VDC power supply including a battery charger.
- F. The FACP shall include the following additional features:
 1. Abort options including IRI method.
 2. Microcomputer based, circuit performance fully field programmable.
 3. History file records for 65 alarm, 65 trouble, and 2 service events.
 4. Backlit LCD display with 2 lines, 16 characters each, plus 3 LED indicators for alarm, trouble, and AC power.
 5. On-board keypad for direct user interface to program circuit performance.
 6. Optional RS 232 Communication Interface module for downloading a custom program created on a PC, retrieving a program from a control unit, and to retrieve history from control unit.
 7. Three (3) levels of security for user, service, and programming.
 8. Power limited circuits.

9. Four supervised circuits Style "B" or "D" Initiating or Style "Y" or "Z" indicating appliance circuits (Class "B" or "A").
10. Smoke detection circuit programmable as single zone, counting zone, cross zones, or alarm verification.
11. Output circuits protected with automatically resetting solid state polyfuse
12. Supervisory switch circuit capability.
13. Three service routines including system simulations, verification (walk test), and full function test.
14. Outputs can be disabled during service.
15. Self-diagnostics to pinpoint trouble.

G. Batteries:

1. Shall be 2- 12 volt, Gel-Cell type providing 24 VDC.
2. Batteries shall have sufficient capacity to power the fire detection, alarm, and release system for not less than 24 hours in standby plus 5 minutes in alarm upon a normal AC power failure.
3. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks, refilling, spills, and leakage shall not be accepted.

2.13 DETECTION DEVICES

A. General Requirements for Detection Devices:

1. Comply with NFPA 2001, NFPA 72, and UL 268.
2. Smoke detectors shall be 24 VDC and shall be UL listed and F M Global approved.
3. Each detector shall include a visual status indicator, provide remote LED output, and include a built-in test capability.
4. The sensitivity shall be factory set per UL 268.
5. The detector cover and screen shall be easily removable for field cleaning.
6. A special vandal-resistant locking screw shall be provided to lock the head to the base.
7. The head-to-base connection shall be made by use of bifurcated contacts. Terminal connections to the base shall be the screw type that are accessible with the base installed on the mounting box.
8. Where specifically identified on the contract drawings, detector bases shall incorporate a relay with Form C contacts rated at 1 amp at 120 VAC or 2 amp at 28 VOC for remote LED alarm annunciation of the detector.
9. Ionization-type smoke detector shall be the dual chamber type and compatible with the Ansul control system. The detector shall have an LED in its base, which is illuminated in a steady-on mode when in alarm and pulse mode when in standby. Reset of the detector shall be performed by the control unit reset switch.
10. The design of the ionization detector compensating circuits shall provide stable operation with regard to minor changes in temperature, humidity, and atmospheric conditions.
11. Photoelectric-type smoke detector shall be the light reflective type and compatible with the Ansul control system. The detector shall have an LED in its base, which is illuminated in a steady-on mode when in alarm and pulse mode

when in standby. Reset of the detector shall be performed by the control unit reset switch.

12. The design of the photoelectric detector compensating circuits shall provide stable operation with regard to minor changes in temperature, humidity, and atmospheric conditions.
13. Photoelectric-type smoke detector with heat detector shall be the light reflective type and compatible with the Ansul control system. The detector shall have an LED in its base, which is illuminated in a steady-on mode when in alarm and pulse mode when in standby. Reset of the detector shall be performed by the control unit reset switch.

2.14 INDICATING APPLIANCES

A. Sounder/Strobe Combination:

1. The sounder/strobe combination shall operate on 24 VDC and shall be approved for use with the listed control system.
2. The sounder/strobe combination shall be polarized and powered from the control unit.
3. The device shall be UL listed or FM Global approved.
4. The strobe shall be listed to UL Standard 1971 for the Hearing Impaired, approved for Fire Protective Service, and rated per NFPA and ADA requirements.
5. The sounder shall have eight (8) tone options selected by means of programming clips.

B. Strobe:

1. The strobe shall operate at 24 VDC and shall be approved for use with the listed control system.
2. The strobe shall be polarized and powered from the control unit.
3. The strobe shall be UL listed or FM approved.
4. The strobe shall be listed to UL Standard UL 1971 for the Hearing Impaired, approved for Fire Protective Service and rated per NFPA and ADA requirements.

C. Sounder:

1. The sounder shall operate at 24 VDC and shall be approved for use with the listed control system.
2. The sounder shall be polarized and powered from the control unit.
3. The device shall be UL listed or F M Global approved.
4. The sounder shall have eight (8) tone options selected by means of programming clips.

D. Remote Air-Sampling Detector System: Includes air-sampling pipe network, a laser-based photoelectric detector, a sample transport fan, and a control unit.

1. Pipe Network: CPVC tubing connects control unit with calibrated sampling holes.
2. Smoke Detector: Particle-counting type with continuous laser beam. Sensitivity adjustable to a minimum of four preset values.

3. Sample Transport Fan: Centrifugal type, creating a minimum static pressure of 0.05-inch wg (12.5 Pa) at all sampling ports.
 4. Control Unit: Multizone unit as indicated on Drawings. Provide same system power supply, supervision, and alarm features as specified for the control panel plus separate trouble indication for airflow and detector problems.
- E. Signals to the Central Fire Alarm Control Panel: Any type of local system trouble is reported to the central fire alarm control panel as a composite "trouble" signal. Alarms on each system zone are individually reported to the central fire alarm control panel as separately identified

2.15 MANUAL STATIONS

A. General Requirements for Manual Stations:

1. The manual pull stations shall be provided for the release (electrical) of the fire suppression system in case of an emergency.
2. The device shall be UL and FM Global listed.
3. Manual stations shall be metal with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front and both sides of the stations.
4. Operation shall require two (2) actions.
5. Manual stations shall be re-setable with a key. Provide two (2) keys for each device. The key shall match the cabinet enclosure key.
6. Abort Switch: "ABORT" caption, momentary contact, with green finish.
7. EPO Switch: "EPO" caption, with yellow finish.

2.16 SWITCHES, GENERAL

- A. Description: FM Approved or NRTL listed, where available, [120-V] <Insert value> ac or low voltage compatible with controls. Include contacts for connection to control panel.

2.17 ABORT SWITCH

- A. The abort switch shall be used where an investigative delay is desired between detection and actuation of the fire suppression system.
- B. The switch shall be a momentary-contact "dead-man" type switch requiring constant pressure to transfer one set of contacts. Clear operating instructions shall be provided at the abort switch.
- C. This switch shall be rated at 28 VDC @ 1.1 amp make/break or 6 amp continuous carry.
- D. The terminal connections shall be of the screw type.

2.18 MAINTENANCE LOCK-OUT SWITCH

- A. The maintenance lock-out switch shall be used where it is desired to disable the fire suppression system during routine maintenance.
- B. This switch shall be key operated allowing removal of the key in either the "Normal" or "Lock-Out" position. A red indicator lamp shall be included on the switch assembly to be illuminated when in the "Lock-Out" position. The control unit is to indicate a trouble condition when in the "Lock-Out" position.
- C. The switch shall include one (1) set of normally open and one (1) set of normally closed contacts rated at 28 VDC @ 1.1 amp make/break or 6 amp continuous carry.
- D. The terminal connections shall be of the screw type.

2.19 SELECTOR SWITCH

- A. The selector switch shall be used where a connected reserve is required.
- B. This switch shall be key operated allowing removal of the key in either the "Main" or "Reserve" position.
- C. This switch shall be rated at 28 VDC @ 1.1 amp make/break or 6 amp continuous carry.
- D. The terminal connections shall be of the screw type.

2.20 OTHER SWITCHES

- A. Low Agent Pressure Switches: Pneumatic operation.
- B. Power Transfer Switches: Key-operation selector, for transfer of release circuit signal from main supply to reserve supply.
- C. Door Closers: Magnetic retaining and release device or electrical interlock to cause the door operator to drive the door closed.

2.21 ALARM DEVICES

- A. Description: Listed and labeled by an NRTL or FM Approved, low voltage, and surface mounting. Comply with requirements in Section 283100 "Intelligent Life-Safety Fire-Management System for alarm and monitoring devices.
- B. Bells: Minimum 6-inch (150-mm) diameter.
- C. Horns: 90 to 94 dBA.
- D. Strobe Lights: Translucent lens, with "FIRE" or similar caption.

2.22 ELECTRICAL POWER AND WIRING

A. General Requirements for Electrical Power and Wiring:

1. Electrical power, wiring, and devices are specified in Division 26.
2. All electrical enclosures, raceways, and conduits shall be employed in accordance with applicable codes and intended use and contain only those electrical circuits associated with the fire detection and control system and shall not contain any circuit that is unrelated to the system.
3. Unless specifically provided otherwise in each case, all conductors shall be enclosed in steel conduit, rigid or thin wall as conditions dictate.
4. Any conduit or raceway exposed to weather or other similar conditions shall be properly sealed and installed to prevent damage. Provisions for draining and/or drying shall be employed.
5. NEMA rating and/or electrically hazardous classifications shall be observed and any equipment or materials installed must meet or exceed the requirements of service.
6. Any wiring shall be of the proper size to conduct the circuit current but shall not be smaller than #18 AWG unless otherwise specified for a given purpose. Wire that has scrapes, nicks, gouges or crushed insulation shall not be used. The use of aluminum wire is strictly prohibited.
7. Wire splice is not allowed.
8. All wire terminations shall be made with crimp terminals for stranded wire. Terminations for solid wire shall not use crimp terminals.
9. All electrical circuits shall be numerically tagged with suitable devices at the terminating point and/or splice. All circuit numbers shall correspond with the installation drawings.
10. The use of colored wires is required and is dictated by drawings and project specification.
11. White colored wire shall be used exclusively for the identification of the neutral conductor of an alternating current circuit.
12. Green colored wire shall be used exclusively for the identification of the earth ground conductor of an AC or DC circuit.
13. Comply with DEN wire color requirements for all other wires.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with hazard-area leakage requirements, installation tolerances, and other conditions affecting work performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CLEAN-AGENT PIPING INSTALLATION

- A. Install clean-agent extinguishing piping and other components level and plumb, according to manufacturers' written instructions.
- B. Grooved Piping Joints: Groove pipe ends according to AWWA C606 dimensions. Assemble grooved-end steel pipe and steel, grooved-end fittings with steel, keyed couplings and lubricant according to manufacturer's written instructions.
- C. Install extinguishing-agent containers anchored to substrate.
- D. Install pipe and fittings, valves, and discharge nozzles according to requirements listed in NFPA 2001, Section "Distribution."
 - 1. Install valves designed to prevent entrapment of liquid, or install pressure relief devices in valved sections of piping systems.
 - 2. Support piping using supports and methods according to NFPA 13.
 - 3. Install seismic restraints for extinguishing-agent containers and piping systems.
 - 4. Install control panels, detection system components, alarms, and accessories, complying with requirements of NFPA 2001, Section "Detection, Actuation, and Control Systems," as required for supervised system application.
- E. System shall be installed in accordance with manufacturer's instructions. Install piping in accordance with the following requirements:
 - 1. Piping shall be installed in accordance with good commercial practice to the appropriate codes, securely supported with hangers, and arranged with close attention to the design layout since deviations may alter the design flow performance as calculated.
 - 2. Contractor shall determine that appropriate venting from protected spaces is in place, and that provisions for containment of agent are adequate. Proceeding with project work shall mean acceptance of conditions.
 - 3. Piping shall be bracketed within 12 inches of all discharge nozzles.
 - 4. All piping shall be reamed, blown clear, and swabbed with appropriate solvent to remove mill varnish and cutting oils before assembly.
 - 5. Multi-outlet fittings, other than tees, shall not be permitted.
 - 6. Assembly of all joints shall conform to the appropriate standards. Threaded pipe joints shall utilize Teflon tape applied to the male threads only.

3.3 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to equipment, allow space for service and maintenance.
- C. Connect electrical devices to control panel and to building's fire-alarm system. Electrical power, wiring, and devices are specified in Section 283100 "Intelligent Life-Safety Fire-Management System"

3.4 IDENTIFICATION

- A. Identify system components and equipment. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify piping, extinguishing-agent containers, other equipment, and panels according to NFPA 2001.
- C. Install signs at entry doors for protected areas to warn occupants that they are entering a room protected with a clean-agent fire-extinguishing system.
- D. Install signs at entry doors to advise persons outside the room the meaning of the horn(s), bell(s), and strobe light(s) outside the protected space.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: **[Owner will engage] [Engage]** a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 - 1. After installing clean-agent extinguishing piping system and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections "Inspection and Test Procedures" and "System Function Tests." Certify compliance with test parameters.
 - 3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
 - 5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 6. Units will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 SYSTEM CHECKOUT AND TESTING

- A. The completed installation shall be inspected by factory authorized and trained personnel. The inspection shall include a full operational test of all components per the equipment manufacturer's recommendations (including agent discharge).
- B. Inspection shall be performed in the presence of the DEN Project Manager's representative, insuring authority and/or the local authority having jurisdiction.
- C. All mechanical and electrical components shall be tested according to the manufacturer's recommended procedure to verify system integrity.
- D. Inspection shall include a complete checkout of the detection/control system and certification of cylinder pressure. A written report shall be filed with the DEN Project Manager.
- E. As-built drawings shall be provided by the Contractor (2 copies) indicating the installation details. All routing of piping, electrical conduit and accessories shall be noted.
- F. Equipment installation and maintenance manuals shall be provided in addition to the as-built drawings.
- G. Prior to final acceptance, the Contractor shall provide operational training in all concepts of the system to the DEN Project Manager's key personnel. Training shall include:
 - 1. Control system operation.
 - 2. Trouble procedures.
 - 3. Abort procedures.
 - 4. Emergency procedures.
 - 5. Safety requirements.
 - 6. Demonstration of the system (excluding clean-agent release).
- H. The quantity of agent shall reflect the actual design quantity of clean-agent.
- I. A functional test shall be completed prior to the concentration test consisting of detection, release, alarm, accessories related to the system, control unit and a review of the cylinders, piping, fittings, hangers and cylinder pressure.
- J. Concentration testing shall be performed under the supervision of the Contractor's authorized personnel in the presence of the DEN Project Manager's representative, local authorities, and any other insuring authority.
- K. Clean-agent test procedures shall be recommended by the equipment manufacturer and/or the clean-agent equipment supplier.
- L. The Contractor shall provide a gas analyzer capable of automatically recording sampling points. Concentration recording shall continue until authorities are satisfied with hazard integrity or until 10 minutes have elapsed, whichever is greater.

- M. The sampling point(s) shall be located at a strategic area(s) but no higher than the highest combustible contents.
- N. If the test results indicate that the design concentration was not achieved and/or held, the Contractor shall determine the cause of the failure. After determination of the cause, the system shall be recharged and again placed in operation. The Contractor shall only be responsible for retest based on equipment design failure.
- O. Refill cylinders after testing has been accepted by code agencies and DEN Life Safety Team.

3.7 CLEANING

- A. Each pipe section shall be cleaned internally after preparation and before assembly by means of swabbing, using a suitable nonflammable cleaner. Pipe network shall be free of particulate matter and oil residue before installing nozzles or discharge devices.

3.8 SYSTEM FILLING

A. Preparation:

1. Verify that piping system installation is completed and cleaned.
2. Check for complete enclosure integrity.
3. Check operation of ventilation and exhaust systems.

B. Filling Procedures:

1. Fill extinguishing-agent containers with extinguishing agent, and pressurize to indicated charging pressure.
2. Install filled extinguishing-agent containers.
3. Energize circuits.
4. Adjust operating controls.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to assist Contractor and train Owner's maintenance personnel to adjust, operate, and maintain clean-agent fire-extinguishing systems.
 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 212200

SECTION 213113 - ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. **[End-suction] [In-line] [Split-case]** fire pumps.
 - 2. Fire-pump accessories and specialties.
 - 3. Flowmeter systems.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Fire pumps shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7] <Insert requirement>**.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[**and the unit will be fully operational after the seismic event**]."
- B. Pump Equipment, Accessory, and Specialty Pressure Rating: **175 psig** (1200 kPa) minimum unless higher pressure rating is indicated.
- C. Environmental Conditions: The equipment shall be designed and constructed to operate successfully at the rated values under the following environmental conditions:
 - 1. Location: (Indoors/Outdoors).
 - 2. Altitude: 5,500 feet (1677 m) above sea level.
 - 3. Ambient Temperature Range: Minus 30 deg F (minus 35 deg C) to 120 deg F (49 deg C).
 - 4. Wind Load: 115 mph with gust factor of 1.3.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's product

literature, general assembly, rated capacities, operating characteristics, performance curves showing performance characteristics with pump and system, NPSB curve, electrical characteristics, wiring diagrams, and furnished specialties and accessories, and service conditions.

1. Manufacturer's Installation Instructions: Indicate support details and connection requirements, and include startup instructions for fire pump system.
2. Include data substantiating that materials comply with requirements.

B. Shop Drawings: For fire pumps, motor drivers, and fire-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For fire pumps, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Product Certificates: For each fire pump, from manufacturer:

1. Manufacturer's Certificate: The pump manufacturer will assume responsibility for authority having jurisdiction approval of a fully tested package unit and will assume unit responsibility for the proper operation of the entire package system. Certify that fire pumps meet or exceed specified requirements at specified operating conditions. Submit summary and results of shop tests performed in accordance with NFPA 20.
2. Company specializing in manufacturing the products specified in this section with minimum five (5) years' documented experience.

C. All field personnel must be a current holder of the City & County of Denver Fire Department Fire Protection Installer's license.

D. Installer: Company specializing in performing the work of this section with minimum five (5) years' documented experience. Comply with installer qualifications as indicated in all applicable specifications Sections.

E. Source quality-control reports.

F. Field quality-control reports:

1. Indicate summary of hydrostatic test and field acceptance tests performed in accordance with NFPA 20 and FM Data Sheets.

G. Obtain DEN Life Safety Team review and stamp prior to submittal for permit.

H. Provide sample copies of special product warranties.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire pumps to include in operation and maintenance manuals.

1. Operation Data: Include manufacturer's instructions, startup data, and troubleshooting checklists for pumps, drivers, and controllers.
2. Maintenance Data: Include manufacturer's literature, cleaning procedures, replacement parts lists, and repair data for pumps, drivers, and controllers, inspection data, availability, addresses, and phone numbers of service depot.

B. As-Built Plans:

1. "As Built" Plans shall be provided in the same format and manner as described above for shop drawings. Each set shall be equipped with a plan holder equal to "Stacor Plan Clamps" for the appropriate size drawings.
2. Submit As-Built plans to Owner prior to final testing of fire pump systems.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 20, "Installation of Stationary Pumps for Fire Protection."

C. Equipment and Components: Bear UL and FM label or marking.

D. Comply with all requirements of Owner's Insurance Underwriter.

1.8 WARRANTY

A. All work and equipment shall be warranted to be free from defects in workmanship and material for a period of minimum twelve (12) months from the date of Substantial Completion. Any material or equipment found to be defective during this period shall be repaired or replaced without expense to the Owner.

1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate installation of fire pumps with all existing DEN systems.

1.10 EXTRA STOCK

- A. Furnish under provisions of Division 01.
- B. Provide one complete set of gaskets, screens, tools, and packing seals for each pump type and model supplied.
- C. Provide DEN Representatives all special tools required for installation and maintenance

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR CENTRIFUGAL FIRE PUMPS

- A. Description: Factory-assembled and -tested fire-pump and driver unit.
- B. Base: Fabricated and attached to fire-pump and driver unit with reinforcement to resist movement of pump during seismic events when base is anchored to building substrate.
- C. Finish: Red paint applied to factory-assembled and -tested unit before shipping.
- D. Current Denver Water Department test reports (less than six (6) months old) for the underground supply shall be provided for all new calculations
- E. Information to be provided by Designer of Record:
 - 1. Rated discharge in GPM and net head of boost in PSI.
 - 2. Style and manufacture of pump and controller. The same information shall be provided for both the fire and jockey pump. In addition, the jockey pump will require both here and in the electric specification indications for the necessary electrical components.
- F. Provide fire proofing repair damaged by this work.

- G. Provide all required fire sealants and smoke stopping required by this work.
- H. Provide certificate of compliance from Denver Fire Department and DEN Project Manager indicating acceptance of final field testings.

2.2 END-SUCTION FIRE PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. A-C Fire Pump Systems; a business of ITT Industries.
 - 2. Corcoran Piping System Co.
 - 3. Patterson Pump Company; a subsidiary of the Gorman-Rupp Company.
 - 4. Peerless Pump, Inc.
 - 5. Reddy-Buffaloes Pump Company.
 - 6. S.A. Armstrong Limited.
 - 7. **<Insert manufacturer's name>**.
 - 8. or approved equal.
- B. Pump:
 - 1. Standard: **[UL 448]** **<Insert standard>**, for end-suction pumps for fire service.
 - 2. Casing: Radially split case, cast iron with ASME B16.1 pipe-flange connections.
 - 3. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
 - 4. Wear Rings: Replaceable bronze.
 - 5. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - a. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
 - b. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
 - 6. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.
- C. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
- D. Driver:
 - 1. Standard: **[UL 1004A]** **<Insert standard>**.
 - 2. Type: Electric motor; NEMA MG 1, polyphase Design B.
- E. Capacities and Characteristics:
 - 1. Rated Capacity: **<Insert gpm (L/minute)>**.
 - 2. Total Rated Head: **<Insert feet or psig (kPa)>**.
 - 3. Inlet Flange: **[Class 125] [Class 250]**.
 - 4. Outlet Flange: **[Class 125] [Class 250] <Insert class>**.
 - 5. Suction Head Available at Pump: **<Insert feet (m)>**.
 - 6. Motor Horsepower: **<Insert value>**.

7. Motor Speed: **<Insert rpm>**.
8. Electrical Characteristics:
 - a. Volts: **[208] [230] [460] <Insert value>**.
 - b. Phase: Three.
 - c. Hertz: 60.
 - d. Full-Load Amperes: **<Insert value>**.
 - e. Minimum Circuit Ampacity: **<Insert value>**.
 - f. Maximum Overcurrent Protection: **<Insert amperage>**.
9. Pump-Start, Pressure-Switch Setting: **<Insert psig (kPa)>**.
10. Pump-Stop, Pressure-Switch Setting: **<Insert psig (kPa)>**.

2.3 IN-LINE FIRE PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. A-C Fire Pump Systems; a business of ITT Industries.
2. Corcoran Piping System Co.
3. Patterson Pump Company; a subsidiary of the Gorman-Rupp Company.
4. Peerless Pump, Inc.
5. Pentair Pump Group; Aurora Pump.
6. Pentair Pump Group; Fairbanks Morse.
7. Plad Equipment, Ltd.
8. Reddy-Buffaloes Pump Company.
9. S.A. Armstrong Limited.
10. **<Insert manufacturer's name>**.
11. or approved equal.

- B. Pump:

1. Standard: **[UL 448] <Insert standard>**, for in-line pumps for fire service.
2. Casing: Radially split case, cast iron with ASME B16.1 pipe-flange connections.
3. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
4. Wear Rings: Replaceable bronze.
5. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - a. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
 - b. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
6. Mounting: Pump and driver shaft is vertical, with motor above pump and pump on base.

- C. Coupling: None or rigid.

- D. Driver:

1. Standard: **[UL 1004A] <Insert standard>**.

2. Type: Electric motor; NEMA MG 1, polyphase Design B.

E. Capacities and Characteristics:

1. Rated Capacity: <Insert gpm (L/minute)>.
2. Total Rated Head: <Insert feet or psig (kPa)>.
3. Inlet Flange: **[Class 125] [Class 250]**.
4. Outlet Flange: **[Class 125] [Class 250] <Insert class>**.
5. Suction Head Available at Pump: <Insert feet (m)>.
6. Motor Horsepower: <Insert value>.
7. Motor Speed: <Insert rpm>.
8. Electrical Characteristics:
 - a. Volts: **[208] [230] [460] <Insert value>**.
 - b. Phase: Three.
 - c. Hertz: 60.
 - d. Full-Load Amperes: <Insert value>.
 - e. Minimum Circuit Ampacity: <Insert value>.
 - f. Maximum Overcurrent Protection: <Insert amperage>.
9. Pump-Start, Pressure-Switch Setting: <Insert psig (kPa)>.
10. Pump-Stop, Pressure-Switch Setting: <Insert psig (kPa)>.

2.4 HORIZONTALLY MOUNTED, SINGLE-STAGE, SPLIT-CASE FIRE PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. A-C Fire Pump Systems; a business of ITT Industries.
2. Corcoran Piping System Co.
3. Patterson Pump Company; a subsidiary of the Gorman-Rupp Company.
4. PACO Pumps; Grundfos Pumps Corporation, U.S.A.
5. Peerless Pump, Inc.
6. Pentair Pump Group; Aurora Pump.
7. Reddy-Buffaloes Pump Company.
8. Ruhrpumpen, Inc.
9. S.A. Armstrong Limited.
10. <Insert manufacturer's name>.
11. or approved equal.

B. Pump:

1. Standard: **[UL 448] <Insert standard>**, for split-case pumps for fire service.
2. Casing: Axially split case, cast iron with ASME B16.1 pipe-flange connections.
3. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
4. Wear Rings: Replaceable bronze.
5. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - a. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.

- b. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
- 6. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.
- C. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
- D. Driver:
 - 1. Standard: **[UL 1004A]** <Insert standard>.
 - 2. Type: Electric motor; NEMA MG 1, polyphase Design B.
- E. Capacities and Characteristics:
 - 1. Rated Capacity: <Insert gpm (L/minute)>.
 - 2. Total Rated Head: <Insert feet or psig (kPa)>.
 - 3. Inlet Flange: **[Class 125] [Class 250]**.
 - 4. Outlet Flange: **[Class 125] [Class 250]** <Insert class>.
 - 5. Suction Head Available at Pump: <Insert feet (m)>.
 - 6. Motor Horsepower: <Insert value>.
 - 7. Motor Speed: <Insert rpm>.
 - 8. Electrical Characteristics:
 - a. Volts: **[208] [230] [460]** <Insert value>.
 - b. Phase: Three.
 - c. Hertz: 60.
 - d. Full-Load Amperes: <Insert value>.
 - e. Minimum Circuit Ampacity: <Insert value>.
 - f. Maximum Overcurrent Protection: <Insert amperage>.
 - 9. Pump-Start, Pressure-Switch Setting: <Insert psig (kPa)>.
 - 10. Pump-Stop, Pressure-Switch Setting: <Insert psig (kPa)>.

2.5 HORIZONTALLY MOUNTED, MULTISTAGE, SPLIT-CASE FIRE PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. A-C Fire Pump Systems; a business of ITT Industries.
 - 2. Patterson Pump Company; a subsidiary of the Gorman-Rupp Company.
 - 3. Peerless Pump, Inc.
 - 4. Pentair Pump Group; Aurora Pump.
 - 5. Reddy-Buffaloes Pump Company.
 - 6. S.A. Armstrong Limited.
 - 7. <Insert manufacturer's name>.
 - 8. or approved equal.

- B. Pump:

1. Standard: **[UL 448]** <Insert standard>, for split-case pumps for fire service.
 2. Number of Stages: Two.
 3. Casing: Axially split case, cast iron with ASME B16.1 pipe-flange connections.
 4. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
 5. Wear Rings: Replaceable bronze.
 6. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - a. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
 - b. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
 7. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.
- C. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
- D. Driver:
1. Standard: **[UL 1004A]** <Insert standard>.
 2. Type: Electric motor; NEMA MG 1, polyphase Design B.
- E. Capacities and Characteristics:
1. Rated Capacity: <Insert gpm (L/minute)>.
 2. Total Rated Head: <Insert feet or psig (kPa)>.
 3. Inlet Flange: **[Class 125]** **[Class 250]**.
 4. Outlet Flange: **[Class 125]** **[Class 250]** <Insert class>.
 5. Suction Head Available at Pump: <Insert feet (m)>.
 6. Motor Horsepower: <Insert value>.
 7. Motor Speed: <Insert rpm>.
 8. Electrical Characteristics:
 - a. Volts: **[208]** **[230]** **[460]** <Insert value>.
 - b. Phase: Three.
 - c. Hertz: 60.
 - d. Full-Load Amperes: <Insert value>.
 - e. Minimum Circuit Ampacity: <Insert value>.
 - f. Maximum Overcurrent Protection: <Insert amperage>.
 9. Pump-Start, Pressure-Switch Setting: <Insert psig (kPa)>.
 10. Pump-Stop, Pressure-Switch Setting: <Insert psig (kPa)>.

2.6 VERTICALLY MOUNTED, SINGLE-STAGE, SPLIT-CASE FIRE PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. A-C Fire Pump Systems; a business of ITT Industries.
 2. Patterson Pump Company; a subsidiary of the Gorman-Rupp Company.

3. Peerless Pump, Inc.
 4. Pentair Pump Group; Aurora Pump.
 5. Reddy-Buffaloes Pump Company.
 6. **<Insert manufacturer's name>**.
 7. or approved equal.
- B. Pump:
1. Standard: **[UL 448] <Insert standard>**, for split-case pumps for fire service.
 2. Casing: Axially split case, cast iron with ASME B16.1 pipe-flange connections.
 3. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
 4. Wear Rings: Replaceable bronze.
 5. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - a. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
 - b. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
 6. Mounting: Pump and driver shafts are vertical, with motor above pump and pump on base.
- C. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
- D. Driver:
1. Standard: **[UL 1004A] <Insert standard>**.
 2. Type: Electric motor; NEMA MG 1, polyphase Design B.
- E. Capacities and Characteristics:
1. Rated Capacity: **<Insert gpm (L/minute)>**.
 2. Total Rated Head: **<Insert feet or psig (kPa)>**.
 3. Inlet Flange: **[Class 125] [Class 250]**.
 4. Outlet Flange: **[Class 125] [Class 250] <Insert class>**.
 5. Suction Head Available at Pump: **<Insert feet (m)>**.
 6. Motor Horsepower: **<Insert value>**.
 7. Motor Speed: **<Insert rpm>**.
 8. Electrical Characteristics:
 - a. Volts: **[208] [230] [460] <Insert value>**.
 - b. Phase: Three.
 - c. Hertz: 60.
 - d. Full-Load Amperes: **<Insert value>**.
 - e. Minimum Circuit Ampacity: **<Insert value>**.
 - f. Maximum Overcurrent Protection: **<Insert amperage>**.
 9. Pump-Start, Pressure-Switch Setting: **<Insert psig (kPa)>**.
 10. Pump-Stop, Pressure-Switch Setting: **<Insert psig (kPa)>**.

2.7 FIRE-PUMP ACCESSORIES AND SPECIALTIES

- A. Automatic Air-Release Valves: Comply with NFPA 20 for installation in fire-pump casing.
- B. Circulation Relief Valves: UL 1478, brass, spring loaded; for installation in pump discharge piping.
- C. Relief Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BERMAD Control Valves.
 - b. CLA-VAL Automatic Control Valves.
 - c. Kunkle Valve; a part of Tyco International Ltd.
 - d. OCV Control Valves.
 - e. Watts Regulator Company; a division of Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Wilkins Water Control Products.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
 - 2. Description: UL 1478, bronze or cast iron, spring loaded; for installation in fire-suppression water-supply piping.
- D. Inlet Fitting: Eccentric tapered reducer at pump suction inlet.
- E. Outlet Fitting: Concentric tapered reducer at pump discharge outlet.
- F. Discharge Cone: [**Closed**] [**Open**] [**Closed or open**] type.
- G. Hose Valve Manifold Assembly:
 - 1. Standard: Comply with requirements in NFPA 20.
 - 2. Header Pipe: ASTM A 53/A 53M, Schedule 40, galvanized steel with ends threaded according to ASME B1.20.1.
 - 3. Header Pipe Fittings: ASME B16.4, galvanized cast-iron threaded fittings.
 - 4. Automatic Drain Valve: UL 1726.
 - 5. Manifold:
 - a. Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
 - b. Body: Flush type, brass or ductile iron, with number of outlets required by NFPA 20.
 - c. Nipples: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with ends threaded according to ASME B1.20.1.
 - d. Adapters and Caps with Chain: Brass or bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
 - e. Escutcheon Plate: Brass or bronze; rectangular.

- f. Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
 - g. Exposed Parts Finish: **[Polished] [Rough] [brass] [, chrome plated]**.
 - h. Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."
6. Manifold:
- a. Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
 - b. Body: Exposed type, brass, with number of outlets required by NFPA 20.
 - c. Escutcheon Plate: Brass or bronze; round.
 - d. Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads. Include caps and chains.
 - e. Exposed Parts Finish: **[Polished] [Rough] [brass] [, chrome plated]**.
 - f. Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."

2.8 FLOWMETER SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Emerson Process Management; Rosemount Division.
 - 2. Fire Research Corp.
 - 3. Gerand Engineering Co.
 - 4. Hydro Flow Products, Inc.
 - 5. Hyspan Precision Products, Inc.
 - 6. Meriam Process Technologies.
 - 7. Preso Meters; Division of Racine Federated Inc.
 - 8. Reddy-Buffaloes Pump Company.
 - 9. Victaulic Company.
 - 10. **<Insert manufacturer's name>**.
 - 11. or approved equal.
- B. Description: UL-listed or FM-Approved, fire-pump flowmeter system with capability to indicate flow to not less than 175 percent of fire-pump rated capacity.
- C. Pressure Rating: **[175 psig (1200 kPa) minimum] [250 psig (1725 kPa)]**.
- D. Sensor: Annubar probe, orifice plate, or venturi unless otherwise indicated. Sensor size shall match pipe, tubing, flowmeter, and fittings.
- E. Permanently Mounted Flowmeter: Compatible with flow sensor; with dial not less than **4-1/2 inches (115 mm)** in diameter. Include bracket or device for wall mounting.
- 1. Tubing Package: **NPS 1/8 or NPS 1/4 (DN 6 or DN 10) [soft copper] [or] [plastic]** tubing with copper or brass fittings and valves.
- F. Portable Flowmeter: Compatible with flow sensor; with dial not less than **4-1/2 inches (115 mm)** in diameter and with two **12-foot- (3.7-m-)** long hoses in carrying case.

2.9 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink and recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.10 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect fire pumps according to UL 448 requirements for "Operation Test" and "Manufacturing and Production Tests."
 - 1. Verification of Performance: Rate fire pumps according to UL 448.
- B. Fire pumps will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment bases and anchorage provisions, with Installer present, for compliance with requirements and for conditions affecting performance of fire pumps.
- B. Examine roughing-in for fire-suppression piping systems to verify actual locations of piping connections before fire-pump installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Division 01 requirements.
- B. Accept fire pumps and components onsite in factory packing. Inspect for damage. Comply with manufacturer's rigging and installation instructions.
- C. Protect fire pumps and components from physical damage, including effects of weather, water, and construction debris.
- D. Provide temporary inlet and outlet caps, and maintain in place until installation.

3.3 INSTALLATION

- A. Fire-Pump Installation Standard: Comply with NFPA 20 for installation of fire pumps, relief valves, and related components.
- B. Equipment Mounting: Install fire pumps on concrete bases. Comply with requirements for concrete bases specified in [**Section 033000 "Cast-in-Place Concrete."**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete."**]
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Install fire-pump suction and discharge piping equal to or larger than sizes required by NFPA 20.
- D. Support piping and pumps separately so weight of piping does not rest on pumps.
- E. Install valves that are same size as connecting piping. Comply with requirements for fire-protection valves specified in [**Section 211200 "Fire-Suppression Standpipes."**] [**Section 211313 "Wet-Pipe Sprinkler Systems."**]
- F. Install pressure gages on fire-pump suction and discharge flange pressure-gage tappings. Comply with requirements for pressure gages specified in [**Section 211200 "Fire-Suppression Standpipes."**] [**Section 211313 "Wet-Pipe Sprinkler Systems."**]
- G. Install piping hangers and supports, anchors, valves, gages, and equipment supports according to NFPA 20.
- H. Install flowmeters and sensors. Install flowmeter-system components and make connections according to NFPA 20 and manufacturer's written instructions.
- I. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.
- J. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- K. Pump installation shall commence 5 feet outside the building wall and shall include a backflow preventer approved by the City of Denver Water Department, installed in the supply to the fire pump.
- L. Provide approved fittings to comply with DEN cathodic protection requirements.

- M. Provide access space around pumps for service. Provide no less than the minimum clearance as recommended by manufacturer.
- N. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For base mounted pumps, provide supports under elbows on pump suction and discharge.
- O. Provide drains for bases and seals, piped to and discharging into floor drains. Closed cone waste to be piped to building exterior and spill on grade.
 - 1. Designer of Record: Confirm location of spill is properly graded to allow water flow to properly sized drains.
- P. Lubricate pumps before startup.
- Q. Check, align, and certify base mounted pumps by qualified millwright prior to startup.
- R. Provide connection to discharge line from north terminal fire pump and discharge line from terminal fire pump.

3.4 ALIGNMENT

- A. Align **[end-suction] [and] [split-case]** pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.
- B. After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.
- C. Align piping connections.
- D. Align pump and driver shafts for angular and parallel alignment according to HI 1.4 and to tolerances specified by manufacturer.

3.5 CONNECTIONS

- A. Comply with requirements for piping and valves specified in **[Section 211200 "Fire-Suppression Standpipes."]** **[Section 211313 "Wet-Pipe Sprinkler Systems."]** Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps and equipment to allow service and maintenance.
- C. Connect relief-valve discharge to drainage piping or point of discharge.
- D. Connect flowmeter-system meters, sensors, and valves to tubing.
- E. Connect fire pumps to their controllers.

3.6 IDENTIFICATION

- A. Identify system components. Comply with requirements for fire-pump marking according to NFPA 20.

3.7 FIELD QUALITY CONTROL

- A. Test each fire pump with its controller as a unit. Comply with requirements for electric-motor-driver fire-pump controllers specified in Section 213900 "Controllers for Fire-Pump Drivers."
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist Contractor in testing.
- C. Tests and Inspections:
 - 1. After installing components, assemblies, and equipment including controller, test for compliance with requirements.
 - 2. Test according to NFPA 20 for acceptance and performance testing.
 - 3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Components, assemblies, and equipment will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Hoses are for tests only and do not convey to Owner.

3.8 STARTUP SERVICE

- A. Engage a factory-authorized service representative to assist Contractor and perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. **<Insert startup steps if any>.**

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to assist Contractor and train Owner's maintenance personnel to adjust, operate, and maintain fire pumps.
 - 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - PART 4- MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PART 5- PAYMENT

5.1 PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract. price.

END OF SECTION 213113

SECTION 213213 - ELECTRIC-DRIVE, VERTICAL-TURBINE FIRE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Vertical-turbine fire pumps.
 - 2. Fire-pump accessories and specialties.
 - 3. Flowmeter systems.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Fire pumps shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7] <Insert requirement>.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[**and the unit will be fully operational after the seismic event**]."
- B. Pump Equipment, Accessory, and Specialty Pressure Rating: 175 psig (1200 kPa) minimum unless higher pressure rating is indicated.
- C. Environmental Conditions: The equipment shall be designed and constructed to operate successfully at the rated values under the following environmental conditions:
 - 1. Location: (Indoors/Outdoors).
 - 2. Altitude: 5,500 feet (1677 m) above sea level.
 - 3. Ambient Temperature Range: Minus 30 deg F (minus 35 deg C) to 120 deg F (49 deg C).
 - 4. Wind Load: 115 mph with gust factor of 1.3.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities,

manufacturer's product literature, operating characteristics, performance curves showing performance characteristics with pump and system, NPSB curve, electrical characteristics, wiring diagrams, and furnished specialties and accessories, and service conditions.

1. Manufacturer's Installation Instructions: Indicate support details and connection requirements, and include startup instructions for fire pump system.
2. Include data substantiating that materials comply with requirements.

B. Shop Drawings: For fire pumps, motor drivers, and fire-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For fire pumps, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Product Certificates: For each fire pump, from manufacturer.

1. Manufacturer's Certificate: The pump manufacturer will assume responsibility for authority having jurisdiction approval of a fully tested package unit and will assume unit responsibility for the proper operation of the entire package system. Certify that fire pumps meet or exceed specified requirements at specified operating conditions. Submit summary and results of shop tests performed in accordance with NFPA 20.
2. Company specializing in manufacturing the products specified in this section with minimum five (5) years' documented experience.

C. All field personnel must be a current holder of the City & County of Denver Fire Department Fire Protection Installer's license.

D. Installer: Company specializing in performing the work of this section with minimum five (5) years' documented experience. Comply with installer qualifications as indicated in all applicable specifications Sections.

E. Source quality-control reports.

F. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire pumps to include in operation and maintenance manuals.
 - 1. Operation Data: Include manufacturer's instructions, startup data, and troubleshooting checklists for pumps, drivers, and controllers.
 - 2. Maintenance Data: Include manufacturer's literature, cleaning procedures, replacement parts lists, and repair data for pumps, drivers, and controllers, inspection data, availability, addresses, and phone numbers of service depot.
- B. As-Built Plans:
 - 1. "As Built" Plans shall be provided in the same format and manner as described above for shop drawings. Each set shall be equipped with a plan holder equal to "Stacor Plan Clamps" for the appropriate size drawings.
 - 2. Submit As-Built plans to Owner prior to final testing of fire pump systems.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 20, "Installation of Stationary Pumps for Fire Protection."
- C. Equipment and Components: Bear UL and FM label or marking.
- D. Comply with all requirements of Owner's Insurance Underwriter.

1.8 WARRANTY

- A. All work and equipment shall be warranted to be free from defects in workmanship and material for a period of twelve (12) months from the date of Substantial Completion. Any material or equipment found to be defective during this period shall be repaired or replaced without expense to the Owner.

1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate installation of fire pumps with all existing DEN systems.

1.10 EXTRA STOCK

- A. Furnish under provisions of Division 01.

- B. Provide one complete set of gaskets, screens, tools, and packing seals for each pump type and model supplied.
- C. Provide DEN Representatives all special tools required for installation and maintenance

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VERTICAL-TURBINE FIRE PUMPS

- A. Description: Factory-assembled and -tested fire-pump and driver unit.
- B. Base: Fabricated and attached to fire-pump and driver unit with reinforcement to resist movement of pump during seismic events when base is anchored to building substrate.
- C. Finish: Red paint applied to factory-assembled and -tested unit before shipping.
- D. Current Denver Water Department test reports (less than six (6) months old) for the underground supply shall be provided for all new calculations
- E. Information to be provided by Designer of Record:
 - 1. Rated discharge in GPM and net head of boost in PSI.
 - 2. Style and manufacture of pump and controller. The same information shall be provided for both the fire and jockey pump. In addition, the jockey pump will require both here and in the electric specification indications for the necessary electrical components.
- F. Provide fire proofing repair damaged by this work.
- G. Provide all required fire sealants and smoke stopping required by this work.
- H. Provide certificate of compliance from Denver Fire Department and DEN Project Manager indicating acceptance of final field testing.

2.2 VERTICAL-TURBINE FIRE PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. A-C Fire Pump Systems; a business of ITT Industries.
 2. Patterson Pump Company; a subsidiary of the Gorman-Rupp Company.
 3. Peerless Pump, Inc.
 4. Pentair Pump Group; Aurora Pump.
 5. Pentair Pump Group; Fairbanks Morse.
 6. Reddy-Buffaloes Pump Company.
 7. Ruhrpumpen, Inc.
 8. S.A. Armstrong Limited.
 9. Sulzer Pumps Ltd.
 10. Weir Floway Inc.; a company of Weir Clear Liquid.
 11. **<Insert manufacturer's name>**.
 12. or approved equal.
- B. Pump Head: Cast iron, for surface discharge.
1. Discharge Outlet: With flange according to ASME B16.1 except connections may be threaded according to ASME B1.20.1, in sizes where flanges are not available.
 2. Pump Head Seal: Stuffing box and packing.
 3. Base: Cast iron or steel with hole for electrical cable.
- C. Pump:
1. Standard: **[UL 448]** **<Insert standard>**, for vertical-turbine pumps for fire service.
 2. Line Shaft: Stainless steel or steel, with corrosion-resistant shaft sleeves.
 3. Line Shaft Bearings: Rubber sleeve, water lubricated.
 4. Line Shaft: Steel.
 5. Line Shaft Bearings: Corrosion resistant, oil lubricated.
 6. Impeller Shaft: Monel metal or stainless steel.
 7. Bowl Section: Multiple cast-iron bowls with closed-type bronze or stainless-steel impellers.
 8. Column Pipe: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with threaded ends and cast-iron or steel fittings, in sections **10 feet** (3 m) or less.
 9. Suction Strainer: Cast or fabricated, bronze or stainless steel, and sized to restrict passage of **0.5-inch** (12.7-mm) spheres.
- D. Driver:
1. Standard: **[UL 1004A]** **<Insert standard>**.
 2. Type: Electric motor; NEMA MG 1, polyphase Design B.
 3. Mounting: On pump head above pump.
- E. Capacities and Characteristics:
1. Rated Capacity: **<Insert gpm** (L/minute)**>**.
 2. Total Rated Head: **<Insert feet or psig** (kPa)**>**.
 3. Inlet Column Size: **<Insert NPS**DN**>**.
 4. Pump Column Length: **<Insert feet** (m)**>**.
 5. Pump Head Outlet Flange: **[Class 125]** **[Class 250]** **<Insert class>**.
 6. Suction Head Available at Pump: **<Insert feet** (m)**>**.

7. Motor Horsepower: **<Insert value>**.
8. Motor Speed: **<Insert rpm>**.
9. Electrical Characteristics:
 - a. Volts: **[208] [230] [460] <Insert value>**.
 - b. Phase: Three.
 - c. Hertz: 60.
 - d. Full-Load Amperes: **<Insert value>**.
 - e. Minimum Circuit Ampacity: **<Insert value>**.
 - f. Maximum Overcurrent Protection: **<Insert amperage>**.
10. Pump-Start, Pressure-Switch Setting: **<Insert psig (kPa)>**.
11. Pump-Stop, Pressure-Switch Setting: **<Insert psig (kPa)>**.

2.3 FIRE-PUMP ACCESSORIES AND SPECIALTIES

- A. Automatic Air-Release Valves: Comply with NFPA 20 for installation in fire-pump discharge piping.
- B. Relief Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BERMAD Control Valves.
 - b. CLA-VAL Automatic Control Valves.
 - c. Kunkle Valve; a part of Tyco International Ltd.
 - d. OCV Control Valves.
 - e. Watts Regulator Company; a division of Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Wilkins Water Control Products.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
 2. Description: UL 1478, bronze or cast iron, spring loaded; for installation in fire-suppression water-supply piping.
- C. Outlet Fitting: Concentric tapered reducer at pump-head discharge outlet.
- D. Discharge Cone: **[Closed] [Open] [Closed or open]** type.
- E. Hose Valve Manifold Assembly:
 1. Standard: Comply with requirements in NFPA 20.
 2. Header Pipe: ASTM A 53/A 53M, Schedule 40, galvanized steel with ends threaded according to ASME B1.20.1.
 3. Header Pipe Fittings: ASME B16.4, galvanized cast-iron threaded fittings.
 4. Automatic Drain Valve: UL 1726.
 5. Manifold:
 - a. Test Connections: Comply with UL 405 except provide outlets without

- b. clappers instead of inlets.
 - b. Body: Flush type, brass or ductile iron, with number of outlets required by NFPA 20.
 - c. Nipples: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with ends threaded according to ASME B1.20.1.
 - d. Adapters and Caps with Chain: Brass or bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
 - e. Escutcheon Plate: Brass or bronze; rectangular.
 - f. Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
 - g. Exposed Parts Finish: **[Polished] [Rough] [brass] [, chrome plated]**.
 - h. Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."
6. Manifold:
- a. Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
 - b. Body: Exposed type, brass, with number of outlets required by NFPA 20.
 - c. Escutcheon Plate: Brass or bronze; round.
 - d. Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads. Include caps and chains.
 - e. Exposed Parts Finish: **[Polished] [Rough] [brass] [, chrome plated]**.
 - f. Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."

2.4 FLOWMETER SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Emerson Process Management; Rosemount Division.
 - 2. Fire Research Corp.
 - 3. Gerand Engineering Co.
 - 4. Hydro Flow Products, Inc.
 - 5. Hyspan Precision Products, Inc.
 - 6. Meriam Process Technologies.
 - 7. Preso Meters; Division of Racine Federated Inc.
 - 8. Reddy-Buffaloes Pump Company.
 - 9. Victaulic Company.
 - 10. **<Insert manufacturer's name>**.
 - 11. or approved equal.
- B. Description: UL-listed or FM-Approved, fire-pump flowmeter system with capability to indicate flow to not less than 175 percent of fire-pump rated capacity.
- C. Pressure Rating: **[175 psig (1200 kPa) minimum] [250 psig (1725 kPa)]**.
- D. Sensor: Annubar probe, orifice plate, or venturi unless otherwise indicated. Sensor size shall match pipe, tubing, flowmeter, and fittings.

- E. Permanently Mounted Flowmeter: Compatible with flow sensor; with dial not less than 4-1/2 inches (115 mm) in diameter. Include bracket or device for wall mounting.
 - 1. Tubing Package: NPS 1/8 or NPS 1/4 (DN 6 or DN 10) [soft copper] [or] [plastic] tubing with copper or brass fittings and valves.
- F. Portable Flowmeter: Compatible with flow sensor; with dial not less than 4-1/2 inches (115 mm) in diameter and with two 12-foot- (3.7-m-) long hoses in carrying case.

2.5 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink and recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.6 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect fire pumps according to UL 448 requirements for "Operation Test" and "Manufacturing and Protection Tests."
 - 1. Verification of Performance: Rate fire pumps according to UL 448.
- B. Fire pumps will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and conditions affecting performance of fire pumps.
- B. Examine roughing-in for fire-suppression piping systems to verify actual locations of piping connections before fire-pump installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Division 01

requirements.

- B. Accept fire pumps and components onsite in factory packing. Inspect for damage. Comply with manufacturer's rigging and installation instructions.
- C. Protect fire pumps and components from physical damage, including effects of weather, water, and construction debris.
- D. Provide temporary inlet and outlet caps, and maintain in place until installation.

3.3 INSTALLATION

- A. Fire-Pump Installation Standard: Comply with NFPA 20 for installation of fire pumps, relief valves, and related components.
- B. Equipment Mounting: Install fire pumps on concrete bases. Comply with requirements for concrete bases specified in [**Section 033000 "Cast-in-Place Concrete."**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete."**]
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Install fire-pump discharge piping equal to or larger than size required by NFPA 20.
- D. Support piping and pumps separately so weight of piping does not rest on pumps.
- E. Install valves that are same size as connecting piping. Comply with requirements for fire-protection valves specified in [**Section 211200 "Fire-Suppression Standpipes."**] [**Section 211313 "Wet-Pipe Sprinkler Systems."**]
- F. Install pressure gage on pump head discharge flange pressure-gage tapping. Comply with requirements for pressure gages specified in [**Section 211200 "Fire-Suppression Standpipes."**] [**Section 211313 "Wet-Pipe Sprinkler Systems."**]
- G. Install flowmeters and sensors. Install flowmeter-system components and make connections according to NFPA 20 and manufacturer's written instructions.
- H. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.
- I. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

- J. Pump installation shall commence 5 feet outside the building wall and shall include a backflow preventor approved by the City of Denver Water Department, installed in the supply to the fire pump.
- K. Provide approved fittings to comply with DEN cathodic protection requirements.
- L. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.
- M. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For base mounted pumps, provide supports under elbows on pump suction and discharge.
- N. Provide drains for bases and seals, piped to and discharging into floor drains. Closed cone waste to be piped to building exterior and spill on grade.
 - 1. Designer of Record: Confirm location of spill is properly graded to allow water flow to properly sized drains.
- O. Lubricate pumps before startup.
- P. Check, align, and certify base mounted pumps by qualified millwright prior to startup.
- Q. Provide connection to discharge line from north terminal fire pump and discharge line from terminal fire pump.

3.4 ALIGNMENT

- A. Align pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.
- B. After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.
- C. Align piping connection.
- D. Align pump and driver shafts for angular and parallel alignment according to HI 2.4 and to tolerances specified by manufacturer.

3.5 CONNECTIONS

- A. Comply with requirements for piping and valves specified in [**Section 211200 "Fire-Suppression Standpipes."**] [**Section 211313 "Wet-Pipe Sprinkler Systems."**] Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps and equipment to allow service and maintenance.
- C. Connect relief-valve discharge to drainage piping or point of discharge.

- D. Connect flowmeter-system meters, sensors, and valves to tubing.
- E. Connect fire pumps to their controllers.

3.6 IDENTIFICATION

- A. Identify system components. Comply with requirements for fire-pump marking according to NFPA 20.

3.7 FIELD QUALITY CONTROL

- A. Test each fire pump with its controller as a unit. Comply with requirements for electric-motor-driver fire-pump controllers specified in Section 213900 "Controllers for Fire-Pump Drivers."
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist Contractor in testing.
- C. Tests and Inspections:
 - 1. After installing components, assemblies, and equipment including controller, test for compliance with requirements.
 - 2. Test according to NFPA 20 for acceptance and performance testing.
 - 3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Components, assemblies, and equipment will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Hoses are for tests only and do not convey to Owner.

3.8 STARTUP SERVICE

- A. Engage a factory-authorized service representative to assist Contractor and perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written

instructions.

2. **<Insert startup steps if any>**.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to assist Contractor and train Owner's maintenance personnel to adjust, operate, and maintain fire pumps.
 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 213213

SECTION 213400 - PRESSURE-MAINTENANCE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Multistage, pressure-maintenance pumps.
 - 2. Regenerative-turbine, pressure-maintenance pumps.
 - 3. Submersible, pressure-maintenance pumps.
 - 4. Vertical-turbine, pressure-maintenance pumps.
- B. Related Section:
 - 1. Section 213900 "Controllers for Fire-Pump Drivers" for pressure-maintenance-pump controllers.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 PERFORMANCE REQUIREMENTS

- A. Pump Equipment, Accessory, and Specialty Pressure Rating: 175 psig (1200 kPa) minimum unless higher pressure rating is indicated.
- B. Environmental Conditions: The equipment shall be designed and constructed to operate successfully at the rated values under the following environmental conditions:
 - 1. Location: (Indoors/Outdoors)
 - 2. Altitude: 5,500 feet (1677 m) above sea level.
 - 3. Ambient Temperature Range: Minus 30 deg F (minus 35 deg C) to 120 deg F (49 deg C).
 - 4. Wind Load: 115 mph with gust factor of 1.3

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's literature, general assembly, rated capacities, operating characteristics, performance curves

showing performance characteristics with pump and system, electrical characteristics, wiring diagrams, and furnished specialties and accessories, and service conditions.

1. Manufacturer's Installation Instructions: Indicate support details and connection requirements, and include startup instructions for fire pump system.
 2. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For pumps, accessories, and specialties. Include plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps to include in operation and maintenance manuals.
1. Operation Data: Include manufacturer's instructions, startup data, and troubleshooting checklists for pumps, drivers, and controllers.
 2. Maintenance Data: Include manufacturer's literature, cleaning procedures, replacement parts lists, and repair data for pumps, drivers, and controllers, inspection data, availability, addresses, and phone numbers of service depot.
- B. As-Built Plans:
1. "As Built" Plans shall be provided in the same format and manner as described above for shop drawings. Each set shall be equipped with a plan holder equal to "Stacor Plan Clamps" for the appropriate size drawings.
 2. Submit As-Built plans to Owner prior to final testing of fire pump systems.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Equipment and Components: Bear UL and FM label or marking.
- C. Comply with all requirements of Owner's Insurance Underwriter.

1.8 WARRANTY

- A. All work and equipment shall be warranted to be free from defects in workmanship and material for a period of twelve (12) months from the date of Substantial Completion. Any material or equipment found to be defective during this period shall be repaired or replaced without expense to the Owner.

1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate installation of fire pumps with all existing DEN systems.

1.10 EXTRA STOCK

- A. Furnish under provisions of Division 01.
- B. Provide one complete set of gaskets, screens, tools, and packing seals for each pump type and model supplied.
- C. Provide DEN Representatives all special tools required for installation and maintenance

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MULTISTAGE, PRESSURE-MAINTENANCE PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. A-C Fire Pump Systems; a business of ITT Industries.
 - 2. Grundfos Management A/S; Grundfos Pumps Corporation U.S.A.
 - 3. PACO Pumps; Grundfos Pumps Corporation U.S.A.
 - 4. TACO Incorporated.
 - 5. **<Insert manufacturer's name>**.
 - 6. or approved equal.
- B. Description: Factory-assembled and -tested, multistage, barrel-type vertical pump as defined in HI 2.1-2.2 and HI 2.3; designed for surface installation with pump and motor direct coupled and mounted vertically.

C. Pump Construction:

1. Barrel: Stainless steel.
2. Suction and Discharge Chamber: Cast iron with flanged inlet and outlet.
3. Pump Head/Motor Mount: Cast iron.
4. Impellers: Stainless steel, balanced, and keyed to shaft.
5. Pump Shaft: Stainless steel.
6. Seal: Mechanical type with carbon rotating face and silicon-carbide stationary seat.
7. Intermediate Chamber Bearings: Aluminum-oxide ceramic or bronze.
8. Chamber-Base Bearing: Tungsten carbide.
9. O-Rings: EPDM or NBR.

D. Motor: Single speed with permanently lubricated ball bearings and rigidly mounted to pump head. Comply with requirements in Section 210513 "Common Motor Requirements for Fire Suppression Equipment."

1. Power Cord: Factory-connected to motor for field connection to controller and at least [10 feet (3 m)] <Insert dimension> long.

E. Nameplate: Permanently attached to pump and indicating capacity and characteristics.

F. Capacities and Characteristics:

1. Rated Capacity: <Insert gpm (L/minute)>.
2. Total Dynamic Head: <Insert feet (kPa)>.
3. Working Pressure: [175-psig (1200 kPa) **minimum**] [230 psig (1586 kPa)] [300 psig (2070 kPa)] <Insert value>.
4. Inlet and Outlet Size: [NPS 1-1/4 (DN 32)] <Insert size>.
5. Discharge and Suction Flanges: [Class 250] <Insert class>.
6. Suction Head Available at Pump: <Insert feet (m)>.
7. Motor Horsepower: <Insert value>.
8. Motor Speed: <Insert rpm>.
9. Electrical Characteristics:
 - a. Volts: [120] [240] <Insert value>.
 - b. Phases: [Single] [Three].
 - c. Hertz: [60] <Insert value>.
 - d. Full-Load Amperes: <Insert value>.
 - e. Minimum Circuit Ampacity: <Insert value>.
 - f. Maximum Overcurrent Protection: <Insert amperage>.
10. Pump-Start, Pressure-Switch Setting: <Insert psig (kPa)>.
11. Pump-Stop, Pressure-Switch Setting: <Insert psig (kPa)>.

2.2 REGENERATIVE-TURBINE, PRESSURE-MAINTENANCE PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. A-C Fire Pump Systems; a business of ITT Industries.
 2. Crane Pumps and Systems; a Crane Co. company.
 3. MTH Pumps/MTH Tool Company, Inc.
 4. PACO Pumps; Grundfos Pumps Corporation U.S.A.
 5. Pentair Pump Group; Aurora Pump.
 6. **<Insert manufacturer's name>**.
 7. or approved equal.
- B. Description: Factory-assembled and -tested, close-coupled, single-stage, regenerative-turbine centrifugal pump as defined in HI 1.1-1.2 and HI 1.3; with pump and motor mounted horizontally.
- C. Pump Construction:
1. Casing: Radially split, cast iron, with threaded inlet and outlet.
 2. Impeller: Bronze, balanced, and keyed to shaft.
 3. Pump Shaft: Stainless steel[**or steel**] with deflector.
 4. Shaft Sleeve: Bronze.
 5. Seal: Mechanical type with spring-loaded rotating head.
- D. Motor: Single speed with permanently lubricated ball bearings. Comply with requirements in Section 210513 "Common Motor Requirements for Fire Suppression Equipment."
1. Power Cord: Factory-connected to motor for field connection to controller and at least [10 feet (3 m)] **<Insert dimension>** long.
- E. Nameplate: Permanently attached to pump and indicating capacity and characteristics.
- F. Capacities and Characteristics:
1. Rated Capacity: **<Insert gpm (L/minute)>**.
 2. Total Dynamic Head: **<Insert feet (kPa)>**.
 3. Working Pressure: [175 psig (1200 kPa)] [300 psig (2070 kPa)] **<Insert value>**.
 4. Inlet Size: Threaded; **<Insert NPS (DN)>**.
 5. Outlet Size: Threaded; **<Insert NPS (DN)>**.
 6. Suction Head Available at Pump: **<Insert feet (m)>**.
 7. Motor Horsepower: **<Insert value>**.
 8. Motor Speed: **<Insert rpm>**.
 9. Electrical Characteristics:
 - a. Volts: [120] [240] **<Insert value>**.
 - b. Phases: [Single] [Three].
 - c. Hertz: [60] **<Insert value>**.
 - d. Full-Load Amperes: **<Insert value>**.
 - e. Minimum Circuit Ampacity: **<Insert value>**.
 - f. Maximum Overcurrent Protection: **<Insert amperage>**.
 10. Pump-Start, Pressure-Switch Setting: **<Insert psig (kPa)>**.
 11. Pump-Stop, Pressure-Switch Setting: **<Insert psig (kPa)>**.

2.3 SUBMERSIBLE, PRESSURE-MAINTENANCE PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. A-C Fire Pump Systems; a business of ITT Industries.
 2. Pentair Pump Group; Fairbanks Morse.
 3. Sulzer Pumps Ltd.
 4. Weir Floway; a company of Weir Clear Liquid.
 5. **<Insert manufacturer's name>**.
 6. or approved equal.
- B. Description: Factory-assembled and -tested, vertical, multistage, submersible pump as defined in HI 2.1-2.2 and HI 2.3; with pump motor mounted below pump.
- C. Pump Construction:
1. Pump Head or Elbow: Cast iron, for surface discharge, with flanged or threaded connections.
 2. Pump Shaft: Stainless steel.
 3. Bearings: Bronze.
 4. Bowl Section: Multiple cast-iron bowls with closed-type bronze or stainless-steel impellers.
 5. Column Pipe: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with threaded ends and cast-iron or steel fittings, in sections **10 feet (3 m)** or less, with strainer of cast or fabricated bronze or stainless steel between pump and bowl section.
- D. Motor: Single speed with permanently lubricated ball bearings and capable of continuous operation under water. Comply with requirements in Section 210513 "Common Motor Requirements for Fire Suppression Equipment."
1. Power Cord: Capable of continuous under-water operation, factory-connected to motor for field connection to controller, and at least [**10 feet (3 m)**] **<Insert dimension>** long.
- E. Base: Cast iron or steel with hole for electrical cable.
- F. Nameplate: Permanently attached to pump and indicating capacity and characteristics.
- G. Capacities and Characteristics:
1. Rated Capacity: **<Insert gpm (L/minute)>**.
 2. Total Dynamic Head: **<Insert feet (kPa)>**.
 3. Working Pressure: **<Insert psig (kPa)>**.
 4. Inlet Column Size: **<Insert NPS (DN)>**.
 5. Pump Column Length: **<Insert feet (m)>**.
 6. Outlet Size: **<Insert NPS (DN)>**.
 7. Flange: [**Class 125**] **<Insert class>**.
 8. Suction Head Available at Pump: **<Insert feet (m)>**.

9. Motor Horsepower: <Insert value>.
10. Motor Speed: <Insert rpm>.
11. Electrical Characteristics:
 - a. Volts: [120] [240] <Insert value>.
 - b. Phases: [Single] [Three].
 - c. Hertz: [60] <Insert value>.
 - d. Full-Load Amperes: <Insert value>.
 - e. Minimum Circuit Ampacity: <Insert value>.
 - f. Maximum Overcurrent Protection: <Insert amperage>.
12. Pump-Start, Pressure-Switch Setting: <Insert psig (kPa)>.
13. Pump-Stop, Pressure-Switch Setting: <Insert psig (kPa)>.

2.4 VERTICAL-TURBINE, PRESSURE-MAINTENANCE PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. A-C Fire Pump Systems; a business of ITT Industries.
 2. Patterson Pump Company; a subsidiary of the Gorman-Rupp Company.
 3. Peerless Pump, Inc.
 4. Pentair Pump Group; Aurora Pump.
 5. Pentair Pump Group; Fairbanks Morse.
 6. Reddy-Buffaloes Pump Company.
 7. Ruhrpumpen, Inc.
 8. S.A. Armstrong Limited.
 9. Sulzer Pumps Ltd.
 10. Weir Floway; a company of Weir Clear Liquid.
 11. <Insert manufacturer's name>.
 12. or approved equal.
- B. Description: Factory-assembled and -tested, vertical, multistage, open-line-shaft turbine pump as defined in HI 2.1-2.2 and HI 2.3; with pump motor mounted above pump head.
- C. Pump Construction:
 1. Pump Head: Cast iron, for surface discharge, with flange except connections may be threaded in sizes in which flanges are not available.
 2. Pump Head Seal: Stuffing box and stuffing.
 3. Line Shaft: Stainless steel or steel, with corrosion-resistant shaft sleeves.
 4. Line Shaft Bearings: Rubber sleeve, water lubricated.
 5. Line Shaft: Steel.
 6. Line Shaft Bearings: Corrosion resistant, oil lubricated.
 7. Impeller Shaft: Monel metal or stainless steel.
 8. Bowl Section: Multiple cast-iron bowls with closed-type bronze or stainless-steel impellers.

9. Column Pipe: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with threaded ends and cast-iron or steel fittings, in sections **10 feet** (3 m) or less, with strainer of cast or fabricated bronze or stainless steel at bottom.
- D. Motor: Single speed with permanently lubricated ball bearings. Comply with requirements in Section 210513 "Common Motor Requirements for Fire Suppression Equipment."
 1. Power Cord: Factory-connected to motor for field connection to controller and at least [**10 feet** (3 m)] **<Insert dimension>** long.
- E. Base: Cast iron or steel with hole for electrical cable.
- F. Nameplate: Permanently attached to pump and indicating capacity and characteristics.
- G. Capacities and Characteristics:
 1. Rated Capacity: **<Insert gpm** (L/minute)>.
 2. Total Dynamic Head: **<Insert feet** (kPa)>.
 3. Working Pressure: **<Insert psig** (kPa)>.
 4. Inlet Column Size: **<Insert NPS** (DN)>.
 5. Pump Column Length: **<Insert feet** (m)>.
 6. Outlet Size: **<Insert NPS** (DN)>.
 7. Flange: [**Class 125**] **<Insert class>**.
 8. Suction Head Available at Pump: **<Insert feet** (m)>.
 9. Motor Horsepower: **<Insert value>**.
 10. Motor Speed: **<Insert rpm>**.
 11. Electrical Characteristics:
 - a. Volts: [**120**] [**240**] **<Insert value>**.
 - b. Phases: [**Single**] [**Three**].
 - c. Hertz: [**60**] **<Insert value>**.
 - d. Full-Load Amperes: **<Insert value>**.
 - e. Minimum Circuit Ampacity: **<Insert value>**.
 - f. Maximum Overcurrent Protection: **<Insert amperage>**.
 12. Pump-Start, Pressure-Switch Setting: **<Insert psig** (kPa)>.
 13. Pump-Stop, Pressure-Switch Setting: **<Insert psig** (kPa)>.

2.5 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 210513 "Common Motor Requirements for Fire Suppression Equipment."
 1. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment bases and anchorage provisions, with Installer present, for compliance with requirements and for conditions affecting performance of fire pumps.
- B. Examine roughing-in for fire-suppression piping systems to verify actual locations of piping connections before fire-pump installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Division 01 requirements.
- B. Accept fire pumps and components onsite in factory packing. Inspect for damage. Comply with manufacturer's rigging and installation instructions.
- C. Protect fire pumps and components from physical damage, including effects of weather, water, and construction debris.
- D. Provide temporary inlet and outlet caps, and maintain in place until installation.

3.3 EQUIPMENT INSTALLATION

- A. NFPA Standard: Comply with NFPA 20 for installation of pressure-maintenance pumps.
- B. Base-Mounted Pump Mounting: Install pumps on concrete bases. Comply with requirements for concrete bases specified in **[Section 033000 "Cast-in-Place Concrete.]"** **[Section 033053 "Miscellaneous Cast-in-Place Concrete.]"**
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch** (450-mm) centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 5. Attach pumps to equipment base using anchor bolts.
- C. Install **[multistage]** **[and]** **[regenerative-turbine]**, pressure-maintenance pumps according to HI 1.4.

- D. Install [**submersible**] [**and**] [**vertical-turbine**], pressure-maintenance pumps according to HI 2.4.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist Contractor in testing.
- B. Tests and Inspections:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Pressure-maintenance pumps will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Lubricate pumps as recommended by manufacturer.
- B. Set field-adjustable pressure-switch ranges as indicated.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 213400

SECTION 213900 - CONTROLLERS FOR FIRE-PUMP DRIVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Full-service, **[full] [reduced]**-voltage controllers rated 600 V and less.
 - 2. Limited-service controllers rated 600 V and less.
 - 3. Controllers for pressure-maintenance pumps.
 - 4. Remote alarm panels.
 - 5. Low-suction-shutdown panels.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by alternates.

1.3 DEFINITIONS

- A. ATS: Automatic transfer switches.
- B. ECM: Electronic control module.
- C. MCCB: Molded-case circuit breaker.
- D. N.O.: Normally open.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Fire-pump controllers and alarm panels shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7] <Insert requirement>**.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified **[and the unit will be fully operational after the seismic event].**"

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's name and product number, rated capacities, operating characteristics, electrical characteristics and ratings, mounting method, mounting position, supports, and furnished specialties and accessories.
1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For each type of product indicated. Include dimensioned plans, elevations, sections, details, and attachments to other work, including required clearances and service spaces around controller enclosures.
1. Show tabulations of the following:
 - a. Each installed unit's type and details.
 - b. Enclosure types and details for types other than NEMA 250, Type 2.
 - c. Factory-installed devices.
 - d. Nameplate legends.
 - e. Short-circuit current (withstand) rating of integrated unit.
 - f. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices.
 - g. Specified modifications.
 2. Detail equipment assemblies and indicate dimensions, weights, loads, method of field assembly, components, and location and size of each field connection.
 3. Schematic and Connection Diagrams: For power, signal, alarm, and control wiring and for pressure-sensing tubing.
- C. Coordination Drawings: Include floor plans and sections to show fire pump control layouts and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
1. For qualified testing agency.
 2. For firms and persons specified in "Quality Assurance" Article.
- B. Seismic Qualification Certificates: For each type of product indicated, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- C. Product Certificates: For each type of product indicated, from manufacturer.
- D. Manufacturer's factory test reports of fully assembled and tested equipment.
- E. Source quality-control reports: Indicate and interpret test results for compliance with performance requirements.
- F. Field quality-control reports.
- G. Warranty: Submit copies of special product warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of product indicated to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
 - 2. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor-based logic controls.
- B. Torque Values: Submit torque values for all connections with a torque schedule and witness signature.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials including ten (10) percent of installed Units, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver materials as directed by DEN Project Manager.
- B. Extra materials to include the following:
 - 1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - a. Indicating Lights: **[Two]** <Insert number> of each type and color of lens installed; **[two]** <Insert number> of each type and size of lamp installed.
 - b. Auxiliary Contacts: **[One]** <Insert number> for each size and type of magnetic contactor installed.
 - c. Power Contacts: **[Three]** <Insert number> for each size and type of magnetic contactor installed.
 - d. Contactor Coils: **[One]** <Insert number> for each size and type of magnetic controller installed.
 - e. Relay Boards: **[One]** <Insert number> for each size and type of relay board installed.
 - f. Operator Interface: **[One]** <Insert number> microprocessor board(s), complete with display and membrane keypad.

2. <Insert extra materials>.

1.9 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of an NRTL.
- B. Source Limitations: Obtain fire-pump controllers and all associated equipment from single source or producer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with standards of authorities having jurisdiction pertaining to materials and installation.
- E. Comply with NFPA 20 and NFPA 70 for all components and installation.
- F. Fire pump controller Assemblies, Devices, and Accessories: Listed and labeled as defined in NFPA 20 and NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction
- G. Comply with UL Standard 218, Factory Mutual, ASME and OSHA.
- H. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- I. Comply with the requirements of the reference standards noted herein, except where more stringent requirements are listed herein or otherwise required by the Contract Documents.
- J. The most stringent interpretations shall apply. All appendices shall apply.
- K. All work shall be in strict accordance with all applicable codes including Building Code for the City and County of Denver, National Electrical Code (NEC), National Fire Protection Association (NFPA), and Life Safety Code (NFPA 101).

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, protect controllers from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; **[install temporary electric heating, with at least 250 W per controller] [connect factory-installed space heaters to temporary electrical service]**.

1.11 PROJECT CONDITIONS

A. Environmental Limitations:

1. Ambient Temperature Rating: Not less than **40 deg F (5 deg C)** and not exceeding **122 deg F (50 deg C)** unless otherwise indicated.
2. Altitude Rating: Not exceeding **6600 feet (2010 m)** unless otherwise indicated.

B. Retain paragraph below if interruption of existing electric service is required. Power Outages: Any power outages necessary to install or test electrical systems and/or equipment shall be coordinated with Denver International Airport Maintenance/Engineering. A written shutdown request form shall be submitted to and approved by the DEN Project Manager two (2) weeks prior to the shutdown. Comply with NFPA 70E.

1.12 COORDINATION

- ### A. Coordinate layout and installation of controllers with other construction including conduit, piping, fire-pump equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels. Ensure that controllers are within sight of fire-pump drivers.
- ### B. Coordinate sizes and locations of concrete bases with actual equipment provided.
- ### C. Construction Drawings:
1. The drawings are diagrammatic and indicate the general arrangement of electrical work. Locations are approximate and shall be subject to minor modifications as dictated by field conditions and as directed by DEN Project Manager.

1.13 CONSTRUCTION WASTE MANAGEMENT

- ### A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- ### A. All materials, parts, and components used in system shall be new and of the highest grade.
- ### B. All magnetic power devices shall be vacuum impregnated.

2.2 FULL-SERVICE CONTROLLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aquarius Fluid Products, Inc.
 2. ASCO Power Technologies, LP; Firetrol Products.
 3. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 4. Hubbell Incorporated; Hubbell Industrial Controls.
 5. Joslyn Clark Corporation.
 6. Master Control Systems, Inc.
 7. Metron, Inc.
 8. Tornatech.
 9. **<Insert manufacturer's name>**.
 10. or approved equal.
- B. General Requirements for Full-Service Controllers:
1. Comply with NFPA 20 and **[UL 218] <Insert standard>**.
 2. Listed by an NRTL for electric-motor driver for fire-pump service.
 3. **[Combined automatic and nonautomatic] [Nonautomatic]** operation.
 4. Factory assembled, wired, and tested; continuous-duty rated.
 5. Service Equipment Label: NRTL labeled for use as service equipment.
- C. Method of Starting:
1. **[Pressure] [Nonpressure]**-switch actuated.
 - a. Water-pressure-actuated switch and pressure transducer with independent high- and low-calibrated adjustments responsive to water pressure in fire-suppression piping.
 - b. System pressure recorder, electric ac driven, with spring backup.
 - c. Programmable minimum-run-time relay to prevent short cycling.
 - d. Programmable timer for weekly tests.
 2. Magnetic Controller: **[Across-the-line] [Autotransformer] [Part-winding] [Primary-resistor] [Wye-delta (open transition)] [Wye-delta (closed transition)] <Insert type>** type.
 3. Solid-State Controller: **[Reduced-voltage] <Insert type>** type.
 4. Emergency Start: Mechanically operated start handle that closes and retains the motor RUN contactor independent of all electric or pressure actuators.
- D. Method of Stopping: **[Automatic and nonautomatic shutdown after automatic starting] [Nonautomatic]**.
- E. Capacity: Rated for fire-pump-driver horsepower and short-circuit-current (withstand) rating equal to or greater than short-circuit current available at controller location.

- F. Method of Isolation and Overcurrent Protection: Interlocked isolating switch and nonthermal MCCB; with a common, externally mounted operating handle, and providing locked-rotor protection.
- G. Door-Mounted Operator Interface and Controls:
1. Monitor, display, and control the devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.
 2. Method of Control and Indication:
 - a. **[Microprocessor-based logic]** <Insert logic type> controller, with multiline digital readout.
 - b. **[Membrane]** <Insert keypad type> keypad.
 - c. **[LED]** <Insert lamp type> alarm and status indicating lights.
 3. Local[**and Remote**] Alarm and Status Indications:
 - a. Controller power on.
 - b. Motor running condition.
 - c. Loss-of-line power.
 - d. Line-power phase reversal.
 - e. Line-power single-phase condition.
 - f. **<Insert indication>**.
 4. Audible alarm, with silence push button.
 5. Nonautomatic START and STOP push buttons or switches.
 6. **<Insert function>**.
- H. Optional Features:
1. Extra Output Contacts:
 - a. **[One]** <Insert number> N.O. contact(s) for motor running condition.
 - b. **[One]** <Insert number> set(s) of contacts for loss-of-line power.
 - c. **[One]** <Insert number> each, Form C contacts for high and low reservoir level.
 - d. **<Insert contact type>**.
 2. Local alarm bell.
 3. Door-mounted thermal or impact printer for alarm and status logs.
 4. Operator Interface Communications Ports: USB, Ethernet, and RS485.
 5. **<Insert optional feature>**.
- I. ATS:
1. Complies with NFPA 20, **[UL 218]** <Insert standard>, and **[UL 1008]** <Insert standard>.
 2. Integral with controller as a listed combination fire-pump controller and power transfer switch.

3. Automatically transfers fire-pump controller from normal power supply to alternate power supply in event of power failure.
4. Allows manual transfer from one source to the other.
5. Alternate-Source Isolating and Disconnecting Means: Integral molded-case switch, with an externally mounted operating handle.
6. Alternate-Source Isolating and Disconnecting Means: Mechanically interlocked isolation switch and circuit breaker rated at a minimum of 115 percent of rated motor full-load current, with an externally mounted operating handle; circuit breaker shall be provided with nonthermal sensing, instantaneous-only short-circuit overcurrent protection to comply with available fault currents.
7. Local[**and Remote**] Alarm and Status Indications:
 - a. Normal source available.
 - b. Alternate source available.
 - c. In normal position.
 - d. In alternate position.
 - e. Isolating means open.
 - f. **<Insert indication>**.
8. Audible alarm, with silence push button.
9. Nonautomatic (manual, nonelectric) means of transfer.
10. Engine test push button.
11. Start generator output contacts.
12. Timer for weekly generator tests.
13. **<Insert function>**.

2.3 LIMITED-SERVICE CONTROLLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Aquarius Fluid Products, Inc.
 2. ASCO Power Technologies, LP; Firetrol Products.
 3. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 4. Hubbell Incorporated; Hubbell Industrial Controls.
 5. Joslyn Clark Corporation.
 6. Master Control Systems, Inc.
 7. Metron, Inc.
 8. Tornatech.
 9. **<Insert manufacturer's name>**.
 10. or approved equal.
- B. General Requirements for Limited-Service Controllers:
 1. Comply with NFPA 20 and **[UL 218] <Insert standard>**.
 2. Listed by an NRTL for electric-motor driver for fire-pump service.
 3. **[Combined automatic and nonautomatic] [Nonautomatic]** operation.
 4. Factory assembled, wired, and tested; continuous-duty rated.
 5. Service Equipment Label: NRTL labeled for use as service equipment.

- C. Method of Starting:
1. **[Pressure] [Nonpressure]**-switch actuated.
 - a. Water-pressure-actuated switch and pressure transducer with independent high- and low-calibrated adjustments responsive to water pressure in fire-suppression piping.
 - b. System pressure recorder, electric ac driven, with spring backup.
 - c. Programmable minimum-run-time relay to prevent short cycling.
 - d. Programmable timer for weekly tests.
 2. Across-the-line magnetic controller.
 3. Emergency Start: Mechanically operated start handle that closes and retains the motor RUN contactor independent of all electric or pressure actuators.
- D. Method of Stopping: **[Automatic and nonautomatic shutdown after automatic starting] [Nonautomatic]**.
- E. Capacity: Rated for fire-pump-driver horsepower and short-circuit-current (withstand) rating equal to or greater than short-circuit current available at controller location.
- F. Method of Isolation and Overcurrent Protection: Inverse-time, nonadjustable MCCB, with an externally mounted operating handle.
- G. Door-Mounted Operator Interface and Controls:
1. Monitor, display, and control the devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.
 2. Method of Control and Indication:
 - a. **[Microprocessor-based logic] <Insert logic type>** controller, with multiline **[LCD] <Insert display type>** digital readout.
 - b. **[Membrane] <Insert keypad type>** keypad.
 - c. **[LED] <Insert lamp type>** alarm and status indicating lights.
 3. Local[**and Remote**] Alarm and Status Indications:
 - a. Controller power on.
 - b. Motor running condition.
 - c. Loss-of-line power.
 - d. Line-power phase reversal.
 - e. Line-power single-phase condition.
 - f. **<Insert indication>**.
 4. Audible alarm, with silence push button.
 5. Nonautomatic START and STOP push buttons.
 6. **<Insert function>**.
- H. Optional Features:
1. Extra Output Contacts:

- a. [One] <Insert number> N.O. contact(s) for motor running condition.
 - b. [One] <Insert number> set(s) of contacts for loss-of-line power.
 - c. [One] <Insert number> each, Form C contacts for high and low reservoir level.
 - d. <Insert contact type>.
2. Local alarm bell.
 3. Door-mounted thermal or impact printer for alarm and status logs.
 4. Operator Interface Communications Ports: USB, Ethernet, and RS485.
 5. <Insert optional feature>.
- I. ATS:
1. Complies with NFPA 20, [UL 218] <Insert standard>, and [UL 1008] <Insert standard>.
 2. Integral with controller as a listed combination fire-pump controller and power transfer switch.
 3. Automatically transfers fire-pump controller from normal power supply to alternate power supply in event of power failure.
 4. Allows manual transfer from one source to the other.
 5. Alternate-Source Isolating and Disconnecting Means: Integral molded-case switch, with an externally mounted operating handle.
 6. Alternate-Source Isolating and Disconnecting Means: Mechanically interlocked isolation switch and circuit breaker rated at a minimum of 115 percent of rated motor full-load current, with an externally mounted operating handle; circuit breaker shall be provided with nonthermal sensing, instantaneous-only short-circuit overcurrent protection to comply with available fault currents.
 7. Local[and Remote] Alarm and Status Indications:
 - a. Normal source available.
 - b. Alternate source available.
 - c. In normal position.
 - d. In alternate position.
 - e. Isolating means open.
 - f. <Insert indication>.
 8. Audible alarm, with silence push button.
 9. Nonautomatic (manual, nonelectric) means of transfer.
 10. Engine test push button.
 11. Start generator output contacts.
 12. Timer for weekly generator tests.
 13. <Insert function>.

2.4 STANDALONE ATS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aquarius Fluid Products, Inc.

2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 3. Hubbell Incorporated; Hubbell Industrial Controls.
 4. **<Insert manufacturer's name>**.
 5. or approved equal.
- B. General Requirements for Standalone ATS:
- C. Complies with NFPA 20, **[UL 218] <Insert standard>**, and **[UL 1008] <Insert standard>**.
1. Listed by an NRTL for fire-pump service.
 2. Automatic and nonautomatic operation.
 3. Separate from controller and individually listed as a fire-pump-controller power transfer switch.
 4. Automatically transfers fire-pump controller from normal power supply to alternate power supply in event of power failure.
 5. Allows manual transfer from one source to the other; factory assembled, wired, and tested.
- D. Capacity: Rated for fire-pump-driver horsepower and short-circuit-current (withstand) rating equal to or greater than short-circuit current available at ATS location.
- E. Alternate-Source Isolating and Disconnecting Means: Integral molded-case switch, with an externally mounted operating handle.
- F. Alternate-Source Isolating and Disconnecting Means:
1. Mechanically interlocked isolation switch and circuit breaker rated at a minimum of 115 percent of rated motor full-load current.
 2. Externally mounted operating handle.
 3. Circuit breaker provided with nonthermal sensing, instantaneous-only, short-circuit overcurrent protection.
 4. Equipped with a voltage surge arrester.
- G. Door-Mounted Operator Interface and Controls:
1. Monitor, display, and control devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.
 2. Method of Control and Indication:
 - a. **[Microprocessor-based logic] <Insert logic type>** controller, with multiline **[LCD] <Insert display type>** readout.
 - b. **[Membrane] <Insert keypad type>** keypad.
 - c. **[LED] <Insert lamp type>** alarm and status indicating lights.
 3. Local[**and Remote**] Alarm and Status Indications:
 - a. Normal source available.
 - b. Alternate source available.
 - c. In normal position.

- d. In alternate position.
 - e. Isolating means open.
 - f. **<Insert indication>**.
4. Audible alarm, with silence push button.
 5. Nonautomatic (manual, nonelectric) means of transfer.
 6. Engine test push button.
 7. Start generator output contacts.
 8. Timer for weekly generator tests
 9. **<Insert function>**.
- H. Optional Features:
1. Extra Output Contacts:
 - a. **[One]** **<Insert number>** each, Form A; isolating means open.
 - b. **[One]** **<Insert number>** each, Form C; in normal or alternate position
 - c. **<Insert contact type>**.
 2. Door-mounted thermal or impact printer for alarm and status logs.
 3. Operator Interface Communications Ports: USB, Ethernet, and RS485.
 4. **<Insert optional feature>**.

2.5 CONTROLLERS FOR PRESSURE-MAINTENANCE PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aquarius Fluid Products, Inc.
 2. ASCO Power Technologies, LP; Firetrol Products.
 3. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 4. Hubbell Incorporated; Hubbell Industrial Controls.
 5. Joslyn Clark Corporation.
 6. Master Control Systems, Inc.
 7. Metron, Inc.
 8. Tornatech.
 9. **<Insert manufacturer's name>**.
 10. or approved equal.
- B. General Requirements for Pressure-Maintenance-Pump Controllers:
1. Type: UL 508 factory assembled, -wired, and tested, across-the-line; for combined automatic and manual operation.
 2. Enclosure: UL 508 and NEMA 250, Type 2 for wall-mounting.
 3. Factory assembled, wired, and tested.
 4. Finish: Manufacturer's standard color paint.
- C. Rate controller for scheduled horsepower and include the following:
1. Fusible disconnect switch.

2. Pressure switch.
3. Hand-off-auto selector switch.
4. Pilot light.
5. Running period timer.

2.6 REMOTE ALARM PANELS

- A. General Requirements for Remote Alarm Panels: Comply with NFPA 20 and **[UL 218]** **<Insert standard>**; listed by an NRTL for fire-pump service.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Aquarius Fluid Products, Inc.
 2. ASCO Power Technologies, LP; Firetrol Products.
 3. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 4. Hubbell Incorporated; Hubbell Industrial Controls.
 5. Joslyn Clark Corporation.
 6. Master Control Systems, Inc.
 7. Metron, Inc.
 8. Tornatech.
 9. **<Insert manufacturer's name>**.
 10. or approved equal.
- C. General Requirements for Remote Alarm Panels: Factory assembled, wired, and tested.
- D. Supervisory[**and Normal**] Control Voltage: **[120-V ac] [240-V ac] <Insert voltage>**; **[single] [dual]** source.
- E. Audible and Visual Alarm and Status Indications:
 1. Driver running.
 2. Loss of phase.
 3. Phase reversal.
 4. Supervised power on.
 5. **[Common] [Separate]** trouble on the controller.
 - a. **<Insert alarm>**.
 6. Controller connected to alternate power source.
 7. **<Insert indication>**.
- F. Audible and Visual Alarm and Status Indications: Manufacturer's standard indicating lights; **[push-to-test] [non-push-to-test, with separate test push button]**.
 1. Engine running.
 2. Controller main switch turned to the off or manual position.
 3. Supervised power on.
 4. **[Common] [Separate]** trouble on the controller or engine.

- a. **<Insert alarm>**.
- 5. Common pump room trouble.
- 6. Controller connected to alternate power source.
- 7. **<Insert indication>**.
- G. Audible alarm, with silence push button.
- H. Pump REMOTE START push button.

2.7 LOW-SUCTION-SHUTDOWN PANELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Aquarius Fluid Products, Inc.
 - 2. ASCO Power Technologies, LP; Firetrol Products.
 - 3. Hubbell Incorporated; Hubbell Industrial Controls.
 - 4. Joslyn Clark Corporation.
 - 5. Master Control Systems, Inc.
 - 6. Metron, Inc.
 - 7. Tornatech.
 - 8. **<Insert manufacturer's name>**.
 - 9. or approved equal.
- B. General Requirements for Low-Suction-Shutdown Panels:
 - 1. Listed by an NRTL for fire-pump service.
 - 2. Factory assembled, wired, and tested.
 - 3. Prevents automatic start of fire pump, and shuts down automatically started fire pump, on low-suction pressure.
 - 4. **[Automatic] [Manual]** reset.
- C. Operation: **[External contact input] [Integral pressure switch] <Insert operation>**.
- D. Supervisory[**and Normal**] Control Voltage: **[120-V ac] [240-V ac] <Insert voltage>**; **[single] [dual]** source.
- E. Include audible and visual alarms and status indications, with silence push button, for the following conditions:
 - 1. Control power available.
 - 2. Low-suction pressure.
 - 3. Normal-suction pressure.
 - 4. **<Insert optional features>**.

2.8 ENCLOSURES

- A. Fire-Pump Controllers, ATS, Remote Alarm Panels, and Low-Suction-Shutdown

Panels: NEMA 250, to comply with environmental conditions at installed locations and NFPA 20.

1. Indoor, Dry and Clean Locations: [**Type 1 (IEC IP10)**] <Insert type>.
2. Indoor Locations Subject to Dripping Noncorrosive Liquids: [**Type 2 (IEC IP11)**] <Insert type>.
3. Outdoor Locations: [**Type 3R (IEC IP14)**] [**Type 4 (IEC IP56)**] [**Type 4X (IEC IP56)**] <Insert type>.
4. Other Wet or Damp, Indoor Locations: [**Type 4 (IEC IP56)**] [**Type 4X (IEC IP56)**] <Insert type>.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12 (IEC IP12).

- B. Enclosure Color: [**Manufacturer's standard "fire-pump-controller red"**] <Insert color>.
- C. Nameplates: Comply with NFPA 20; complete with capacity, characteristics, approvals, listings, and other pertinent data.
- D. Optional Features:
1. Floor stands, **12 inches** (305 mm) high, for floor-mounted controllers.
 2. Space heater, [**120-V ac**] [**240-V ac**] [, with humidistat] [, with thermostat].
 3. Tropicalization.
 4. <Insert optional feature>.

2.9 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect fire-pump controllers according to requirements in NFPA 20 and [**UL 218**] <Insert standard>.
1. Verification of Performance: Rate controllers according to operation of functions and features specified.
- B. Fire-pump controllers will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive equipment, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine equipment before installation. Reject equipment that is wet or damaged by moisture or mold.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SEQUENCING AND SCHEDULING

- A. The fire pump controller installation is to be sequenced and scheduled with other work to reduce possibility of damage and soiling of equipment during the remainder of construction period.

3.3 FACTORY TESTING

- A. Before shipment, the manufacturer shall fully and completely test the system to factory standards to assure compliance with the specification. Each subassembly shall undergo thorough testing prior to installation in the system. The total system shall be exposed to a functional load test shall be subjected to a minimum of 48 hours "burn-in" test prior to shipment.
- B. A complete test report shall be submitted to DEN Project Manager for each unit and kept on file for future reference.

3.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle fire pump controller according to NEMA BU 1.1.

3.5 PROJECT CONDITIONS

- A. Field Measurements: Verify existing dimensions by field measurements. Verify clearances and locate obstructions within manufacturing and installation tolerances of fire pump controller assemblies.

3.6 CONTROLLER INSTALLATION

- A. Install controllers within sight of their respective drivers.
- B. Install fire pump controller assemblies according to manufacturer's written instructions, Shop Drawings, Coordination Drawings, and referenced standards.
- C. Support fire pump controller assemblies independent of supports for other elements such as equipment enclosure at connections to panelboards and switchboards, pipe, conduit, ceilings, and ducts.
 - 1. Fasten supports securely to building structure according to Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- D. Coordinate fire pump controller assembly terminations to equipment enclosures to ensure proper phasing, connection, and closure.

- E. Tighten fire pump controller assembly joints with torque wrench or similar tool recommended by bus assembly manufacturer. Tighten joints again after bus assemblies have been energized for 30 days.
- F. Connect fire pump controller assemblies and components to wiring system and to ground as indicated and instructed by manufacturer.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
 - 2. Torque Values: Submit torque values for all connections with a torque schedule and witness signature.
- G. Connect controllers to their dedicated pressure-sensing lines.
- H. Wall-Mounting Controllers: Install controllers on walls with disconnect operating handles not higher than **79 inches** (2006 mm) above finished floor, and bottom of enclosure not less than **12 inches** (305 mm) above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."
- I. Floor-Mounting Controllers: Install controllers on **4-inch** (100-mm) nominal-thickness concrete bases, using floor stands high enough so that the bottom of enclosure cabinet is not less than **12 inches** (305 mm) above finished floor. Comply with requirements for concrete bases specified in **[Section 033000 "Cast-in-Place Concrete. "] [Section 033053 "Miscellaneous Cast-in-Place Concrete. "]**
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch** (450-mm) centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- J. Seismic Bracing: Comply with requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- K. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- L. Comply with NEMA ICS 15.

3.7 STANDALONE ATS INSTALLATION

- A. Wall-Mounting ATS: Install ATS on walls with disconnect operating handles not higher

than **79 inches** (2066 mm) above finished floor, and bottom of enclosure not less than **12 inches** (305 mm) above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For ATS not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

- B. Floor-Mounting ATS: Install ATS on **4-inch** (100-mm) nominal-thickness concrete bases, using floor stands high enough so that the bottom of enclosure cabinet is not less than **12 inches** (305 mm) above finished floor. Comply with requirements for concrete bases specified in **[Section 033000 "Cast-in-Place Concrete.]"** **[Section 033053 "Miscellaneous Cast-in-Place Concrete.]"**
1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch** (450-mm) centers around the full perimeter of concrete base.
 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Seismic Bracing: Comply with requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.8 REMOTE ALARM[**AND LOW-SUCTION-SHUTDOWN**] PANEL INSTALLATION

- A. Install panels on walls with tops not higher than **[72 inches** (1829 mm)] **<Insert height>** above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For ATS not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

3.9 POWER WIRING INSTALLATION

- A. Install power wiring between controllers and their services or sources, and between controllers and their drivers. Comply with requirements in NFPA 20, NFPA 70, and Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.10 CONTROL AND ALARM WIRING INSTALLATION

- A. Install wiring between controllers and remote devices[**and facility's central monitoring system**]. Comply with requirements in NFPA 20, NFPA 70, and Section 260523 "Control-Voltage Electrical Power Cables."

- B. Install wiring between remote alarm[**and low-suction-shutdown**] panels and controllers. Comply with requirements in NFPA 20, NFPA 70, and Section 260523 "Control-Voltage Electrical Power Cables."
- C. Install wiring between controllers and the building's fire-alarm system. Comply with requirements specified in Section 283111 "Digital, Addressable Fire-Alarm System."
- D. Bundle, train, and support wiring in enclosures.
- E. Connect remote manual and automatic activation devices where applicable.

3.11 IDENTIFICATION

- A. Comply with requirements in NFPA 20 for marking fire-pump controllers.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification in NFPA 20 and as specified in Section 260553 "Identification for Electrical Systems."

3.12 FIELD QUALITY CONTROL

- A. Testing Agency: [**Engage**] a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist Contractor in testing.
- C. Acceptance Testing Preparation:
 - 1. Inspect and Test Each Component:
 - a. Inspect wiring, components, connections, and equipment installations. Test and adjust components and equipment.
 - b. Test insulation resistance for each element, component, connecting supply, feeder, and control circuits.
 - c. Test continuity of each circuit.
 - 2. Verify and Test Each Electric-Driver Controller:
 - a. Verify that voltages at controller locations are within plus 10 or minus 1 percent of motor nameplate rated voltages, with motors off. If outside this range for any motor, notify DEN Project Manager before starting the motor(s).
 - b. Test each motor for proper phase rotation.
 - 3. Operational Test: After electrical circuitry has been energized, start units to

- confirm proper unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Field Acceptance Tests:

1. Do not begin field acceptance testing until suction piping has been flushed and hydrostatically tested and the certificate for flushing and testing has been submitted to DEN Project Manager and authorities having jurisdiction.
2. Prior to starting, notify authorities having jurisdiction of the time and place of the acceptance testing.
3. Engage manufacturer's factory-authorized service representative to be present during the testing.
4. Perform field acceptance tests as outlined in NFPA 20.

E. Controllers will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.13 STARTUP SERVICE

A. Engage a factory-authorized service representative to assist Contractor and perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. **<Insert startup steps if any>**.

3.14 ADJUSTING

A. Adjust controllers[**and battery charger systems**] to function smoothly and as recommended by manufacturer.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, and timers.

C. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

D. Set field-adjustable pressure switches.

3.15 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.

- B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.
- C. ADJUSTING
 - 1. Set field-adjustments to match loads.
- D. CLEANING
 - 1. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris. Repair damaged finish to match original finish.
- E. PROTECTION
 - 1. Provide final protection to ensure that moisture does not enter fire pump controller assembly.
- F. COMMISSIONING
 - 1. Manufacturer's representative shall visit site, verify installation, start up and test, and submit to DEN Project Manager, a letter stating equipment and installation meets intent of Contract Documents and manufacturer's warranties and guarantees are in effect.

3.16 DEMONSTRATION

- A. Engage a factory-authorized service representative to assist Contractor and train Owner's maintenance personnel to adjust, operate, and maintain controllers[, **remote alarm panels**] [, **low-suction-shutdown panels**] [, **and to use and reprogram microprocessor-based controls within this equipment**].
 - 1. Train Owner's maintenance personnel on procedures and schedules for starting up and shutting down, troubleshooting, servicing, and maintaining equipment and schedules.
 - 2. Review data in maintenance manuals in accordance with requirements of Division 01.
 - 3. Review data in maintenance manuals in accordance with requirements of Division 01.
 - a. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days' advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 213900

SECTION 220400 - BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Basic requirements common to the Work in general of Division 22 and other Divisions and Sections of the Specification where referenced.
- B. Provide, unless specified otherwise, all labor, materials and equipment necessary for completely finished and operational mechanical systems described and specified under other Sections of this Division 22.
- C. Provide all minor incidental items such as offsets, fittings, and accessories required as part of the Work even though not specified or indicated.
- D. Inspection: Inspect Work preceding or interfacing with Work of Division 22 and report any known or observed defects that affect the Work to the General Contractor. Do not proceed with the Work until defects are corrected.
- E. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 REFERENCES

- A. General:
 - 1. For products or workmanship specified by association, trades, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable Codes.
 - 2. The date of the standard is that in effect as the date of the Contract Documents, except when a specific date is specified.
 - 3. When required by individual Specifications Section by means of reference for cleaning or installation requirements, etc., obtain a copy of the standard. Maintain the copy at job site during work until substantial completion. Copy may be in electronic format.
 - 4. Schedule of Referenced Organizations: Reference Section 014210 "Referenced Material" for a list of the acronyms of organizations referenced in these Specifications:

1.4 DEFINITIONS

- A. Conform to Division 01: These Specifications are of abbreviated, simplified, or streamlined type and include incomplete sentences. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of the Contract Documents so indicates.
- B. The following words are re-defined and/or elaborated on for the context of Division 22 Work:
 - 1. Furnish: Except as otherwise defined in greater detail, term "furnish" is used to mean supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.
 - 2. Install: Except as otherwise defined in greater detail, term "install" is used to describe operations at Project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations, as applicable in each instance.
 - 3. Provide: Except as otherwise defined in greater detail, term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.
 - 4. General Contractor: The term "General Contractor" used in Division 22 and elsewhere in the Contract Documents means the party with whom the Owner has executed the Owner-Contractor Agreement.

1.5 QUALITY CONTROL

- A. Conform to Division 01. Materials and apparatus required for the Work to be new; to be furnished, delivered, erected, connected and finished in every detail; and to be so selected and arranged so as to fit properly into the building spaces.
- B. Unless otherwise specifically indicated, equipment and materials to be installed in accordance with the recommendations of the Manufacturer. This includes the performance of tests as recommended by the Manufacturer.

1.6 REGULATORY REQUIREMENTS

- A. Comply with latest editions of all applicable Codes, Standards, Ordinances and Regulations in effect as of the date of the Contract Documents including but not necessarily limited to the following:
 - 1. ABMA - American Bearing Manufacturers Association.
 - 2. ACGIH - American Conference of Governmental Industrial Hygienists.
 - 3. ACI - American Concrete Institute.
 - 4. AGA - American Gas Association.
 - 5. ASHRAE - American Society of Heating, Refrigeration, and Air Conditioning Engineers.
 - 6. ANSI - American National Standards Institute.
 - 7. API - American Petroleum Institute.

8. ASTM - American Society for Testing of Materials.
9. AWS - American Welding Society.
10. AWWA - American Water Works Association.
11. FM - Factory Mutual Insurance Association.
12. MSS - Manufacturers Standardization Society of the Valve and Fittings Industry.
13. NACE - National Association of Corrosion Engineers.
14. NAPCA - National Association of Pipe Coating Applicators.
15. National Electrical Code NFPA-70.
16. NFPA - National Fire Protection Association.
17. SMACNA - Sheet Metal and Air Conditioning Contractors National Association.
18. SSPC - The Society for Protective Coatings.
19. STI - Steel Tank Institute.
20. UL - Underwriters Laboratories.

- B. If discrepancies occur between the Contract Documents and any applicable Codes, Guidelines, Ordinances, Acts, or Standards, the most stringent requirements shall apply.
- C. Where hourly fire ratings are indicated or required, provide components and assemblies meeting requirements of the American Insurance Association, Factory Mutual Insurance Association and listed by Underwriters Laboratories, Inc.

1.7 PRODUCT OPTIONS AND SUBSTITUTIONS

- A. Substitutions: Refer to Division 01, General Requirements.
- B. Some materials and equipment are specified by Manufacturer and catalog numbers. The Manufacturer and catalog numbers are used to establish a degree of quality and style for such equipment and material.
- C. When alternate or substitute materials and equipment are used, Contractor shall be responsible for space requirements, configurations, performance, changes in bases, supports, structural members and openings in structure, electrical changes and other apparatus and trades that may be affected by their use.
- D. When providing a product and/or service under the qualification of "acceptable equal," Contractor shall be entirely responsible for additional costs incurred due to modifications to the civil, architectural, structural, mechanical, and electrical design that may be required to accommodate the "acceptable equal."
- E. Substitute materials and equipment are only allowed to be provided from the Manufacturers listed as approved.

1.8 SHOP DRAWINGS AND PRODUCT DATA

- A. General: Comply with the General Conditions of the Contract and with Division 01 - General Requirements.
- B. All documents shall be submitted in electronic format. Each submittal shall be in a

single security free PDF document. PDF documents shall be compatible with Adobe Acrobat 10.0 or newer. All as-built documents shall be submitted in Revit in accordance with Division 1 requirements.

1.9 CONTRACT RECORD DOCUMENTS

- A. General: Comply with the General Conditions of the Contract and with Division 01 - General Requirements,

1.10 OPERATING AND MAINTENANCE DATA

- A. Plumbing Contractor shall submit electronic copy containing a single PDF file of the entire maintenance manual to the DEN Project Manager, General Contractor for their approval.

- B. The manual shall have:

1. Alphabetical list of all system components including the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year's operation.
2. Operating instructions for complete system, including emergency procedures for fire or failure of major equipment and procedures for normal starting/operating/shutdown and long-term shutdown.
3. Maintenance instructions, including valves, valve tag and other identified equipment lists, proper lubricants and lubricating instructions for each piece of equipment and necessary cleaning/replacing/adjusting schedules.
4. Manufacturer's data on each piece of equipment, including:
 - a. Installation instructions.
 - b. Drawings and specifications (approved shop drawings).
 - c. Parts lists.
 - d. Complete wiring and temperature control diagrams (approved shop drawings).
5. Each piece identified on any schedule shall be bookmarked in the electronic file by its scheduled tag ID (IE: WH-1)

- C. In addition to the maintenance manual, and keyed to it, the equipment shall be identified and tagged as specified.

1. Identify all starters, disconnect switches, and manually operated controls, except integral equipment switches with permanently applied, legible markers corresponding to operating instructions in the "Maintenance Manual".
2. Tag all manual operating valves with 1-1/2" diameter brass tags attached with chains. Tags are to be sequence numbered with legible metal stamps.
3. Provide a typed tag list or schedule mounted under glass in the room designated by DEN Project Manager stating number, location, and function of each tagged item. Insert a copy of tag list in each "Maintenance Manual".

- D. Plumbing Contractor shall be responsible for scheduling instructional meetings for maintenance personnel on the proper operation and maintenance of all mechanical systems, using the maintenance manual as a guide. These meetings must be scheduled through the DEN Project Manager, and General Contractor far enough in advance so that all personnel can be notified.
- E. Division 22 Contractor shall provide proof of performance certification of all Plumbing Equipment and Systems to demonstrate that all Plumbing Equipment and Systems are operating to the intent of the design.

1.11 FINAL OBSERVATION

- A. Comply with the requirements of Division 01 and the following:
 - 1. Prior to the request for final observation, all Work under the contract shall be complete; all systems shall be in proper working order and placed in operation for a minimum duration of 48 hours.
 - 2. All plumbing systems shall be properly functioning with quantities shown on the Drawings, and all water circuits shall be adjusted to provide the proper flows.
 - 3. All equipment shall be cleaned. All debris and construction materials shall be removed from the DEN property to a DEN approved landfill off-airport.
 - 4. Pumps shall be tested in accordance with other Division 22 Sections and shall be in proper working order and placed in operation.
 - 5. The temperature control system shall be complete and in proper working order. All instruments shall be properly and accurately field calibrated.
 - 6. At the request of the DEN Project Manager, a representative of the Contractor who is thoroughly familiar with the Project and operation of the various systems shall be present during the final observation to demonstrate proper operation of the equipment and controls. If requested by the DEN Project Manager, the Contractor shall have representatives from the Contractor's subcontractors present to assist during final observation.

1.12 PROJECT CONDITIONS

- A. Accessibility:
 - 1. Division 22 Contractor shall locate all equipment, which must be serviced, operated, or maintained in fully accessible positions. Such equipment shall include (but not be limited to) valves, shock absorbers, motors, controllers, switchgear, and drain points. If required for better accessibility, furnish access doors for this purpose. Minor deviations from Drawings may be allowed to provide for better accessibility. Any changes shall be approved by the DEN Project Manager prior to making the change.
 - 2. Division 22 Contractor shall provide the General Contractor with the exact locations of access doors for each concealed valve, shock absorber control, damper, or other device requiring service. Locations of these doors shall be submitted in sufficient time to be installed in the normal course of work.
 - 3. Provide carpentry, masonry, concrete and metalwork required for work of this

Division where not specifically called for under other Sections.

B. Freeze Protection:

1. Do not run plumbing systems piping in outside walls, or locations where freezing may occur. Piping next to outside walls shall be in furred spaces with insulation between the piping and the outside wall. Insulation of piping shall not be considered freeze protection.

C. Scaffolding, Rigging and Hoisting:

- a. Provide all scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises of any equipment and apparatus furnished; remove same from premises when no longer required. Conform to OSHA requirements and standards.

1.13 COORDINATION

- A. General: Coordinate and order the progress of plumbing Work to conform to the progress of the Work of the other trades. Complete the entire installation as soon as the condition of the building will permit.
- B. Coordinate Work with Division 21 Fire Suppression, Division 23 HVAC, Division 26 Electrical, and Division 33 Utilities and other Divisions as required to perform the Work.
- C. Existing System Interruptions: Comply with Division 01.
- D. Cutting and Patching: Reference Section 017330 "Cutting and Patching".
- E. Drawings and Specifications: The Plumbing Drawings indicate the general design and arrangement of lines, equipment, systems, etc. Information shown is diagrammatic in character and does not necessarily indicate every required offset, fitting, etc. Do not scale the Drawings for dimensions. Take dimensions, measurements, locations, levels, etc., from the Architectural and Engineering Drawings and equipment to be furnished.
- F. Discrepancies: Examine Drawings and Specifications for other parts of the Work, and if any discrepancies occur between the plans for the Work of this Division and the plans for the work of others, report such discrepancies to the DEN Project Manager and obtain written instructions for any changes necessary.
- G. Order of Precedence: The precedence of construction documents are as Specified in the General Conditions.

1.14 START-UP PROCEDURES

- A. Before start-up, each piece of equipment comprising a part of the system shall be checked for proper lubrication, drive rotation, proper control sequence, and any other condition, which may cause damage to equipment or endanger personnel.

- B. Ensure that all control systems are fully operational in automatic mode.
- C. If systems are not to continue in use following the start-up procedures, steps should be taken to ensure against accidental operation or operation by unauthorized personnel.
- D. Factory personnel shall be notified as appropriate to start systems requiring their services.
- E. Notify the DEN Project Manager in writing a minimum of 72 hours prior to start-up of all major mechanical equipment and systems if no shutdown request is required.
- F. Should there be any equipment found which had not been properly started up, it will be the responsibility of this Contractor to arrange for the appropriate personnel to start up the equipment at the Contractor's expense and at a time as scheduled by the DEN Project Manager.

1.15 SCHEDULE OF TESTING

- A. Provide testing in accordance with the General Conditions of the Contract and as per requirements in Division 22 Sections.
- B. A schedule of testing shall be drawn up by the Division 22 Contractor in such a manner that it will show areas tested, test pressure, length of test, date, time and signature of testing personnel.
- C. Notify the DEN Project Manager, DEN Mechanical Inspector and DEN Mechanical Engineer in writing a minimum of 72 hours prior to testing of any mechanical equipment and systems if no shutdown request is required.
- D. All testing must be performed in the presence DEN Project Manager and or designated representative; the DEN Project Manager's signature for verification of the test must appear on the schedule.
- E. All testing must be performed in accord with the procedures set forth in Division 22 and other Sections of the Specifications where referenced. At completion of testing, the schedule shall then be submitted in triplicate to the DEN Project Manager.
- F. Ensure operational and performance tests are made on seasonal equipment.
- G. Complete all tests required by Code Authorities, such as health codes, building codes, and safety codes.
- H. After test runs have been completed and systems have been demonstrated to be satisfactory and ready for permanent operation, all permanent pipeline strainers and filters shall be cleaned, valve and pump packing properly adjusted, final adjustments made, drive guards secured in place, lubrication checked and replenished if required.

1.16 CLEANING AND FINISHING

- A. Provide cleaning in accordance with the General Requirements of the Contract
- B. Cleaning shall include but not be limited to removing grease, dirt, dust, stains, labels, fingerprints, and other foreign materials from sight-exposed piping, equipment, fixtures, and other such items installed under Division 22 of the Work. If finishes have been damaged, refinish to original condition and leave everything in proper working order and of intended appearance.
- C. Clean Domestic Water Systems in accordance with applicable Division 22 Sections.

1.17 WARRANTIES

- A. Conform to Division 01: Provide a written warranty covering the entire plumbing Work to be free from defective materials, equipment, and workmanship for a minimum period of two (2) years after date of acceptance. During this period, provide labor and materials as required to repair or replace defects. Provide certificates for such items of equipment, which have or are specified to have warranties in excess of one (1) year.

1.18 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 220400

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following basic mechanical materials and methods to complement other Division 22 Sections.
1. Piping materials and installation instructions common to most piping systems.
 2. Dielectric fittings.
 3. Sleeves.
 4. Nonshrink grout for equipment installations.
 5. Flowable backfill for underground piping.
 6. Field-fabricated metal equipment supports.
 7. Concrete bases
 8. Installation requirements common to equipment specification Sections.
 9. Cutting and patching.
 10. Touch up painting and finishing.

for Alternates with DEN Project Manager.

- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of Contract, including General and the Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 050510 "Welding"
- C. Section 220400 "Basic Plumbing Requirements".
- D. Section 220553 "Identification for Plumbing Piping and Equipment".
- E. Division 31 Earthwork Sections.

1.3 DEFINITIONS

- A. Pipe, pipe fittings, and piping include tube, tube fittings, and tubing.
- B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below the roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

- C. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- D. Exposed Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- E. Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- F. Concealed Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections:
 - 1. Shop drawings detailing fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.
 - 2. Prepare coordination drawings according to Division 01 Section "Submittals" to a 1/4 inch equals 1 foot scale or larger. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Show where sequence and coordination of installations are important to the efficient flow of the Work. Include the following:
 - a. Clearances for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.
 - b. Pump metal support details.
 - 3. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the Quality Assurance Article.
 - 4. Floor x-rays and/or ground penetrating radar reports.
 - 5. All documents shall be submitted in electronic format. Each submittal shall be in a single security free PDF document. PDF documents shall be compatible with Adobe Acrobat 10.0 or newer. All as-built documents shall be submitted in Revit in accordance with Division 1 requirements.
 - 6. Contractor shall submit fully dimensioned spool drawings for all welded piping work. Drawings shall indicate all weld types, sizes and materials to be used. The spool drawing size shall match the full size contract documents of either 24"x36" or 34"x44". Spool drawings shall be submitted in electronic format in Revit in compliance with Division 1 requirements. Files shall not contain security. Other file formats will not be accepted.
 - 7. Field Test Reports: Written reports of each pressure tests specified in Division 22 Sections. Include the following:
 - a. Test procedures used.
 - b. Test results that comply with requirements.

- c. Failed test results and corrective action taken to achieve requirements.

1.5 QUALITY CONTROL

- A. Equipment Selection: Equipment of greater or larger power, dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing by the DEN Project Manager and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.
- B. Electronic Equipment Compliance:
1. Contractor warrants that all equipment, devices, items, systems, software, hardware, or firmware provided shall properly, appropriately, and consistently function and accurately process date and time data (including without limitation: calculating, comparing, and sequencing). This warranty supersedes anything in the Specifications or other Contract Documents which might be construed inconsistently. This warranty is applicable whether the equipment, device, item, system, software, hardware, or firmware is specified with or without reference to a manufacturer's name, make, or model number.
- C. Unless specified otherwise, all materials and equipment shall be of domestic (USA) manufacture and shall be of the best quality used for the purpose in commercial practice.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored, pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.
- C. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.
- D. Protect flanges, fittings, and piping specialties from moisture and dirt.
- E. Deliver fittings with plastic sheeting to protect it from elements. Inspect duct liner for exposure to dirt and tears.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate plumbing equipment installation with other building components.

- B. Coordinate the installation of required supporting devices.
- C. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work.
- D. Coordinate connection of electrical services.
- E. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

- A. Refer to individual piping system specification Sections for pipe and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual piping system specification Sections in Division 22 for special joining materials not listed below.
- B. Grooved Mechanical Couplings: Acceptable only for fire protection piping; not acceptable for any other applications.
- C. Pipe Flange Gasket Materials: Suitable for the chemical, pressure, and thermal conditions of the piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, except where thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125 cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250 cast-iron and steel flanges.
- D. Solder Filler Metal: ASTM B 32.
 - 1. Alloy Sn95 or Alloy Sn94: Tin (approximately 95 percent) and silver (approximately 5 percent) – Not industry standard, usually 5% antimony.
- E. Brazing Filler Metals: AWS A5.8.
 - 1. BCuP Series: Copper-phosphorus alloys.
 - 2. BAg1: Silver alloy.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded. All welding rod is to

be kept in a operable rod oven at all times.

2.3 PIPING SPECIALTIES

- A. Dielectric Fittings: Assembly or fitting having insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.
1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.
 2. Insulating Material: Suitable for system fluid, pressure, and temperature.
 3. Dielectric Waterway Fittings: Dielectric fittings designed to effectively separate dissimilar metals exposed to water or other electrolytes, conforming to NSF and ASTM F492 standards for continuous use at temperatures up to 225 degrees F and pressures up to 300 psi. Fittings to have electro-zinc-plated steel casings providing for maintained exterior electrical continuity, threaded or flanged ends as applicable, and inert linings.
 4. Dielectric Flanges: Factory-fabricated, companion-flange assembly for 150- or 300-psig minimum pressure to suit system pressures.
 5. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - a. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure to suit system pressures.

2.4 SLEEVE SEALS

- A. Reference Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping" for sleeve seals.

2.5 ESCUTCHEONS

- A. Reference Section 220518 "Escutcheons for Plumbing Piping" for escutcheons.

2.6 GROUT

- A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psi, 28-day compressive strength.
 3. Packaging: Premixed and factory-packaged.

2.7 BACKFILL

- A. Flowable Backfill: Designed in accordance with ASTM C 94 and ASTM D 4832.
 - 1. Refer to Section 033350 "Flowable Backfill Low-Strength Concrete" for material and installation requirements.
 - 2. Minimum Requirements:
 - a. Compressive Strength: 50-100 psi
 - b. Slump: 6-8 inches.
 - 3. Required for all piping and ductwork installed below concrete slabs, apron paving, and roadways.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General: Install piping as described below, except where system Sections specify otherwise. Individual piping system specification Sections in Division 22 specify piping installation requirements unique to the piping system.
- B. General Locations and Arrangements: Drawings indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, except where deviations to layout are approved on coordination drawings.
- C. Install piping at indicated slope.
- D. Install piping free of sags and bends.
- E. Install piping plumb and at right angles and plumb or parallel to building walls. Diagonal runs are prohibited, except where indicated.
- F. Install piping tight to slabs, beams, joists, columns, walls, and other building elements.
- G. Install fittings for changes in direction and branch connections.
- H. Install couplings according to manufacturer's printed instructions.
- I. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping system Sections.
 - 1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 - 2. Remove scale, slag, dirt, rust, and debris from inside and outside of pipe and fittings before assembly.
 - 3. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends

to remove burrs and restore full inside diameter. Join pipe fittings and valves as follows:

- a. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
- b. Apply appropriate tape or thread compound to external pipe threads (except where dry seal threading is specified).
- c. Align threads at point of assembly.
- d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
- e. Damaged Threads: Do not use pipe or pipe fittings having threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

J. Piping Connections: Except as otherwise indicated, make piping connections as specified below.

1. Install unions in piping 2 inches and smaller adjacent to each valve and at final connection to each piece of equipment having a 2-inch or smaller threaded pipe connection.
2. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

K. Piping below apron, concrete slabs or paving shall be encased in flowable backfills.

3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to provide the maximum possible headroom where mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the DEN Project Manager.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.
- D. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
- E. Install equipment giving right-of-way to piping systems installed at a required slope.

3.3 PAINTING AND FINISHING

- A. Refer to Division 09 Sections for Painting for field painting requirements. Paint color schedule shall conform to ASME A13.1-1996, "Scheme for the Identification of Piping Systems."

- B. Damage and Touch Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- C. All rooftop equipment exposed to public or aircraft view shall be painted flat white or grey in accordance with Division 09.

3.4 CONCRETE PENETRATIONS

- A. Reference Section 017330 "Cutting and Patching" for core drilling and saw cutting requirements.
- B. Reference Section 024119 "Selective Demolition" for demolition and removal of selected portions of a building or structure, and repair procedures for selective demolition operations.
- C. All penetrations required through completed concrete construction shall be core drilled or saw cut at minimum size required. All penetrations in concrete require an x-ray or ground penetrating radar to determine if the location is clear of reinforcing steel and embedded systems. Precautions shall be taken when drilling to prevent damage to structural concrete.
 - 1. The Contractor shall provide an interpretation of the x-rays or radar shot and obtain written acceptance from the DEN Project Manager before proceeding with drilling.

3.5 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project location.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use [**3000-psi**] <Insert other>, 28-day compressive-strength concrete and reinforcement as specified in Division 03.

3.6 WELDING

- A. Qualify welding processes and operators for structural steel according to AWS D1.1 Structural Welding Code - Steel. See Division 05 for additional requirements.
- B. All welding shall be inspected in process by a contractor-provided, Certified, Independent Testing Agency by an AWS certified welding inspector.
- C. Qualify welding processes and operators for piping according to ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.
 - 1. Comply with provisions of ASME B31 Series "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Refer to Division 05 for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Field Welding: Comply with AWS D1.1 Structural Welding Code - Steel, as referenced in Part 1.

3.8 DEMOLITION

- A. Refer to Division 01 and Division 02 for general demolition requirements and procedures.
- B. Where pipe, ductwork, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.
- C. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.
- D. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping and associated supports indicated to be removed, provide a shutoff valve with plug or cap in pressurized systems and cap or plug remaining piping with same or compatible piping material. No piping shall be abandoned in place. Repair insulation.
 - 2. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 3. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 4. Equipment to Be Removed and Salvaged: Disconnect and cap services and

- remove equipment and deliver to Owner.
5. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
 6. Repair structure [**floor, ceilings, roof, slabs**] from removed supports in accordance with [**Division 03**], [**Division 05**], [**and Division 09**]

3.9 GROUTING

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the applicable unit price item, work order or lump sum bid item.

END OF SECTION 220500

SECTION 220505 - COATINGS AND CORROSION PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Field and shop applied corrosion protective coatings for [fuel] [deicing] systems piping, valves, fittings, flanges, equipment, and all related materials to be installed underground.
2. Internal [linings] [and] [coatings] for [fuel] [deicing] system tanks and associated pipe and fittings.

B. Related Sections:

1. Section 099113 "Exterior Painting" for exterior painting of items not covered in this Section.
2. Section 099123 "Interior Painting" for interior painting of items not covered in this Section.
3. Section 211110 "Facility Fire-Suppression Water-Service Piping.
4. Section 220400 "Basic Plumbing Requirements".
5. Section 220500 "Common Work Results for Plumbing".
6. Section 221016 "Facility Hydraulic Piping and Fittings".
7. Section 221113 "Facility Water Distribution Piping".
8. Section 22221116 "Domestic Water Piping".
9. Section 264200 "Cathodic Protection"
10. Section 335243.13 "Aviation Fuel Piping, Valves and Fittings".
11. Section 335643.13 "Aboveground Aviation Fuel Storage Tanks".

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 REFERENCED STANDARDS

- A. Materials and workmanship shall conform to the latest issue of all industry standards, publications, or regulations referenced in this section and with the following references as applicable. Refer to Section 014200 "References" for listing of issuing organizations or agencies.

B. Applicable Standards:

1. American Water Works Association (AWWA).
 - a. AWWA C-210 - Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
 - b. AWWA C-213 - Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
2. International Fire Code (IFC) with the Denver Amendments.
3. International Building Code (IBC) with the Denver Amendments.
4. National Association of Corrosion Engineers.
 - a. NAPCA 12-78-83 - Application Specifications for Mill Applied Fusion Bonded Epoxy Coatings.
5. National Bureau of Standards (NBS).
 - a. Certified Coating Thickness Calibration Standards.
6. U.S. Government Specification.
 - a. MIL-C-4556-E - Coating Kit, Epoxy for Interior, Steel Fuel Tanks.
7. Steel Structures Painting Council (SSPC).
 - a. SSPC-SP5 - White Metal Blast Cleaning.
 - b. SSPC-SP10 - Near-White Metal Blast Cleaning.

1.4 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's product data and application instructions for all coatings and linings.
 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings shall be submitted in accordance with Division 01 General Requirements.
- C. "As Built" Plans shall be provided in the same format and manner as described above. Each set shall be equipped with a plan holder equal to "Stacor Plan Clamps" for the appropriate size drawing.

1.5 EXTENT OF WORK

- A. All **[fuel] [deicing systems]** pipe and fittings to be partially or completely buried shall be externally factory coated.

- B. Field welded joints in referenced piping systems and underground structures shall be coated and wrapped in accordance with "Field Procedures".
- C. All **[internal surfaces of the tank[s], along with all] [fuel] [Type II deicing fluid]** supply, transfer, drain, and vent piping and fittings 2-1/2 inches and larger shall be internally epoxy coated. Pipes and fittings smaller than 2-1/2 inches need not be internally coated.
- D. Apply internal epoxy-based paint coating system for storage tank[s] for **[Type I deicing fluid] [gasoline]**, including **[bottom surface of fixed roof,] [tank bottom, sides and all surfaces of structure and piping which will contact the fluid.]**
- E. All **[internal surfaces of the tank[s], along with all] [fuel] [Type II deicing fluid]** supply, transfer, drain, and vent piping and fittings 2-1/2 inches and larger shall be coated internally with polyurethane coating system. Pipes and fittings smaller than 2-1/2 inches need not be internally coated.
- F. External painting of all piping, equipment, valves, fittings, flanges, tanks, gauge connections, structural and miscellaneous steel and other appurtenances aboveground **[and in pits]** is specified in Section 099113 "Exterior Painting".

1.6 MAINTENANCE MATERIALS

- A. Leave on premises, where directed by the DEN Project Manager, not less than one (1) unopened gallon of each field-applied paint product and color used.
- B. Containers shall be tightly sealed and clearly labeled for identification.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. All materials and products to be stored as approved by manufacturer and completely protected from from damaging elements.

1.8 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 SHOP-APPLIED EXTERNAL PROTECTIVE PIPE COATING

- A. All **[fuel] [deicing system]** pipe and fittings to be installed underground **[, or in pits,]** shall have an external coating system applied either in the pipe manufacturer's shop or in the mill of an approved custom applicator.

- B. Coating system shall meet the following specifications:
1. Surface preparation, material, application, testing, inspection, handling, storage, and field installation shall be in accordance with the applicable requirements of AWWA C213, Fusion Bonded Epoxy Coating.
 2. Coatings shall be applied in accordance with NAPCA Bulletin 12-78-83. Application Specifications Mill Applied Fusion Bonded Epoxy Coatings.
 3. Surfaces shall be sandblasted in accordance with Steel Structures Painting Council Surface Preparation Specification No. 10, "near-white" metal blast.
 4. Sandblasting shall be coordinated with coating application, which shall be applied as soon as possible after blasting. If blasted surface remains uncoated overnight, it shall be reblasted.
 5. Care shall be taken to prevent grease, oil, or other organic matter from contacting the blasted surface prior to application of the prime coat.
 6. All burrs and rough protrusions on the outer surface of the pipe shall be ground smooth prior to coating.
 7. Apply coating to produce a uniform dry film thickness of 15 mils.
 8. Dry film thickness shall be spot checked at random on ten percent of the coated surfaces. If film thickness is not found to be uniform and to specification, the Contractor shall apply additional coats at no cost to the Owner until the specified film thickness has been obtained.
 - a. Dry film thickness shall be checked by the Contractor at the Contractor's expense.
 - b. Provide complete records of dry film thickness measurements to DEN Project Manager.
 9. Provide a 3 inch cut-back from each end.
- C. The coating shall be holiday tested in the shop prior to shipment. Surfaces shall be checked for freedom from defects using a low-pulse electronic holiday detector at 125 volts per mil of coating thickness.
- D. The Contractor shall secure the services of an independent testing and inspection laboratory to witness the coating application and testing and to certify that the pipe and fittings were prepared, cleaned, and coated using methods and materials conforming with these specifications.
- E. Contractor shall perform final holiday test of all coatings prior to backfilling in accordance with the requirements of Section 330850 "Commissioning of Fuel Distribution Facilities" and other Division 22 and Division 33 requirements.

2.2 SHOP-APPLIED INTERNAL EPOXY LINING (COATING) FOR PIPING

- A. All **[fuel]** **[Type II deicing fluid]** supply, transfer, drain, and vent piping and pipe fittings 2-1/2 inches and larger in size shall be internally coated in the manufacturer's shop or in the mill of an approved internal epoxy applicator with a two coat high solids amine-cured epoxy system in accordance with Military Specification MIL-C-4556E and the following specifications. All materials used shall be lead-free, and shall not contain

not more than VOC component quantities permitted by local regulatory authorities, as applied (in thinned state) unless noted otherwise.

1. Remove all grease or oil by thorough cleaning using an oil-free solvent.
 2. Sandblast inside of pipe to "near-white" metal, confirming with Steel Structures Painting Council Surface Preparation Specification No. 10. No rust preventative coating material or other temporary coating shall be applied after sandblasting and before application of the internal epoxy coating. Care shall be taken to prevent grease, oil, or other organic matter from contacting the blasted surface prior to application of the prime coat. Blasting shall be coordinated with primer application, which shall be applied as soon as possible after blasting. If the blasted surface remains uncoated overnight, it shall be re-blasted.
 3. The ends of the pipe and fittings shall have the paint wiped back 2-inches with cloth or other approved absorbent material. Masking the ends will not be acceptable as a thin film of paint is desired to prevent rust until installation of the material.
 4. Apply one coat polyamide cured orange two-component epoxy resin primer. The thickness of the cured primer shall be not less than [3] <insert thickness> mils, but shall not exceed [4] <insert thickness> mils.
 5. The prime coat shall be allowed to cure in accordance with manufacturer's recommendation for immersion service.
 6. Apply one coat of polyamide-cured off-white two-component epoxy resin protective top coating. The cured thickness of the top coat shall be not less than [3] <insert thickness> mils, but shall not exceed [4] <insert thickness> mils.
 7. After the top coat has been cured in accordance with manufacturer's recommendation for immersion service, the internal epoxy lining shall be tested electrically using an approved holiday detector and shall be free of missed spots, pinholes or holidays. Apply additional primer and finished coats to areas requiring touch-up.
 8. Dry film thickness shall be spot checked at random on ten percent of the coated surfaces. If film thickness is not found to be uniform and to specification, the Contractor shall be required to apply additional coats at no cost to the Owner until the specified film thickness has been obtained.
 - a. Dry film thickness is to be checked by the Contractor at the Contractor's expense.
 - b. Provide complete records of dry film thickness measurements to DEN Project Manager.
 9. If, in the opinion of the DEN Project Manager, the coatings show ridges, waves, runs or holidays indicating uneven coverage or improper application, the Contractor shall be required to remove and reapply the coating at no cost to the Owner.
 10. Prior to shipping to the project site, the ends of the pipe shall be capped using suitable plastic caps secured with a double wrap of 2-inch wide pressure sensitive tape.
- B. All applications shall be in accordance with the manufacturer's published instructions.
- C. The Contractor shall secure the services of an independent testing and inspection

laboratory to witness the lining application and testing and to certify that the pipe and fittings were prepared, cleaned and lined using methods and materials conforming with these specifications.

- D. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amercoat 395, as manufactured by Ameron Protective Coatings Division, Diamond Vogel's Amerlock 400 FD.
 2. or approved equal.

2.3 FIELD-APPLIED EXTERNAL PROTECTIVE COATING AND PROCEDURE

A. All field welds of **[fuel] [deicing system]** piping, including fittings and areas of thermit welding and where the shop coat has been damaged, valves and equipment in pits, shall receive a field-applied external protective coating using a two part liquid epoxy coating system in accordance with AWWA C-210.

1. Sandblast surfaces to "near-white" metal, conforming with Steel Structures Painting Council Surface Preparation Specification No. 10. No rust preventative coating material or other temporary coating shall be applied after sandblasting and before application of the epoxy coating. Care shall be taken to prevent grease, oil or other organic matter from contacting the blasted surface prior to application of the prime coat. Blasting shall be coordinated with primer application, which shall be applied as soon as possible after blasting. If the blasted surface remains uncoated overnight, it shall be reblasted.
2. Grind smooth all burrs and sharp protrusions.
3. Surfaces must be dry before application of coating system.
4. Apply primer following manufacturer's recommendations. The thickness of the cured primer shall be not less than 1.5 mils.
5. Apply finish coat(s) of epoxy top coating in accordance with manufacturer's recommendations. The cured thickness of the total system shall be not less than 15 mils, but shall not exceed 25 mils.
6. After the top coat has been cured in accordance with manufacturer's recommendation, the epoxy coating shall be tested electrically using an approved holiday detector and shall be free of missed spots, pinholes or holidays. Apply additional primer and finished coats to areas requiring touch-up.
7. Coatings for piping to be pressure tested shall be applied after testing and acceptance.
8. Application, testing, and inspection shall be in accordance with AWWA C210.
9. Leave welds uncovered until after testing and acceptance.

B. Alternatives for Joint and Fitting Wrapping and Coating:

1. Thermofit pipe sleeves; Tapecoat CSS 1100 primer and CSS wrap around sleeve, or approved equal. Sleeve length shall overlap pipe coating four inches minimum on each side of joint.
2. Hot-applied tape:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Tapecoat 20 with TC primecoat. Provide a two-layered, half-lapped, spiral wrap.
 - 2) **<Insert manufacturer>**
 - 3) or approved equal.
- C. Do not coat manufacture's nametags, identification tags, instruction tag(s) or control mechanisms.
- D. Holiday test all coatings prior to backfilling in accordance with the applicable requirements of Section 330850 "Commissioning of Fuel Distribution Facilities" and other Division 22 and Division 33 requirements.

2.4 [FIELD] [SHOP] APPLIED INTERNAL TANK LINING

- A. The interior surfaces of **[fuel] [Type II deicing fluid]** storage tanks including **[bottom of fixed roof, roof supports, tank bottom, side and]** all surfaces of structure and piping systems within the tank which will contact the **[deicing fluid] [fuel]**, shall be coated with a two coat high solids amine-cured epoxy in accordance with Military Specification MIL-C-4556E. All materials used shall be lead-free, and shall not contain not more than VOC component quantities permitted by local regulatory authorities, as applied (in thinned state) unless noted otherwise.
- B. The interior surfaces of fuel storage tanks including **[bottom of fixed roof, roof supports, tank bottom, side and]** all surfaces of structure and piping systems within the tank which will contact the fuel, shall be coated with a polyurethane coating system, as follows:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Corrocote II Petroliner, as manufactured by Madison Chemical Industries, Inc.
 - b. **<Insert manufacturer>**
 - c. Or approved equal.
 - 2. All materials used shall contain not more than VOC component quantities permitted by local regulatory authorities, as applied, unless noted otherwise.
- C. Thoroughly examine surfaces scheduled to be **[painted] [and] [coated]** prior to commencement of work. Report in writing, to DEN Project Manager, any condition that may potentially affect proper application. Do not commence until such defects have been corrected.
- D. Delivery, Storage and Handling:
 - 1. Deliver **[paint] [and] [coating]** materials in sealed original labeled containers bearing manufacturer's name, type of product, brand name, color designation,

- and instructions for mixing and/or reducing.
2. Provide adequate storage facilities. Store paint materials at minimum ambient temperature of 45 degrees F.
3. Store all materials in well-ventilated area.
4. Take precautionary measures to prevent fire hazards and spontaneous combustion.

E. Protection:

1. Adequately protect other surfaces from paint and damage. Repair damage as a result of inadequate or unsuitable protection.
2. Furnish sufficient drop cloths, shields and protective equipment to prevent spray or droppings from fouling surfaces not being painted and, in particular, surfaces within storage and preparation area.
3. Place cotton waste, cloths and material, which may constitute a fire hazard in closed metal containers and remove daily from site.

F. Preparation of Surfaces:

1. Surfaces shall be sandblasted in accordance with Steel Structures Painting Council Surface Preparation Specification No. 10, "near-white" metal blast.
2. Sandblasting shall be coordinated with primer application, which shall be applied as soon as possible after blasting. If blasted surface remains uncoated overnight, it shall be reblasted.
3. Care shall be taken to prevent grease, oil, or other organic matter from contacting the blasted surface prior to application of the prime coat.

G. Applications:

1. Apply coatings in accordance with manufacturer's recommendations.
2. Allow ample curing time in accordance with manufacturer's recommendations for immersion service.
3. Finished surfaces shall be free from runs, drips, ridges, brush marks, and variation in color, texture and finish.
4. Do not paint when temperature is below 50 degrees F. or during periods of inclement weather.

H. Cleaning:

1. As work proceeds and upon completion, promptly remove paint where spilled, splashed, or spattered.
2. During progress of work, keep premises free from any unnecessary accumulation of tools, equipment, surplus material, and debris. Remove waste materials from painting operations daily.
3. Upon completion of work, leave premises neat and clean, to the satisfaction of the Construction Manager.

I. The tank lining system shall be as follows:

1. Manufacturers: Subject to compliance with requirements, provide products by

one of the following:

- a. Amercoat 395, manufactured by Ameron Protective Coatings Division.
- b. **<Insert manufacturer>**
- c. or approved equal.

J. The tank lining system shall be as follows:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Corrocote II Petroliner, as manufactured by Madison Chemical Industries, Inc.
 - b. **<Insert manufacturer>**
 - c. or approved equal.
2. Coating product shall be a plural component 100% solids polyurethane coating system for use as a lining in petroleum products storage tanks, consisting of a polyisocyanate resin and polyol resin which meets the following performance and properties requirements:

Property or Test:	Requirement:
Percent Solids	100
Mix Ratio	1:1
Elcometer Adhesion to Steel (white blast 2.5 mil/65 micron profile; no primer)	>1800 psi
Cathodic Disbondment per ASTM G-8 (28 day/20 degrees C/18 mils, near-white blast)	<10 mm radius
Flexibility (ASTM D522) over 1" mandrel	180 minimum
Hardness (ASTM D543)	Shore D 80 " 5

3. Surface preparation shall be by sandblasting as specified in this section. Surfaces to be coated shall be completely dry and free of moisture, dust, grease, or any other deleterious substances at the time the coating or lining is applied.
4. Nominal coating thickness shall be 18 mils, with minimum acceptable thickness of 15 mils. Bolts, rivets, or other protrusions shall be coated to a thickness of 30 mils, using five passes from all directions.
5. A heated, plural-component airless spray pump shall be used to apply the coating in a one-coat, multi-pass operation. No primers shall be used; Contractor shall consult manufacturer for temperature and humidity restrictions.
6. Repair and field touch-up shall be compatible with the main coating system and shall be applied in accordance with manufacturer's recommendations.
7. Holiday inspection shall be conducted by using a wet sponge tester for thicknesses less than 20 mils and a low voltage spark tester (100 volts per mil) for coatings of 20 mils to greater thickness.

2.5 FIELD APPLIED INTERNAL TANK PAINTING

- A. Paint all interior surfaces, including underside of roof and roof framing and interior of all nozzles and tank fittings, as specified in Section 099113 "Exterior Painting".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine all coating systems carefully and document any damages or coating work that does not meet industry standards or specifications.

3.2 COATING REPAIRS

- A. Repair all damages to pipe coating systems on pipe and fittings before the piping is holiday tested.
- B. Repair all cuts, breaks, voids, bruised or scarred spots, and any other damage caused prior to delivery, or resulting from handling or installation of the pipe and fittings, or from any cause whatsoever.
- C. Repair the coating where welds are made and where the coating is damaged or broken by the installation of instrumentation or other accessories or appurtenances.
- D. Perform all repairs in accordance with the requirements specified herein before under "Field-Applied External Protective Coating and Procedure".
- E. Repairs to shop-applied coating shall be such as to provide a thickness equal to or greater than the factory applied coating.

3.3 CERTIFICATION

- A. A log of mill procedure and quality control tests shall be kept daily by the coating, lining and wrapping applicator(s) and a certified copy of this log(s) shall be submitted to the DEN Project Manager with each delivery of pipe and equipment.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement will be made for work under this Section.

PART 5 - PAYMENT

5.1 PAYMENT

- A. No separate payment will be made for work under this section. The cost of the work described in this section shall be included in the Lump Sum Contract price.

END OF SECTION 220523

SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
- B. Related Sections:
 - 1. Section 262419 "Motor-Control Centers".
 - 2. Section 262913 "Enclosed Controllers".
 - 3. Section 262923 "Variable-Frequency Motor Controllers".
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

1.4 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 5500 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: **[Class F]** <Insert class>.
- J. Code Letter Designation:
 - 1. Motors **[15]** <Insert number> HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than **[15]** <Insert number> HP: Manufacturer's standard starting characteristic.

- K. Enclosure Material: Cast iron for motor frame sizes [324T] <Insert number> and larger; rolled steel for motor frame sizes smaller than [324T] <Insert number>.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: **[Ratings, characteristics, and features coordinated with and approved by controller manufacturer.]**
1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
1. Permanent-split capacitor.
 2. Split phase.
 3. Capacitor start, inductor run.
 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 220513

SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section includes fittings and practices used to compensate for thermal expansion and other movements in piping systems; in fire protection, plumbing, hydronic, and refrigerant systems.

- B. Section Includes:

1. Flexible-hose packless expansion joints.
2. Metal-bellows packless expansion joints.
3. Rubber packless expansion joints.
4. Grooved-joint expansion joints.
5. Pipe loops and swing connections.
6. Alignment guides and anchors.
7. Expansion compensators.
8. Packed slip expansion joints.
9. Flexible ball joints.

- C. Related Sections:

1. Section 220400 "Basic Plumbing Requirements".
2. Section 220500 "Common Work Results for Plumbing".
3. Section 220529 "Hangers and Supports for Plumbing Piping and Equipment".
4. Section 221116 "Domestic Water Piping".
5. Section 221119 "Domestic Water Piping Specialties".

- D. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 REFERENCES

- A. Materials and workmanship shall conform to the latest issue of all industry standards, publications, or regulations referenced in this section and with the following references as applicable. Refer to Section 014225 "Referenced Standards" for listing of issuing organizations or agencies.

- B. Applicable Standards:
- C. American Society for Testing and Materials (ASTM):
 - 1. A36/A36M - Carbon Structural Steel.
 - 2. A183 - Carbon Steel Track Bolts and Nuts.
 - 3. A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 - 4. C881 - Epoxy-Resin-Base Bonding Systems for Concrete.
 - 5. C1107 - Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
 - 6. F844 - Washers, Steel, Plain (flat), Unhardened for General Use.
 - 7. F1007 - Pipe-Line Expansion Joints of the Packed Slip Type for Marine Application.
 - 8. F1120 - Circular Metallic Bellows Type Expansion Joints for Piping Applications.
 - 9. F1123 - Nonmetallic Expansion Joints.
- D. American Welding Society (AWS):
 - 1. D1.1 - Structural Welding Code - Steel.
- E. ASME International (ASME):
 - 1. B18.10 - Track Bolts and Nuts.
 - 2. B31.9 - Building Services Piping.
 - 3. ASME Boiler and Pressure Vessel Code: Section II, "Materials;" Section IX, "Welding and Brazing Qualifications."
- F. International Fire Code (IFC) with the Denver Amendments
- G. International Building Code (IBC) with the Denver Amendments.
- H. Fluid Sealing Association (994 Old Eagle School Rd., #1019, Wayne, PA 19087-1866; 610-971-4850):
 - 1. Technical Handbook: Nonmetallic Expansion Joints and Flexible Pipe Connectors.
- I. U.S. Government Specification:
 - 1. MIL-E-17814E - Expansion Joints, Pipe, Slip-Type, Packed.
- J. Conform to Standards of Expansion Joint Manufacturer's Association.

1.4 DEFINITIONS

- A. BR: Butyl rubber.
- B. Buna-N: Nitrile rubber.
- C. CR: Chlorosulfonated polyethylene synthetic rubber.

- D. CSM: Chlorosulfonyl-polyethylene rubber.
- E. EPDM: Ethylene-propylene-diene terpolymer rubber.
- F. NR: Natural rubber.
- G. PTFE: Polytetrafluoroethylene plastic.

1.5 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.
 - 1. Capability: Products to absorb 200 percent of maximum axial movement between anchors.
- C. Expansion Calculations:
 - 1. Installation Temperature: 50 degrees F.
 - 2. Domestic Hot Water: 140 degrees F.
 - 3. Safety Factor: 30 percent.
- D. Compatibility: Products shall be suitable for piping system fluids, materials, working pressures, and temperatures.
- E. ACTION SUBMITTALS
- F. Product Data: For each type of product indicated, and as follows:
 - 1. Include data substantiating that materials comply with requirements.
 - 2. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 3. Expansion Joints: Indicate maximum temperature and pressure rating, and the estimated number of full flexures before joint failure. Provide multi-wall convoluted bellows where possible to reduce joint end force reactions on building structure.
 - 4. Design Data: Indicate selection calculations.
 - 5. For each type of pipe expansion joint and alignment guide indicated.
 - 6. Include data substantiating that materials comply with requirements.
- G. Shop Drawings:
 - 1. Expansion Joints: Submit for each assembly shop drawings, along with detailed

calculations and procedures applied in making selections as appropriate to lifetime cycles ratings specified. Identify materials of construction and indicate maximum temperature and pressure ratings.

- H. Shop Drawings: Signed and sealed by a qualified professional engineer.
 - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and bends.
 - 2. Drawings: Plans and sections identifying locations of all expansion fittings and anchors.
 - 3. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 - 4. Alignment Guide Details: Detail field assembly and attachment to building structure.
 - 5. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.
- I. Design Data: Indicate selection calculations.
- J. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
 - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
 - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of expansion joint, from manufacturer.
- C. Operation and Maintenance Data: For pipe expansion joints to include in emergency, operation, and maintenance manuals.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For expansion joints to include in maintenance manuals.
 - 1. General: O&M data shall comply with the requirements as outlined in Division 01.

2. Maintenance Data: Include maintenance and adjustment instructions.

B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1. Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum of three (3) years experience.

B. Contractor shall design expansion compensating system under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State of Colorado.

1.9 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. ASME Boiler and Pressure Vessel Code: Section IX.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products under provisions of Division 01 and Section 220400 "Basic Plumbing Requirements"..

B. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

C. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.11 CONSTRUCTION WASTE MANAGEMENT

A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Expansion compensation for us with steel piping:
1. Inner Hose: Stainless Steel.
 2. Exterior Sleeve: Double braided stainless steel.
 3. Pressure Rating: 125 psig WSP and 450 degrees F, 200 psig WOG and 250 degrees F at 70 degrees F.
 4. Joint: As specified for pipe joints.
 5. Size: Use pipe sized units.
 6. Maximum offset: 3/4 inch on each side of installed center line.
- B. Expansion compensation for us with copper piping:
1. Inner Hose: Bronze.
 2. Exterior Sleeve: Braided bronze.
 3. Pressure Rating: 125 psig WSP and 450 degrees F.
 4. Joint: As specified for pipe joints.
 5. Size: Use pipe sized units.
 6. Maximum offset: 3/4 inch on each side of installed center line.

2.2 EXPANSION JOINTS

- A. Stainless Steel Bellows Type:
1. Pressure Rating: 200 psig WOG and 250 degrees F.
 2. Maximum Operating Travel Criteria (not including installation misalignment allowances):
 - a. Axial Extension: <insert number> inches.
 - b. Axial Compression: <insert number> inches.
 - c. Lateral Offset: <insert number> inches.
 - d. Angular Displacement: <insert number> degrees.
 3. Required Design Lifetime (cycles): [1,000] [10,000] [100,000] <insert number>.
 4. Selection Requirements: Contractor shall select units based on operating travel and lifetime cycles as indicated (including appropriate and acceptable allowances for installation misalignment) and shall prepare and submit for approval shop drawings of each assembly required, along with detailed calculations and procedures applied in making selections.
 5. Joint: As specified for pipe joints.
 6. Size: Use pipe sized units.
 7. Application: Steel piping 3 inch and under.
- B. External Ring Controlled Stainless Steel Bellows Type:

1. Pressure Rating: 200 psig WOG and 250 degrees F
 2. Maximum Operating Travel Criteria (not including installation misalignment allowances):
 - a. Axial Extension: <insert number> inches.
 - b. Axial Compression: <insert number> inches.
 - c. Lateral Offset: <insert number> inches.
 - d. Angular Displacement: <insert number> degrees.
 3. Required Design Lifetime (cycles): [1,000] [10,000] [100,000] <insert number>.
 4. Selection Requirements: Contractor shall select units based on operating travel and lifetime cycles as indicated (including appropriate and acceptable allowances for installation misalignment) and shall prepare and submit for approval shop drawings of each assembly required, along with detailed calculations and procedures applied in making selections.
 5. Joint: Flanged.
 6. Size: Use pipe sized units.
 7. Accessories: Internal flow liner.
 8. Application: Steel piping over 3 inch.
- C. Two-Ply Bronze Bellows Type:
1. Construction: Bronze with anti-torque device, limit stops, internal guides.
 2. Pressure Rating: 200 psi WOG and 250 degrees F.
 3. Maximum Compression: [1-3/4 inch] [3 inch].
 4. Maximum Extension: 1/4 inch.
 5. Joint: As specified for pipe joints.
 6. Size: Use pipe sized units.
 7. Application: Copper piping.
- D. Low Pressure Compensator with Two-Ply Bronze Bellows:
1. Working Pressure: [75 psig] [80 psig].
 2. Maximum Temperatures: 250 degrees F.
 3. Maximum Compression: 1/2 inch.
 4. Maximum Extension: 5/32 inch.
 5. Joint: Soldered.
 6. Size: Use pipe sized units.
 7. Application: Copper or steel piping 2 inch and under.
- E. Copper with Packed Sliding Sleeve:
1. Working Pressure: 125 psi.
 2. Maximum Temperature: 250 degrees F.
 3. Joint: As specified for pipe joints.
 4. Size: Use pipe sized units.
 5. Copper or steel piping 2 inches and over.
 6. Application: Copper or steel piping 2 inch and over.
- F. Flexible-Hose Expansion Joints: Manufactured assembly with two flexible-metal-hose

legs joined by long-radius, 180-degree return bend or center section of flexible hose; with inlet and outlet elbow fittings, corrugated-metal inner hoses, and braided outer sheaths.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.
 - c. Flex-Pression, Ltd.
 - d. Metraflex, Inc.
 - e. **<Insert manufacturer's name.>**
 - f. or approved equal.
 2. Flexible-Hose Expansion Joints for Copper Piping: Copper-alloy fittings with solder-joint end connections.
 - a. NPS 2 and Smaller: Bronze hoses and single-braid bronze sheaths with 450 psig at 70°F and 340 psig at 450°F (ratings).
 - b. NPS 2-1/2 to NPS 4: Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70°F and 225 psig at 450°F ratings.
 - c. NPS 2 and Smaller: Bronze hoses and double-braid bronze sheaths with 500 psig at 450°F ratings.
 - d. NPS 2-1/2 to NPS 4: Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70°F and 315 psig at 450°F ratings.
 3. Flexible-Hose Expansion Joints for Steel Piping: Carbon-steel fittings with threaded end connections for NPS 2 and smaller and **[flanged] [weld]** end connections for NPS 2-1/2 and larger.
 - a. NPS 2 and Smaller: Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70°F and 325 psig at 600°F ratings.
 - b. NPS 2-1/2 to NPS 6: Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70°F and 145 psig at 600°F ratings.
 - c. NPS 8 to NPS 12: Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70°F and 90 psig at 600°F ratings.
 - d. NPS 2 and Smaller: Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70°F and 515 psig at 600°F ratings.
 - e. NPS 2-1/2 to NPS 6: Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70°F and 200 psig at 600°F ratings.
 - f. NPS 8 and Larger: Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70°F and 120 psig at 600°F ratings.
- G. Swivel Joints: **[Fabricated steel] [Bronze] [Ductile Iron] [Cast steel]** <insert> body, double ball bearing race, field lubricated, with **[rubber (Buna-N)]** <insert> o-ring seals.

2.3 MATERIALS FOR ANCHORS

- A. Steel Shapes and Plates: ASTM A36/A36M.

- B. Bolts and Nuts: ASME B18.10 or ASTM A183, steel, hex head.
- C. Washers: ASTM F844, steel, plain, flat washers.
- D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.
 - 1. Stud: Threaded, zinc-coated carbon steel.
 - 2. Expansion Plug: Zinc-coated steel.
 - 3. Washer and Nut: Zinc-coated steel.
- E. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application.
 - 1. Bonding Material: ASTM C881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - 2. Stud: ASTM A307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
 - 3. Washer and Nut: Zinc-coated steel.
- F. Concrete: Portland cement mix, [**3000 psi**] minimum. Refer to Division 03 for formwork, reinforcement, and concrete.
- G. Grout: ASTM C1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink, nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: [**5000-psi**], 28-day compressive strength.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine piping layout and notify DEN Project Manager of additional anchors or expansion joints required to adequately protect system.
- B. Provide inspection services by flexible pipe manufacturer's representative for final installing and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

3.2 INSTALLATION - GENERAL

- A. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Axial and lateral offsets shall not exceed manufacturers'

recommendations.

- B. Accomplish structural work and provide equipment required to control expansion and contraction of piping, loops, pipe offsets, and swing joints, and provide corrugated bellows type expansion joints where required.
- C. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end.
- D. Rigidly anchor pipe to building structure where necessary. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.
- E. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where **[required]** **[indicated]**.
- F. Provide expansion loops as indicated on drawings.

3.3 EXPANSION-JOINT INSTALLATION

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
- C. Install grooved-joint expansion joints to grooved-end steel piping

3.4 PIPE LOOP AND SWING CONNECTION INSTALLATION

- A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Connect risers and branch connections to mains with at least **[five]** **<Insert number>** pipe fittings including tee in main.
- C. Connect risers and branch connections to terminal units with at least **[four]** **<Insert number>** pipe fittings including tee in riser.
- D. Connect mains and branch connections to terminal units with at least **[four]** **<Insert number>** pipe fittings including tee in main.
- E. Attach pipe bends and loops to anchors.
 - 1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

3.5 SWING CONNECTIONS

- A. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
- B. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
- C. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.6 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install **[one]** **[two]** guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than **[four]** **<Insert number>** pipe diameters from expansion joint.
- C. Attach guides to pipe and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
 - 1. Anchor Attachment to Black-Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Anchor Attachment to Galvanized-Steel Pipe: Attach with pipe hangers. Use MSS SP-69, Type 42, riser clamp welded to anchor.
 - 3. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
 - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
 - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

3.7 MANUFACTURER'S FIELD SERVICES

- A. Provide services under provisions of Division 1 requirements.

- B. Provide inspection services by flexible pipe manufacturer's representative for final installing and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 220516

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Stack-sleeve fittings.
 - 3. Sleeve-seal systems.
 - 4. Sleeve-seal fittings.
 - 5. Grout.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 REFERENCES

- A. Materials and workmanship shall conform to the latest issue of all industry standards, publications, codes, or regulations referenced in this Section and with the references listed in other Sections as applicable. Refer to Section 014225 "Referenced Standards" for listing of issuing organizations or agencies.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include data substantiating that materials comply with requirements.
- B. Submit product samples if requested by DEN Project Manager.

1.5 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- F. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- G. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- H. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Smith, Jay R. Mfg. Co.
 - 2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
 - 3. <Insert manufacturer's name>.
 - 4. or approved equal.
- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.
6. **<Insert manufacturer's name>**.
7. or approved equal.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: [**EPDM-rubber**] [**NBR**] interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: [**Carbon steel**] [**Plastic**] [**Stainless steel**]. Include two (2) for each sealing element.
3. Connecting Bolts and Nuts: [**Carbon steel, with corrosion-resistant coating,**] [**Stainless steel**] of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Presealed Systems.
2. **<Insert manufacturer's name>**.
3. or approved equal.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B. post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Post-hardening and volume-adjusting, dry, hydraulic-cement grout; nonstaining, noncorrosive, nongaseous, nonshrink; recommended for interior and exterior applications.

C. Design Mix: **5000-psi (34.5-MPa)**, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 CONCRETE PENETRATIONS

- A. Reference Section 017330 "Cutting and Patching" for core drilling and saw cutting requirements.
- B. Reference Section 024119 "Selective Demolition" for demolition and removal of selected portions of a building or structure, and repair procedures for selective demolition operations.
- C. All penetrations required through completed concrete construction shall be core drilled or saw cut at minimum size required. All penetrations in concrete require an x-ray or ground penetrating radar to determine if the location is clear of reinforcing steel and embedded systems. Precautions shall be taken when drilling to prevent damage to structural concrete.
- D. The Contractor shall provide an interpretation of the x-rays or radar shot and obtain written acceptance from the DEN Project Manager before proceeding with drilling.

3.2 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide [1-inch (25-mm)] <Insert dimension> annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas [2 inches (50 mm)] <Insert dimension> above finished floor level.
 - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
1. Install fittings that are large enough to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and pipe or pipe insulation.
 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
 3. Install section of cast-iron soil pipe to extend sleeve to **2 inches (50 mm)** above finished floor level.
 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 5. Using grout, seal the space around outside of stack-sleeve fittings.
- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.4 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.5 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.

- D. Using grout, seal the space around outside of sleeve-seal fittings.

3.6 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

- a. Piping Smaller Than [**NPS 6 (DN 150)**] <Insert pipe size>: [**Cast-iron wall sleeves**] [**Galvanized-steel wall sleeves**] [**Galvanized-steel-pipe sleeves**] [**Sleeve-seal fittings**] <Insert material>.
- b. Piping [**NPS 6 (DN 150)**] <Insert pipe size> and Larger: [**Cast-iron wall sleeves**] [**Galvanized-steel wall sleeves**] [**Galvanized-steel-pipe sleeves**] <Insert material>.

2. Exterior Concrete Walls below Grade:

- a. Piping Smaller Than [**NPS 6 (DN 150)**] <Insert pipe size>: [**Cast-iron wall sleeves with sleeve-seal system**] [**Galvanized-steel wall sleeves with sleeve-seal system**] [**Galvanized-steel-pipe sleeves with sleeve-seal system**] [**Sleeve-seal fittings**] <Insert material>.
 - 1) Select sleeve size to allow for **1-inch (25-mm)** annular clear space between piping and sleeve for installing sleeve-seal system.
- b. Piping [**NPS 6 (DN 150)**] <Insert pipe size> and Larger: [**Cast-iron wall sleeves with sleeve-seal system**] [**Galvanized-steel wall sleeves with sleeve-seal system**] [**Galvanized-steel-pipe sleeves with sleeve-seal system**] <Insert material>.
 - 1) Select sleeve size to allow for **1-inch (25-mm)** annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

- a. Piping Smaller Than [**NPS 6 (DN 150)**] <Insert pipe size>: [**Cast-iron wall sleeves with sleeve-seal system**] [**Galvanized-steel wall sleeves with sleeve-seal system**] [**Galvanized-steel-pipe sleeves with sleeve-seal system**] [**Sleeve-seal fittings**] <Insert material>.
 - 1) Select sleeve size to allow for **1-inch (25-mm)** annular clear space between piping and sleeve for installing sleeve-seal system.
- b. Piping [**NPS 6 (DN 150)**] <Insert pipe size> and Larger: [**Cast-iron wall sleeves with sleeve-seal system**] [**Galvanized-steel wall sleeves with sleeve-seal system**] [**Galvanized-steel-pipe sleeves with sleeve-seal system**] [**Galvanized-steel-pipe sleeves**] <Insert material>.
 - 1) Select sleeve size to allow for **1-inch (25-mm)** annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:
 - a. Piping Smaller Than [**NPS 6 (DN 150)**] <Insert pipe size>:
[Galvanized-steel-pipe sleeves] [PVC-pipe sleeves] [Stack-sleeve fittings] [Sleeve-seal fittings] [Molded-PE or -PP sleeves] [Molded-PVC sleeves] <Insert material>.
 - b. Piping [**NPS 6 (DN 150)**] <Insert pipe size> and Larger:
[Galvanized-steel-pipe sleeves] [PVC-pipe sleeves] [Stack-sleeve fittings] <Insert material>.

5. Interior Partitions:
 - a. Piping Smaller Than [**NPS 6 (DN 150)**] <Insert pipe size>:
[Galvanized-steel-pipe sleeves] [PVC-pipe sleeves] <Insert material>.
 - b. Piping [**NPS 6 (DN 150)**] <Insert pipe size> and Larger:
[Galvanized-steel-sheet sleeves] <Insert material>.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 REFERENCES

- A. Materials and workmanship shall conform to the latest issue of all industry standards, publications, codes, or regulations referenced in this Section and with the references listed in other Sections as applicable. Refer to Section 014200 "References" for listing of issuing organizations or agencies.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include data substantiating that materials comply with requirements.

1.5 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Cast-Brass Type: With [polished, chrome-plated] [and] [rough-brass] finish and setscrew fastener.
- C. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish and spring-clip fasteners.
- D. One-Piece, Stamped-Steel Type: With chrome-plated finish and [**set screw**] [**spring-clip**] [**set screw or spring clips**] fasteners.
- E. Split-Casting Brass Type: With [**polished, chrome-plated**] [and] [**rough-brass**] finish and with concealed hinge and setscrew.
- F. Split-Plate, Stamped-Steel Type: With chrome-plated finish, [**concealed**] [and] [**exposed-rivet**] hinge, and [**set screw**] [**spring-clip**] [**set screw or spring clip**] fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange[**with holes for fasteners**].
- B. Split-Casting Floor Plates: Cast brass with concealed hinge and set screw.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - a. Chrome-Plated Piping: One-piece, cast-brass[**or split-casting brass**] type with polished, chrome-plated finish.
 - b. Insulated Piping: One-piece, stamped-steel type[or split-plate, stamped-steel type with concealed hinge] [or split-plate, stamped-steel

- c. type with exposed-riquet hinge].
Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass[**or split-casting brass**] type with polished, chrome-plated finish.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type[or split-plate, stamped-steel type with concealed hinge] [or split-plate, stamped-steel type with exposed-riquet hinge].
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass[**or split-casting brass**] type with polished, chrome-plated finish.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type[or split-plate, stamped-steel type with concealed hinge] [or split-plate, stamped-steel type with exposed-riquet hinge].
 - g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass[**or split-casting brass**] type with [**polished, chrome-plated**] [**rough-brass**] finish.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type[or split-plate, stamped-steel type with concealed hinge] [or split-plate, stamped-steel type with exposed-riquet hinge].
 - i. Bare Piping in Equipment Rooms: One-piece, cast-brass[**or split-casting brass**] type with [**polished, chrome-plated**] [**rough-brass**] finish.
 - j. Bare Piping in Equipment Rooms: One-piece, stamped-steel type[or split-plate, stamped-steel type with concealed hinge] [or split-plate, stamped-steel type with exposed-riquet hinge].
2. Escutcheons for Existing Piping:
- a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with [**concealed**] [**or**] [**exposed-riquet**] hinge.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with [**concealed**] [**or**] [**exposed-riquet**] hinge.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with [**concealed**] [**or**] [**exposed-riquet**] hinge.
 - g. Bare Piping in Unfinished Service Spaces: Split-casting brass type with [**polished, chrome-plated**] [**rough-brass**] finish.
 - h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with [**concealed**] [**or**] [**exposed-riquet**] hinge.
 - i. Bare Piping in Equipment Rooms: Split-casting brass type with [**polished, chrome-plated**] [**rough-brass**] finish.
 - j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with [**concealed**] [**or**] [**exposed-riquet**] hinge.
- C. Install floor plates for piping penetrations of equipment-room floors.

- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping: One-piece, floor-plate type.
 - 2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 220518

SECTION 220519 - METERS AND GAUGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Positive displacement meters.
2. Flow meters.
3. Pressure gauges and pressure gauge taps.
4. Thermometers and thermometer wells.
5. Static pressure gauges.
6. Filter gauges.
7. Bimetallic-actuated thermometers.
8. Filled-system thermometers.
9. Liquid-in-glass thermometers.
10. Light-activated thermometers.
11. Thermowells.
12. Dial-type pressure gages.
13. Gauge attachments.
14. Test plugs.
15. Test-plug kits.
16. Sight flow indicators.

- B. Related Sections:

1. Section 211100 "Facility Fire-Suppression Water-Service Piping" for fire-protection water-service meters outside the building.
2. Section 211200 "Fire-Suppression Standpipes" for fire protection pressure gages.
3. Section 211313 "Wet-Pipe Sprinkler Systems"
4. Section 211316 "Dry-Pipe Sprinkler Systems" for fire protection pressure gages.
5. Section 211339 "Foam-Water Systems" for fire protection pressure gages.
6. Section 221113 "Facility Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.
7. Section 221116 "Domestic Water Piping" for water meters inside the building.
8. Section 230523 "Meters and Gages for HVAC Piping" for meters and gages for HVAC systems.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 REFERENCES

- A. Materials and workmanship shall conform to the latest issue of all industry standards, publications, codes, or regulations referenced in this section and with the following references as applicable. Refer to Section 014225 "Referenced Standards" for listing of issuing organizations or agencies.
- B. Applicable Standards:
1. American Society of Mechanical Engineers (ASME):
 - a. ASME - B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
 - b. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi.
 2. American Society for Testing of Materials (ASTM):
 - a. ASTM D 2458 - Method of Flow Measurement by The Venturi Motor Tube.
 - b. ASTM E 1 - Specification for ASTM Thermometers.
 - c. ASTM E 77 - Verification and Calibration of Liquid-in-Glass Thermometers.
 3. American Water Works Association (AWWA):
 - a. AWWA C700 - Cold Water Meters - Displacement Type.
 - b. AWWA C701 - Cold Water Meters - Turbine Type for Customer Service.
 - c. AWWA C702 - Cold Water Meters - Compound Type.
 - d. AWWA C706 - Direct Reading Remote Registration System for Cold Water Meters.
 - e. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.
 4. Instrument Society of America (ISA):
 - a. ISA RP 3.2 - Flange Mounted Sharp Edged Orifice Plates for Flow Measurement.
 5. International Fire Code (IFC) with the Denver Amendments.
 6. International Building Code (IBC) with the Denver Amendments.
 7. Underwriters' Laboratories (UL).
 - a. UL 393 - Indicating Pressure Gauges for Fire and Protection Services.
 - b. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1. Provide list, which indicates use, operating range, total range and location for manufactured components.
2. Include data substantiating that materials comply with requirements.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gauge, from manufacturer.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".
 1. Record actual locations of components and instrumentation.

1.7 EXTRA MATERIALS

- A. Provide [**two (2)**] <insert number> bottles of red gauge oil for static pressure gauges.
- B. Provide [**two (2)**] <insert number> [**pressure gauges with pulsation damper**] [**dial thermometers**].

1.8 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 POSITIVE DISPLACEMENT AND TURBINE METERS (LIQUID)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Hersey.
 2. Badger.
 3. <Insert manufacturer>
 4. or approved equal.
- B. [**AWWA C700**] [**AWWA C701**] [**AWWA C702**], positive displacement disc type suitable

for fluid with bronze case and cast iron [**frost-proof, breakaway**] bottom cap, hermetically sealed register[, **remote reading to AWWA C706**].

- C. Meter: Brass or stainless steel body turbine meter, insertion type removable through valve, with magnetic drive register.
- a. Service: [**Cold water, 122 degrees F**] [**Hot water, 200 degrees F**].
 - b. Nominal Flow: <insert number> gpm.
 - c. Pressure Drop at Nominal Flow: <insert number> psi.
 - d. Maximum Flow: <insert number> gpm.
 - e. Maximum Operating Pressure: <insert number> psi.
 - f. Accuracy: [**1-1/2**] <insert number> percent.
 - g. Maximum Counter Reading: [**10 million**] [**100 million**] gallons.
 - h. Size: [**1/2 inch**] [**3/4 inch**] [<insert number> inch].

2.2 HEAT CONSUMPTION METERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Clark Solutions.
 2. Onicon Incorporated.
 3. <Insert manufacturer>
 4. or approved equal.
- B. Meter: Brass or stainless steel body turbine meter, removable through valve, with magnetic drive register, platinum temperature sensors.
1. Maximum Service Temperature: 200 degrees F.
 2. Nominal Flow: <insert number> gpm.
 3. Pressure Drop at Nominal Flow: <insert number> psi.
 4. Maximum Flow: <insert number> gpm.
 5. Maximum Operating Pressure: <insert number> psi.
 6. Accuracy: [**1-1/2**] <insert number> percent.
 7. Maximum Counter Reading: [**1 million**] <insert number> btuh.
 8. Size: [**1/2 inch**] [**3/4 inch**] [<insert number> inch].
 9. Power: [**Alkaline Battery**] [**Lithium Battery**] [**24 Volt convertor**].

2.3 FLOW METERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Gustin-Bacon.
 2. BIF.
 3. Hersey Products Inc.
 4. Liquid Controls Corp.
 5. <Insert manufacturer>

6. or approved equal.
 - B. Orifice principle by-pass circuit with direct reading gauge, soldered or flanged piping connections for 125 psig working pressure, with shut off valves, and drain and vent connections.
 - C. Direct reading with insert pitot tube, threaded coupling, for 150 psig working pressure, maximum 240 degrees F, 5 percent accuracy.
 - D. Cast iron, wafer type, orifice insert flow meter for 250 psig working pressure, with read-out valves equipped with integral check valves with gasketed caps.
 - E. Calibrated, plug type balance valve with precision machined orifice, readout valves equipped with integral check valves and gasketed caps, calibrated nameplate and indicating pointer.
 - F. Cast iron or bronze, globe style, balance valve with handwheel with vernier type ring setting and memory stop, [drain connection,] readout valves **[equipped with integral check valves and gasketed caps]**.
 - G. Portable meter consisting of case containing **[one, 3 percent accuracy pressure gauge with 0-60 feet pressure range] [two, 3 percent accuracy pressure gauges with 0-135 inches and 0-60 feet pressure ranges]** for 500 psig maximum working pressure, color coded hoses for low and high pressure connections, and connectors suitable for connection to read-out valves.
 - H. Annular element flow stations with meter set.
 1. Measuring Station: Type 316 stainless steel pitot type flow element **[inserted through welded threaded couplet] [installed in threaded nipple pipe section]**, with safety shut-off valves and quick coupling connections, and permanent metal tag indicating design flow rate, reading for design flow rate, metered fluid, line size, station or location number.
 - a. Pressure rating: 275 psig.
 - b. Maximum temperature: 400 degrees F.
 - c. Accuracy: Plus 0.55 percent to minus 2.30 percent.
 2. Portable Meter Set: Dry single diaphragm type pressure gauge with 6 inch dial pointer, stainless steel wetted metal parts, variable pulsation damper, equalizing valve, two bleed valves, and master chart for direct conversion of meter readings to flow rate, mounted in rust-proof carrying case with two ten foot long rubber test hoses with brass valves or quick connections for measuring stations.
- 2.4 PRESSURE GAUGES
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Terice.

2. Moeller.
3. Dietz.
4. U.S. Gauge.
5. **<Insert manufacturer>**
6. or approved equal.

B. Gauge: ASME B40.1, [UL 393] [UL 404] drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.

1. Case: [Steel with brass bourdon tube] [Cast aluminum with phosphor bronze bourdon tube].
2. Size: [3-1/2 inch] [4-1/2 inch] [6 inch] [8-1/2 inch] diameter.
3. Mid-Scale Accuracy: [One] [1/2] percent.
4. Scale: Pounds per square inch.
5. Range: System design pressure should be in the middle 20% of the gauge range

2.5 PRESSURE GAUGE TAPPINGS

- A. Needle Valve: Stainless Steel, 1/4 inch NPT for minimum 150 psig.
- B. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections.
- C. Syphon: [Steel, Schedule 40] [Brass] [Iron] [Stainless Steel] [Bronze], 1/4 inch angle or straight pattern.

2.6 STEM TYPE THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Terrice.
 2. U.S. Gauge.
 3. Moeller.
 4. Dietz.
 5. **<Insert manufacturer>**
 6. or approved equal.
- B. Thermometer: ASTM E 1, adjustable angle, red or blue appearing organic liquid fill, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.
 1. Size: [7 inch] [9 inch] [12 inch] scale.
 2. Window: Clear [glass] [Lexan].
 3. Stem: 3/4 inch NPT brass.
 4. Accuracy: [ASTM E 77] 2 percent.
 5. Calibration: [Degrees F] [Degrees C] [Both degrees F and degrees C].

2.7 DIAL THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Terrice.
 2. U.S. Gauge.
 3. Moeller.
 4. Dietz.
 5. **<Insert manufacturer>**
 6. or approved equal.
- B. Thermometer: ASTM E 1, stainless steel case, adjustable angle with front recalibration, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem.
1. Size: **[3 inch] [5 inch] <insert number>** diameter dial.
 2. Lens: Clear Lexan.
 3. Accuracy: 1 percent.
 4. Calibration: **[Degrees F] [Degrees C] [Both degrees F and degrees C]**.

2.8 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with extensions where necessary to clear insulation, and with cap and chain.
- B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.9 TEST PLUGS

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
1. Peterson Equipment Co.
 2. **<Insert manufacturer>**
 3. or approved equal.
- B. Test Plug: 1/4 inch or 1/2 inch **[brass] [stainless steel]** fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with **[neoprene core for temperatures up to 200 degrees F] [Nordel core for temperatures up to 350 degrees F] [Viton core for temperatures up to 400 degrees F]**.
- C. Test Kit: Carrying case, internally padded and fitted containing **[one] [two] [2-1/2 inch] [3-1/2 inch]** diameter pressure gauges, **[one] [two]** gauge adapters with 1/8 inch probes, two **[one inch] [1-1/2 inch]** dial thermometers.

2.10 STATIC PRESSURE GAUGES

- A. 3-1/2 inch diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.
- B. Inclined manometer, red liquid on white background with black figures, front recalibration adjustment, 3 percent of full scale accuracy.
- C. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch diameter tubing.

2.11 BIMETALLIC-ACTUATED THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
 - 1. Ashcroft Inc.
 - 2. Ernst Flow Industries.
 - 3. Marsh Bellofram.
 - 4. Miljoco Corporation.
 - 5. Nanmac Corporation.
 - 6. Noshok.
 - 7. Palmer Wahl Instrumentation Group.
 - 8. REOTEMP Instrument Corporation.
 - 9. Tel-Tru Manufacturing Company.
 - 10. Terrice, H. O. Co.
 - 11. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 12. Weiss Instruments, Inc.
 - 13. WIKA Instrument Corporation - USA.
 - 14. Winters Instruments - U.S.
 - 15. **<Insert manufacturer's name>**.
 - 16. or approved equal.
- B. Standard: ASME B40.200.
- C. Case: **[Liquid-filled] [and] [sealed]** type(s); stainless steel with **[3-inch (76-mm)] [5-inch (127-mm)] <Insert dimension>** nominal diameter.
- D. Dial: **[Nonreflective aluminum] <Insert material>** with permanently etched scale markings and scales in **[deg F (deg C)] [deg F and deg C]**.
- E. Connector Type(s): Union joint, **[adjustable angle] [rigid, back] [and] [rigid, bottom] <Insert type>**, with unified-inch screw threads.
- F. Connector Size: **[1/2 inch (13 mm)] <Insert dimension>**, with ASME B1.1 screw threads.
- G. Stem: **[0.25 or 0.375 inch (6.4 or 9.4 mm)]** in diameter; stainless steel.
- H. Window: **[Plain glass] [or] [plastic] <Insert material>**.

- I. Ring: Stainless steel.
- J. Element: Bimetal coil.
- K. Pointer: Dark-colored metal.
- L. Accuracy: Plus or minus [1] [1.5] <Insert number> percent of scale range.

2.12 FILLED-SYSTEM THERMOMETERS

A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft Inc.
 - b. Marsh Bellofram.
 - c. Miljoco Corporation.
 - d. Palmer Wahl Instrumentation Group.
 - e. REOTEMP Instrument Corporation.
 - f. Trerice, H. O. Co.
 - g. Weiss Instruments, Inc.
 - h. <Insert manufacturer's name>.
 - i. or approved equal.
- 2. Standard: ASME B40.200.
- 3. Case: Sealed type, [cast aluminum or drawn steel] <Insert material>; [4-1/2-inch (114-mm)] [5-inch (127-mm)] [6-inch (152-mm)] <Insert dimension> nominal diameter.
- 4. Element: Bourdon tube or other type of pressure element.
- 5. Movement: Mechanical, [dampening type,] with link to pressure element and connection to pointer.
- 6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in [deg F (deg C)] [deg F and deg C].
- 7. Pointer: Dark-colored metal.
- 8. Window: [Glass] [or] [plastic] <Insert material>.
- 9. Ring: [Metal] [Stainless steel] <Insert material>.
- 10. Connector Type(s): Union joint, [adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device] [rigid, back] [and] [rigid, bottom]; with ASME B1.1 screw threads.
- 11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
- 12. Accuracy: Plus or minus [1] <Insert number> percent of scale range.

B. Direct-Mounted, Plastic-Case, Vapor-Actuated Thermometers:

- 1. Manufacturers: Subject to compliance with requirements, provide products by

one of the following:

- a. Ashcroft Inc.
 - b. Miljoco Corporation.
 - c. REOTEMP Instrument Corporation.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
2. Standard: ASME B40.200.
 3. Case: Sealed type, **[plastic]** **<Insert material>**; **[4-1/2-inch (114-mm)]** **[5-inch (127-mm)]** **[6-inch (152-mm)]** **<Insert dimension>** nominal diameter.
 4. Element: Bourdon tube or other type of pressure element.
 5. Movement: Mechanical, with link to pressure element and connection to pointer.
 6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in **[deg F (deg C)]** **[deg F and deg C]**.
 7. Pointer: Dark-colored metal.
 8. Window: **[Glass]** **[or]** **[plastic]** **<Insert material>**.
 9. Ring: **[Metal]** **[or]** **[plastic]** **<Insert material>**.
 10. Connector Type(s): Union joint, **[adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device]** **[rigid, back]** **[and]** **[rigid, bottom]**; with ASME B1.1 screw threads.
 11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 12. Accuracy: Plus or minus **[1]** **<Insert number>** percent of scale range.

C. Remote-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Marsh Bellofram.
 - d. Miljoco Corporation.
 - e. Palmer Wahl Instrumentation Group.
 - f. REOTEMP Instrument Corporation.
 - g. Terice, H. O. Co.
 - h. Weiss Instruments, Inc.
 - i. WIKA Instrument Corporation - USA.
 - j. **<Insert manufacturer's name>**.
 - k. or approved equal.
2. Standard: ASME B40.200.
3. Case: Sealed type, **[cast aluminum or drawn steel]** **<Insert material>**; **[4-1/2-inch (114-mm)]** **[6-inch (152-mm)]** **<Insert dimension>** nominal diameter with **[back]** **[front]** flange and holes for panel mounting.
4. Element: Bourdon tube or other type of pressure element.

5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in [deg F (deg C)] [deg F and deg C].
7. Pointer: Dark-colored metal.
8. Window: [Glass] [or] [plastic] <Insert material>.
9. Ring: [Metal] [Stainless steel] <Insert material>.
10. Connector Type(s): Union joint, [back] [bottom]; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.

a. Design for Thermowell Installation: Bare stem.

12. Accuracy: Plus or minus [1] <Insert number> percent of scale range.

D. Remote-Mounted, Plastic-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Miljoco Corporation.
 - d. REOTEMP Instrument Corporation.
 - e. Terrice, H. O. Co.
 - f. <Insert manufacturer's name>.
 - g. or approved equal.
2. Standard: ASME B40.200.
3. Case: Sealed type, [plastic] <Insert material>; [4-1/2-inch (114-mm)] [6-inch (152-mm)] <Insert dimension> nominal diameter with [back] [front] flange and holes for panel mounting.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in [deg F (deg C)] [deg F and deg C].
7. Pointer: Dark-colored metal.
8. Window: [Glass] [or] [plastic] <Insert material>.
9. Ring: [Metal] [or] [plastic] <Insert material>.
10. Connector Type(s): Union joint, threaded, [back] [bottom]; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
12. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.13 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Terice, H. O. Co.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.
2. Standard: ASME B40.200.
3. Case: [**Cast aluminum**] **<Insert material>**; 6-inch (152-mm) nominal size.
4. Case Form: [**Back angle**] [**Straight**] unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue[**or red**] organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in [**deg F (deg C)**] [**deg F and deg C**].
7. Window: Glass or plastic.
8. Stem: Aluminum or brass and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
9. Connector: 3/4 inch (19 mm), with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Plastic-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flo Fab Inc.
 - b. Miljoco Corporation.
 - c. Tel-Tru Manufacturing Company.
 - d. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - e. Weiss Instruments, Inc.
 - f. WIKA Instrument Corporation - USA.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
2. Standard: ASME B40.200.
3. Case: [**Plastic**] **<Insert material>**; 6-inch (152-mm) nominal size.
4. Case Form: [**Back angle**] [**Straight**] unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue[**or red**] organic liquid.
6. Tube Background: Nonreflective with permanently etched scale markings graduated in [**deg F (deg C)**] [**deg F and deg C**].
7. Window: Glass or plastic.
8. Stem: Aluminum or brass and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.

9. Connector: **3/4 inch (19 mm)**, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

C. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flo Fab Inc.
 - b. Miljoco Corporation.
 - c. Palmer Wahl Instrumentation Group.
 - d. Tel-Tru Manufacturing Company.
 - e. Trerice, H. O. Co.
 - f. Weiss Instruments, Inc.
 - g. Winters Instruments - U.S.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.
2. Standard: ASME B40.200.
3. Case: [**Cast aluminum**] **<Insert material>**; [**7-inch (178-mm)**] [**9-inch (229-mm)**] nominal size unless otherwise indicated.
4. Case Form: [**Adjustable angle**] [**Back angle**] [**Straight**] **<Insert form>** unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue[**or red**] organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in [**deg F (deg C)**] [**deg F and deg C**].
7. Window: [**Glass**] [**or**] [**plastic**] **<Insert material>**.
8. Stem: [**Aluminum**] **<Insert material>** and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
9. Connector: **1-1/4 inches (32 mm)**, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

D. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ernst Flow Industries.
 - b. Marsh Bellofram.
 - c. Miljoco Corporation.
 - d. Palmer Wahl Instrumentation Group.
 - e. REOTEMP Instrument Corporation.
 - f. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - g. Weiss Instruments, Inc.
 - h. WIKA Instrument Corporation - USA.
 - i. **<Insert manufacturer's name>**.

- j. or approved equal.
2. Standard: ASME B40.200.
3. Case: [**Plastic**] <Insert material>; [7-inch (178-mm)] [9-inch (229-mm)] nominal size unless otherwise indicated.
4. Case Form: [**Adjustable angle**] [**Back angle**] [**Straight**] <Insert form> unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue[or red] organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in [deg F (deg C)] [deg F and deg C].
7. Window: [**Glass**] [or] [**plastic**] <Insert material>.
8. Stem: [**Aluminum**] [**Brass**] [**Stainless steel**] [**Aluminum, brass, or stainless steel**] <Insert material> and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.14 LIGHT-ACTIVATED THERMOMETERS

A. Direct-Mounted, Light-Activated Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flo Fab Inc.
 - b. REOTEMP Instrument Corporation.
 - c. Trerice, H. O. Co.
 - d. Weiss Instruments, Inc.
 - e. WIKA Instrument Corporation - USA.
 - f. Winters Instruments - U.S.
 - g. <Insert manufacturer's name>.
 - h. or approved equal.
2. Case: [**Plastic**] [**Metal**] <Insert material>; [7-inch (178-mm)] [9-inch (229-mm)] nominal size unless otherwise indicated.
3. Scale(s): [Deg F (Deg C)] [Deg F and deg C].
4. Case Form: [**Adjustable angle**] <Insert form>.
5. Connector: [1-1/4 inches (32 mm)] <Insert dimension>, with ASME B1.1 screw threads.
6. Stem: [**Aluminum**] <Insert material> and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
7. Display: Digital.
8. Accuracy: Plus or minus 2 deg F (1 deg C).

B. Remote-Mounted, Light-Activated Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Miljoco Corporation.
 - b. Weiss Instruments, Inc.
 - c. Winters Instruments - U.S.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
2. Case: Plastic, for wall mounting.
3. Scale(s): [Deg F (Deg C)] [Deg F and deg C].
4. Sensor: Bulb and thermister wire.
 - a. Design for Thermowell Installation: Bare stem.
5. Display: Digital.
6. Accuracy: Plus or minus 2 deg F (1 deg C).

2.15 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: [CNR] [or] [CUNI] **<Insert material>**.
4. Material for Use with Steel Piping: [CRES] [CSA] **<Insert material>**.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: [Mixture of graphite and glycerin] **<Insert material>**.

2.16 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Ernst Flow Industries.
 - d. Flo Fab Inc.
 - e. Marsh Bellofram.
 - f. Miljoco Corporation.
 - g. Noshok.
 - h. Palmer Wahl Instrumentation Group.
 - i. REOTEMP Instrument Corporation.
 - j. Tel-Tru Manufacturing Company.
 - k. Trerice, H. O. Co.
 - l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - m. Weiss Instruments, Inc.
 - n. WIKA Instrument Corporation - USA.
 - o. Winters Instruments - U.S.
 - p. <Insert manufacturer's name>.
 - q. or approved equal.
2. Standard: ASME B40.100.
 3. Case: [**Liquid-filled**] [**Sealed**] [**Open-front, pressure relief**] [**Solid-front, pressure relief**] <Insert type> type(s); [**cast aluminum or drawn steel**] <Insert material>; [**4-1/2-inch (114-mm)**] [**6-inch (152-mm)**] <Insert dimension> nominal diameter.
 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 5. Pressure Connection: Brass, with [**NPS 1/4 (DN 8)**] [**NPS 1/4 or NPS 1/2 (DN 8 or DN 15)**] [**NPS 1/2 (DN 15)**], ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 6. Movement: Mechanical, with link to pressure element and connection to pointer.
 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in [**psi (kPa)**] [**psi and kPa**].
 8. Pointer: Dark-colored metal.
 9. Window: [**Glass**] [**or**] [**plastic**] <Insert material>.
 10. Ring: [**Metal**] [**Brass**] [**Stainless steel**].
 11. Accuracy: [**Grade A, plus or minus 1 percent of middle half of**] [**Grade B, plus or minus 2 percent of middle half of**] [**Grade C, plus or minus 3 percent of middle half of**] [**Grade D, plus or minus 5 percent of whole**] scale range.

B. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Flo Fab Inc.
 - d. Marsh Bellofram.
 - e. Miljoco Corporation.
 - f. Noshok.
 - g. Palmer Wahl Instrumentation Group.
 - h. REOTEMP Instrument Corporation.

- i. Tel-Tru Manufacturing Company.
 - j. Trerice, H. O. Co.
 - k. Weiss Instruments, Inc.
 - l. WIKA Instrument Corporation - USA.
 - m. Winters Instruments - U.S.
 - n. **<Insert manufacturer's name>**.
 - o. or approved equal.
2. Standard: ASME B40.100.
 3. Case: [**Sealed**] **<Insert type>** type; [**plastic**] **<Insert material>**; [**4-1/2-inch (114-mm)**] [**6-inch (152-mm)**] **<Insert dimension>** nominal diameter.
 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 5. Pressure Connection: Brass, with [**NPS 1/4 (DN 8)**] [**NPS 1/4 or NPS 1/2 (DN 8 or DN 15)**] [**NPS 1/2 (DN 15)**], ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 6. Movement: Mechanical, with link to pressure element and connection to pointer.
 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in [**psi (kPa)**] [**psi and kPa**].
 8. Pointer: Dark-colored metal.
 9. Window: [**Glass**] [**or**] [**plastic**] **<Insert material>**.
 10. Accuracy: [**Grade A, plus or minus 1 percent of middle half of**] [**Grade B, plus or minus 2 percent of middle half of**] [**Grade C, plus or minus 3 percent of middle half of**] [**Grade D, plus or minus 5 percent of whole**] scale range.

C. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Ernst Flow Industries.
 - d. Flo Fab Inc.
 - e. Marsh Bellofram.
 - f. Miljoco Corporation.
 - g. Noshok.
 - h. Palmer Wahl Instrumentation Group.
 - i. REOTEMP Instrument Corporation.
 - j. Tel-Tru Manufacturing Company.
 - k. Trerice, H. O. Co.
 - l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - m. Weiss Instruments, Inc.
 - n. WIKA Instrument Corporation - USA.
 - o. Winters Instruments - U.S.
 - p. **<Insert manufacturer's name>**.
 - q. or approved equal.
2. Standard: ASME B40.100.
3. Case: [**Liquid-filled**] [**Sealed**] **<Insert type>** type; [**cast aluminum or drawn steel**] [**metal**] **<Insert material>**; [**4-1/2-inch (114-mm)**] [**6-inch (152-mm)**]

- <Insert dimension> nominal diameter with [back] [front] flange and holes for panel mounting.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 5. Pressure Connection: Brass, with [NPS 1/4 (DN 8)] [NPS 1/4 or NPS 1/2 (DN 8 or DN 15)] [NPS 1/2 (DN 15)], ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 6. Movement: Mechanical, with link to pressure element and connection to pointer.
 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in [psi (kPa)] [psi and kPa].
 8. Pointer: Dark-colored metal.
 9. Window: [Glass] [or] [plastic] <Insert material>.
 10. Ring: [Metal] [Stainless steel] <Insert material>.
 11. Accuracy: [Grade A, plus or minus 1 percent of middle half of] [Grade B, plus or minus 2 percent of middle half of] [Grade C, plus or minus 3 percent of middle half of] [Grade D, plus or minus 5 percent of whole] scale range.
- D. Remote-Mounted, Plastic-Case, Dial-Type Pressure Gages:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Miljoco Corporation.
 - d. Noshok.
 - e. Palmer Wahl Instrumentation Group.
 - f. REOTEMP Instrument Corporation.
 - g. Tel-Tru Manufacturing Company.
 - h. Terice, H. O. Co.
 - i. Weiss Instruments, Inc.
 - j. WIKA Instrument Corporation - USA.
 - k. Winters Instruments - U.S.
 - l. <Insert manufacturer's name>.
 - m. or approved equal.
 2. Standard: ASME B40.100.
 3. Case: [Sealed] <Insert type> type; [plastic] <Insert material>; [4-1/2-inch (114-mm)] [6-inch (152-mm)] <Insert dimension> nominal diameter with [back] [front] flange and holes for panel mounting.
 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 5. Pressure Connection: Brass, with [NPS 1/4 (DN 8)] [NPS 1/4 or NPS 1/2 (DN 8 or DN 15)] [NPS 1/2 (DN 15)], ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 6. Movement: Mechanical, with link to pressure element and connection to pointer.
 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in [psi (kPa)] [psi and kPa].
 8. Pointer: Dark-colored metal.
 9. Window: [Glass] [or] [plastic] <Insert material>.

10. Accuracy: **[Grade A, plus or minus 1 percent of middle half of]** **[Grade B, plus or minus 2 percent of middle half of]** **[Grade C, plus or minus 3 percent of middle half of]** **[Grade D, plus or minus 5 percent of whole]** scale range.

2.17 GAUGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with **[NPS 1/4 (DN 8)]** **[NPS 1/4 or NPS 1/2 (DN 8 or DN 15)]** **[NPS 1/2 (DN 15)]**, ASME B1.20.1 pipe threads and **[piston]** **[porous-metal]**-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: **[Brass ball]** **[Brass or stainless-steel needle]**, with **[NPS 1/4 (DN 8)]** **[NPS 1/4 or NPS 1/2 (DN 8 or DN 15)]** **[NPS 1/2 (DN 15)]**, ASME B1.20.1 pipe threads.

2.18 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flow Design, Inc.
 2. Miljoco Corporation.
 3. National Meter, Inc.
 4. Peterson Equipment Co., Inc.
 5. Sisco Manufacturing Company, Inc.
 6. Terice, H. O. Co.
 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 8. Weiss Instruments, Inc.
 9. **<Insert manufacturer's name>**.
 10. or approved equal.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: **[NPS 1/4 (DN 8)]** **[or]** **[NPS 1/2 (DN 15)]**, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: **[500 psig at 200 deg F (3450 kPa at 93 deg C)]** **<Insert ratings>**.
- F. Core Inserts: **[Chlorosulfonated polyethylene synthetic]** **[and]** **[EPDM]** self-sealing rubber.

2.19 TEST-PLUG KITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
 2. Miljoco Corporation.
 3. National Meter, Inc.
 4. Peterson Equipment Co., Inc.
 5. Sisco Manufacturing Company, Inc.
 6. Terrice, H. O. Co.
 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 8. Weiss Instruments, Inc.
 9. **<Insert manufacturer's name>**.
 10. or approved equal.
- B. Furnish **[one]** **<Insert number>** test-plug kit(s) containing **[one]** **[two]** thermometer(s), one pressure gauge and adapter, and carrying case. Thermometer sensing elements, pressure gauge, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- C. Low-Range Thermometer: Small, bimetallic insertion type with **[1- to 2-inch- (25- to 51-mm-)]** **<Insert dimension>** diameter dial and tapered-end sensing element. Dial range shall be at least **[25 to 125 deg F (minus 4 to plus 52 deg C)]** **<Insert temperature range>**.
- D. High-Range Thermometer: Small, bimetallic insertion type with **[1- to 2-inch- (25- to 51-mm-)]** **<Insert dimension>** diameter dial and tapered-end sensing element. Dial range shall be at least **[0 to 220 deg F (minus 18 to plus 104 deg C)]** **<Insert temperature range>**.
- E. Pressure Gauge: Small, Bourdon-tube insertion type with **[2- to 3-inch- (51- to 76-mm-)]** **<Insert dimension>** diameter dial and probe. Dial range shall be at least **[0 to 200 psig (0 to 1380 kPa)]** **<Insert range>**.
- F. Carrying Case: Metal or plastic, with formed instrument padding.

2.20 SIGHT FLOW INDICATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Archon Industries, Inc.
 2. Dwyer Instruments, Inc.
 3. Emerson Process Management; Brooks Instrument.
 4. Ernst Co., John C., Inc.
 5. Ernst Flow Industries.
 6. KOBOLD Instruments, Inc. - USA; KOBOLD Messring GmbH.
 7. OPW Engineered Systems; a Dover company.
 8. Penberthy; A Brand of Tyco Valves & Controls - Prophetstown.
 9. **<Insert manufacturer's name>**.
 10. or approved equal.
- B. Description: Piping inline-installation device for visual verification of flow.

- C. Construction: Bronze or stainless-steel body, with sight glass and [**ball, flapper, or paddle wheel**] <Insert device> indicator, and threaded or flanged ends.
- D. Minimum Pressure Rating: [**125 psig (860 kPa)**] [**150 psig (1034 kPa)**] <Insert value>.
- E. Minimum Temperature Rating: [**200 deg F (93 deg C)**] <Insert temperature>.
- F. End Connections for **NPS 2 (DN 50)** and Smaller: Threaded.
- G. End Connections for **NPS 2-1/2 (DN 65)** and Larger: Flanged.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending [**a minimum of 2 inches (51 mm) into fluid**] [**one-third of pipe diameter**] [**to center of pipe**] and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install direct-mounted pressure gages in piping tees with pressure gauge located on pipe at the most readable position.
- H. Install remote-mounted pressure gages on panel.
- I. Install valve and snubber in piping for each pressure gauge for fluids.
- J. Install test plugs in piping tees.
- K. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
 - 2. Inlets and outlets of each domestic water heat exchanger.
 - 3. Inlet and outlet of each domestic hot-water storage tank.
 - 4. Inlet and outlet of each remote domestic water chiller.
 - 5. <Insert location>.

- L. Install pressure gages in the following locations:
1. Building water service entrance into building.
 2. Inlet and outlet of each pressure-reducing valve.
 3. Suction and discharge of each domestic water pump.
 4. **<Insert location>**.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be[**one of**] the following:
1. **[Liquid-filled] [Sealed]**, bimetallic-actuated type.
 2. **[Direct] [Remote]**-mounted, **[metal] [plastic]**-case, vapor-actuated type.
 3. **[Compact] [Industrial]**-style, liquid-in-glass type.
 4. **[Direct] [Remote]**-mounted, light-activated type.
 5. Test plug with **[chlorosulfonated polyethylene synthetic] [EPDM]** self-sealing rubber inserts.
- B. Thermometers at inlets and outlets of each domestic water heat exchanger shall be[**one of**] the following:
1. **[Liquid-filled] [Sealed]**, bimetallic-actuated type.
 2. **[Direct] [Remote]**-mounted, **[metal] [plastic]**-case, vapor-actuated type.
 3. **[Compact] [Industrial]**-style, liquid-in-glass type.
 4. **[Direct] [Remote]**-mounted, light-activated type.
 5. Test plug with **[chlorosulfonated polyethylene synthetic] [EPDM]** self-sealing rubber inserts.
- C. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be[**one of**] the following:
1. **[Liquid-filled] [Sealed]**, bimetallic-actuated type.
 2. **[Direct] [Remote]**-mounted, **[metal] [plastic]**-case, vapor-actuated type.
 3. **[Compact] [Industrial]**-style, liquid-in-glass type.
 4. **[Direct] [Remote]**-mounted, light-activated type.
 5. Test plug with **[chlorosulfonated polyethylene synthetic] [EPDM]** self-sealing rubber inserts.

- D. Thermometers at inlet and outlet of each remote domestic water chiller shall be **one of** the following:
1. **[Liquid-filled] [Sealed]**, bimetallic-actuated type.
 2. **[Direct] [Remote]**-mounted, **[metal] [plastic]**-case, vapor-actuated type.
 3. **[Compact] [Industrial]**-style, liquid-in-glass type.
 4. **[Direct] [Remote]**-mounted, light-activated type.
 5. Test plug with **[chlorosulfonated polyethylene synthetic] [EPDM]** self-sealing rubber inserts.
- E. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: **[0 to 100 deg F (Minus 20 to plus 50 deg C)] [0 to 100 deg F and minus 20 to plus 50 deg C]**.
- B. Scale Range for Domestic Cold-Water Piping: **[0 to 150 deg F (Minus 20 to plus 70 deg C)] [0 to 150 deg F and minus 20 to plus 70 deg C]**.
- C. Scale Range for Domestic Cold-Water Piping: **[30 to 240 deg F (0 to plus 115 deg C)] [30 to 240 deg F and 0 to plus 115 deg C]**.
- D. Scale Range for Domestic Hot-Water Piping: **[0 to 250 deg F (0 to 150 deg C)] [0 to 250 deg F and 0 to 150 deg C]**.
- E. Scale Range for Domestic Hot-Water Piping: **[20 to 240 deg F (0 to 150 deg C)] [20 to 240 deg F and 0 to 150 deg C]**.
- F. Scale Range for Domestic Hot-Water Piping: **[30 to 240 deg F (0 to plus 115 deg C)] [30 to 240 deg F and 0 to plus 115 deg C]**.
- G. Scale Range for Domestic Cooled-Water Piping: **[0 to 100 deg F (Minus 20 to plus 50 deg C)] [0 to 100 deg F and minus 20 to plus 50 deg C]**.
- H. Scale Range for Domestic Cooled-Water Piping: **[0 to 150 deg F (Minus 20 to plus 70 deg C)] [0 to 150 deg F and minus 20 to plus 70 deg C]**.

3.6 PRESSURE-GAUGE SCHEDULE

- A. Pressure gages at discharge of each water service into building shall be **one of** the following:
1. **[Liquid-filled] [Sealed] [Open-front, pressure-relief] [Solid-front, pressure-relief] <Insert type>**, **[direct] [remote]**-mounted, metal case.
 2. **[Sealed] <Insert type>**, **[direct] [remote]**-mounted, plastic case.
 3. Test plug with **[chlorosulfonated polyethylene synthetic] [EPDM]** self-sealing rubber inserts.

- B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be[**one of**] the following:
1. **[Liquid-filled] [Sealed] [Open-front, pressure-relief] [Solid-front, pressure-relief] <Insert type>, [direct] [remote]-mounted, metal case.**
 2. **[Sealed] <Insert type>, [direct] [remote]-mounted, plastic case.**
 3. Test plug with **[chlorosulfonated polyethylene synthetic] [EPDM]** self-sealing rubber inserts.
- C. Pressure gages at suction and discharge of each domestic water pump shall be[**one of**] the following:
1. **[Liquid-filled] [Sealed] [Open-front, pressure-relief] [Solid-front, pressure-relief] <Insert type>, [direct] [remote]-mounted, metal case.**
 2. **[Sealed] <Insert type>, [direct] [remote]-mounted, plastic case.**
 3. Test plug with **[chlorosulfonated polyethylene synthetic] [EPDM]** self-sealing rubber inserts.

3.7 PRESSURE-GAUGE SCALE-RANGE SCHEDULE

- A. Scale Range for Water Service Piping: **[0 to 100 psi (0 to 600 kPa)] [0 to 100 psi and 0 to 600 kPa].**
- B. Scale Range for Water Service Piping: **[0 to 160 psi (0 to 1100 kPa)] [0 to 160 psi and 0 to 1100 kPa].**
- C. Scale Range for Water Service Piping: **[0 to 200 psi (0 to 1400 kPa)] [0 to 200 psi and 0 to 1400 kPa].**
- D. Scale Range for Domestic Water Piping: **[0 to 100 psi (0 to 600 kPa)] [0 to 100 psi and 0 to 600 kPa].**
- E. Scale Range for Domestic Water Piping: **[0 to 160 psi (0 to 1100 kPa)] [0 to 160 psi and 0 to 1100 kPa].**
- F. Scale Range for Domestic Water Piping: **[0 to 200 psi (0 to 1400 kPa)] [0 to 200 psi and 0 to 1400 kPa].**
- G. Scale Range for Domestic Water Piping: **[0 to 300 psi (0 to 2500 kPa)] [0 to 300 psi and 0 to 2500 kPa].**

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 220519

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Bronze angle valves.
2. Bronze ball valves.
3. Iron ball valves.
4. Iron, single-flange butterfly valves.
5. Iron, grooved-end butterfly valves.
6. Bronze lift check valves.
7. Bronze swing check valves.
8. Iron swing check valves.
9. Iron swing check valves with closure control.
10. Iron, grooved-end swing check valves.
11. Iron, center-guided check valves.
12. Iron, plate-type check valves.
13. Bronze gate valves.
14. Iron gate valves.
15. Bronze globe valves.
16. Iron globe valves.
17. Lubricated plug valves.
18. Chainwheels.

- B. Related Sections:

1. Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
2. Section 221113 "Facility Water Distribution Piping" for valves applicable only to this piping.
3. Section 221116 "Domestic Water Piping" for valves applicable only to this piping.
4. Section 221319 "Sanitary Waste Piping Specialties" for valves applicable only to this piping.
5. Section 221423 "Storm Drainage Piping Specialties" for valves applicable only to this piping.
6. Section 221513 "General-Service Compressed-Air Piping" for valves applicable only to this piping.

7. Section 226113 "Compressed-Air Piping for Laboratory and Healthcare Facilities" for valves applicable only to this piping.
 8. Section 226213 "Vacuum Piping for Laboratory and Healthcare Facilities" for valves applicable only to this piping.
 9. Section 226313 "Gas Piping for Laboratory and Healthcare Facilities" for valves applicable only to this piping.
 10. Section 334100 "Storm Utility Drainage Piping" for valves applicable only to this piping.
 11. Section 334600 "Subdrainage" for valves applicable only to this piping.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 REFERENCES

- A. Materials and workmanship shall conform to the latest issue of all industry standards, publications, or regulations referenced in this section and with the following references as applicable. Refer to Section 014200 "References" for listing of issuing organizations or agencies.
- B. Applicable Standards:
 1. American Society of Mechanical Engineers:
 - a. ASME - Boiler and Pressure Vessel Code.
 - b. ASME Sec. 9 - Welding and Brazing Qualifications.
 - c. ASME - Boiler and Pressure Vessel Code.
 - d. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.
 - e. ASME B16.3 - Malleable Iron Threaded Fittings.
 - f. ASME B16.4 - Cast Iron Threaded Fittings Class 125 and 250.
 - g. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings.

- h. ASME B31.8 – Gas Transmission and Distribution Piping Systems.
 - i. ASME B31.9 - Building Service Piping.
2. American Society for Testing and Materials (ASTM):
- a. ASTM A 53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
 - b. ASTM A 74 - Cast Iron Soil Pipe and Fittings.
 - c. ASTM A 234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
 - d. ASTM B 32 - Solder Metal.
 - e. ASTM B 88 - Seamless Copper Water Tube.
 - f. ASTM B 251 - Wrought Seamless Copper and Copper-Alloy Tube.
 - g. ASTM C 14 - Concrete Sewer, Storm Drain, and Culvert Pipe.
 - h. ASTM C 443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
 - i. ASTM C 564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
 - j. ASTM D 1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
 - k. ASTM D 2513 - Thermoplastic Gas Pressure Pipe, Tubing and Fittings.
 - l. ASTM D 2683 - Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe.
 - m. ASTM D 3033 - Type PSP Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - n. ASTM D 3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - o. ASTM F 477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
3. American Water Works Association (AWWA):
- a. AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
 - b. AWWA C110 - Ductile - Iron and Gray - Iron Fittings 3 in. through 48 in., for Water and Other Liquids.
 - c. AWWA C111- Rubber-Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings.
 - d. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
 - e. AWWA C651 - Disinfecting Water Mains.
 - f. M6 - Water Meters - Selection, Installation, Testing, and Maintenance.
4. American Welding Society (AWS):
- a. AWS A5.8 - Brazing Filler Metal.
5. Cast-Iron Soil Pipe Institute (CISPI):
- a. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.

6. International Building Code (IBC) with the Denver Amendments.
7. International Fire Code (IFC) with the Denver Amendments.
8. National Certified Pipe Welding Bureau (NCPWB):
 - a. NCPWB - Procedure Specifications for Pipe Welding.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated.

1. Include data substantiating that materials comply with requirements.
2. Provide manufacturers catalog information. Indicate valve data and ratings.

B. CLOSEOUT DOCUMENTS

C. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1. Record actual locations of valves.

D. Operation and maintenance data.

1. Maintenance data: Include installation instructions, spare parts lists, exploded assembly views.

E. EXTRA MATERIALS

1. Provide two (2) re-packing kits for each type and size valve.

1.6 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. Valve Identification: Manufacturer's name and pressure rating marked on valve body.

C. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

D. NSF Compliance: NSF 61 for valve materials for potable-water service.

E. Perform Work in accordance with City and County of Denver plumbing code.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
1. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
 2. Provide temporary protective coating on cast iron and steel valves.
 3. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
 4. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.
 5. Protect internal parts against rust and corrosion.
 6. Protect threads, flange faces, grooves, and weld ends.
 7. Set angle, gate, and globe valves closed to prevent rattling.
 8. Set ball and plug valves open to minimize exposure of functional surfaces.
 9. Set butterfly valves closed or slightly open.
 10. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

1.8 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves **NPS 8 (DN 200)** and larger.

2. Handwheel: For valves other than quarter-turn types.
 3. Handlever: For quarter-turn valves **NPS 6 (DN 150)** and smaller[**except plug valves**].
 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every **[5] [10] <Insert number>** plug valves, for each size square plug-valve head.
 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With **2-inch (50-mm)** stem extensions and the following features:
1. Gate Valves: With rising stem.
 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
 2. Grooved: With grooves according to AWWA C606.
 3. Solder Joint: With sockets according to ASME B16.18.
 4. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE ANGLE VALVES

- A. Class 125, Bronze Angle Valves with Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.
 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: **200 psig (1380 kPa)**.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron[, **bronze, or aluminum**].

B. Class 125, Bronze Angle Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. NIBCO INC.
 - c. <Insert manufacturer's name>.
 - d. or approved equal.
2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron[, **bronze, or aluminum**].

C. Class 150, Bronze Angle Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Kitz Corporation.
 - c. <Insert manufacturer's name>.
 - d. or approved equal.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron[, **bronze, or aluminum**].

D. Class 150, Bronze Angle Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.

- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Powell Valves.
- h. **<Insert manufacturer's name>**.
- i. or approved equal.

2. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: **300 psig (2070 kPa)**.
- c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
- d. Ends: Threaded.
- e. Stem: Bronze.
- f. Disc: PTFE or TFE.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron[, **bronze, or aluminum**].

2.3 BRASS BALL VALVES

A. One-Piece, Reduced-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kitz Corporation.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.

2. Description:

- a. Standard: MSS SP-110.
- b. CWP Rating: **400 psig (2760 kPa)**.
- c. Body Design: One piece.
- d. Body Material: Forged brass.
- e. Ends: Threaded.
- f. Seats: PTFE or TFE.
- g. Stem: Brass.
- h. Ball: Chrome-plated brass.
- i. Port: Reduced.

B. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. DynaQuip Controls.
 - d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.

- e. Hammond Valve.
- f. Jamesbury; a subsidiary of Metso Automation.
- g. Jomar International, LTD.
- h. Kitz Corporation.
- i. Legend Valve.
- j. Marwin Valve; a division of Richards Industries.
- k. Milwaukee Valve Company.
- l. NIBCO INC.
- m. Red-White Valve Corporation.
- n. RuB Inc.
- o. **<Insert manufacturer's name>**.
- p. or approved equal.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: **150 psig (1035 kPa)**.
- c. CWP Rating: **600 psig (4140 kPa)**.
- d. Body Design: Two piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Brass.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

C. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
- d. Hammond Valve.
- e. Jamesbury; a subsidiary of Metso Automation.
- f. Kitz Corporation.
- g. Marwin Valve; a division of Richards Industries.
- h. Milwaukee Valve Company.
- i. RuB Inc.
- j. **<Insert manufacturer's name>**.
- k. or approved equal.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: **150 psig (1035 kPa)**.
- c. CWP Rating: **600 psig (4140 kPa)**.
- d. Body Design: Two piece.
- e. Body Material: Forged brass.

- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

D. Two-Piece, Regular-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Hammond Valve.
- b. Jamesbury; a subsidiary of Metso Automation.
- c. Legend Valve.
- d. Marwin Valve; a division of Richards Industries.
- e. Milwaukee Valve Company.
- f. **<Insert manufacturer's name>**.
- g. or approved equal.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Brass.
- i. Ball: Chrome-plated brass.
- j. Port: Regular.

E. Two-Piece, Regular-Port, Brass Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Jamesbury; a subsidiary of Metso Automation.
- b. Marwin Valve; a division of Richards Industries.
- c. **<Insert manufacturer's name>**.
- d. or approved equal.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Brass or bronze.
- f. Ends: Threaded.

- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Regular.

F. Three-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Jomar International, LTD.
- b. Kitz Corporation.
- c. Red-White Valve Corporation.
- d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- e. **<Insert manufacturer's name>**.
- f. or approved equal.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Three piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Brass.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

G. Three-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Jomar International, LTD.
- b. Kitz Corporation.
- c. Marwin Valve; a division of Richards Industries.
- d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- e. **<Insert manufacturer's name>**.
- f. or approved equal.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Three piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded.

- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

2.4 BRONZE BALL VALVES

A. One-Piece, Reduced-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Bray.
 - c. Conbraco Industries, Inc.; Apollo Valves.
 - d. Jenkins.
 - e. Milwaukee.
 - f. NIBCO INC.
 - g. Stockham.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.
2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: **400 psig (2760 kPa)**.
 - c. Body Design: One piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE or TFE.
 - g. Stem: Bronze.
 - h. Ball: Chrome-plated brass.
 - i. Port: Reduced.

B. One-Piece, Reduced-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Bray.
 - c. Conbraco Industries, Inc.; Apollo Valves.
 - d. Jenkins.
 - e. Milwaukee.
 - f. NIBCO INC.
 - g. Stockham.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.

2. Description:

- a. Standard: MSS SP-110.
- b. CWP Rating: 600 psig (4140 kPa).
- c. Body Design: One piece.
- d. Body Material: Bronze.
- e. Ends: Threaded.
- f. Seats: PTFE or TFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel, vented.
- i. Port: Reduced.

C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Bray.
- c. Conbraco Industries, Inc.; Apollo Valves.
- d. Crane Co.; Crane Valve Group; Crane Valves.
- e. Hammond Valve.
- f. Jenkins.
- g. Lance Valves; a division of Advanced Thermal Systems, Inc.
- h. Legend Valve.
- i. Milwaukee Valve Company.
- j. NIBCO INC.
- k. Red-White Valve Corporation.
- l. Stockham.
- m. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- n. <Insert manufacturer's name>.
- o. or approved equal.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

D. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Bray.
- c. Conbraco Industries, Inc.; Apollo Valves.
- d. Crane Co.; Crane Valve Group; Crane Valves.
- e. Hammond Valve.
- f. Jenkins.
- g. Lance Valves; a division of Advanced Thermal Systems, Inc.
- h. Milwaukee Valve Company.
- i. NIBCO INC.
- j. Stockham.
- k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- l. **<Insert manufacturer's name>**.
- m. or approved equal.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

E. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Bray.
- c. Conbraco Industries, Inc.; Apollo Valves.
- d. Crane Co.; Crane Valve Group; Jenkins Valves.
- e. Crane Co.; Crane Valve Group; Stockham Division.
- f. DynaQuip Controls.
- g. Hammond Valve.
- h. Jenkins.
- i. Lance Valves; a division of Advanced Thermal Systems, Inc.
- j. Milwaukee Valve Company.
- k. NIBCO INC.
- l. Stockham.
- m. **<Insert manufacturer's name>**.
- n. or approved equal.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Regular.

F. Two-Piece, Regular-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Bray.
- c. Conbraco Industries, Inc.; Apollo Valves.
- d. Crane Co.; Crane Valve Group; Jenkins Valves.
- e. Hammond Valve.f
- f. Jenkins.
- g. Milwaukee Valve Company.
- h. NIBCO Inc.
- i. Stockham.
- j. <Insert manufacturer's name>.
- k. or approved equal.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Regular.

G. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Bray.
- c. Conbraco Industries, Inc.; Apollo Valves.
- d. DynaQuip Controls.

- e. Hammond Valve.
- f. Jenkins.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Red-White Valve Corporation.
- j. Stockham.
- k. **<Insert manufacturer's name>**.
- l. or approved equal.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Three piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

H. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Bray.
- c. Conbraco Industries, Inc.; Apollo Valves.
- d. Hammond Valve.
- e. Jenkins.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Stockham.
- i. **<Insert manufacturer's name>**.
- j. or approved equal.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Three piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

2.5 IRON BALL VALVES

A. Class 125, Iron Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Bray.
 - c. Conbraco Industries, Inc.; Apollo Valves.
 - d. Jenkins.
 - e. Kitz Corporation.
 - f. Milwaukee.
 - g. NIBCO Inc.
 - h. Stockham.
 - i. Sure Flow Equipment Inc.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - k. <Insert manufacturer's name>.
 - l. or approved equal.
2. Description:
 - a. Standard: MSS SP-72.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Split body.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Ends: Flanged.
 - f. Seats: PTFE or TFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel.
 - i. Port: Full.

2.6 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. Bray.
 - c. Conbraco Industries, Inc.; Apollo Valves.
 - d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. DeZurik Water Controls.
 - h. Flo Fab Inc.
 - i. Hammond Valve.

- j. Keystone/Tyco.
- k. Kitz Corporation.
- l. Legend Valve.
- m. Milwaukee Valve Company.
- n. NIBCO INC.
- o. Norriseal; a Dover Corporation company.
- p. Red-White Valve Corporation.
- q. Spence Strainers International; a division of CIRCOR International, Inc.
- r. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- s. **<Insert manufacturer's name>**.
- t. or approved equal.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: **200 psig (1380 kPa)**.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze.

B. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
- b. Bray.
- c. Conbraco Industries, Inc.; Apollo Valves.
- d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
- e. Crane Co.; Crane Valve Group; Jenkins Valves.
- f. Crane Co.; Crane Valve Group; Stockham Division.
- g. DeZurik Water Controls.
- h. Flo Fab Inc.
- i. Hammond Valve.
- j. Keystone/Tyco.
- k. Kitz Corporation.
- l. Legend Valve.
- m. Milwaukee Valve Company.
- n. NIBCO INC.
- o. Norriseal; a Dover Corporation company.
- p. Red-White Valve Corporation.
- q. Spence Strainers International; a division of CIRCOR International, Inc.
- r. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- s. **<Insert manufacturer's name>**.
- t. or approved equal.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: NBR.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze.

C. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
- b. American Valve, Inc.
- c. Bray.
- d. Conbraco Industries, Inc.; Apollo Valves.
- e. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
- f. Crane Co.; Crane Valve Group; Center Line.
- g. Crane Co.; Crane Valve Group; Stockham Division.
- h. DeZurik Water Controls.
- i. Flo Fab Inc.
- j. Hammond Valve.
- k. Keystone/Tyco.
- l. Kitz Corporation.
- m. Legend Valve.
- n. Milwaukee Valve Company.
- o. Mueller Steam Specialty; a division of SPX Corporation.
- p. NIBCO INC.
- q. Norriseal; a Dover Corporation company.
- r. Spence Strainers International; a division of CIRCOR International, Inc.
- s. Sure Flow Equipment Inc.
- t. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- u. <Insert manufacturer's name>.
- v. or approved equal.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Nickel-plated[or -coated] ductile iron.

D. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Ductile-Iron Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
- b. American Valve, Inc.
- c. Bray.
- d. Conbraco Industries, Inc.; Apollo Valves.
- e. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
- f. Crane Co.; Crane Valve Group; Center Line.
- g. Crane Co.; Crane Valve Group; Stockham Division.
- h. DeZurik Water Controls.
- i. Flo Fab Inc.
- j. Hammond Valve.
- k. Keystone/Tyco.
- l. Kitz Corporation.
- m. Legend Valve.
- n. Milwaukee Valve Company.
- o. Mueller Steam Specialty; a division of SPX Corporation.
- p. NIBCO INC.
- q. Norriseal; a Dover Corporation company.
- r. Spence Strainers International; a division of CIRCOR International, Inc.
- s. Sure Flow Equipment Inc.
- t. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- u. **<Insert manufacturer's name>**.
- v. or approved equal.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: NBR.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Nickel-plated[**or -coated**] ductile iron.

E. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
- b. American Valve, Inc.
- c. Bray.
- d. Conbraco Industries, Inc.; Apollo Valves.
- e. Cooper Cameron Valves; a division of Cooper Cameron Corporation.

- f. Crane Co.; Crane Valve Group; Jenkins Valves.
- g. Crane Co.; Crane Valve Group; Stockham Division.
- h. DeZurik Water Controls.
- i. Flo Fab Inc.
- j. Hammond Valve.
- k. Keystone/Tyco.
- l. Kitz Corporation.
- m. Legend Valve.
- n. Milwaukee Valve Company.
- o. Mueller Steam Specialty; a division of SPX Corporation.
- p. NIBCO INC.
- q. Norriseal; a Dover Corporation company.
- r. Red-White Valve Corporation.
- s. Spence Strainers International; a division of CIRCOR International, Inc.
- t. Sure Flow Equipment Inc.
- u. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- v. **<Insert manufacturer's name>**.
- w. or approved equal.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Stainless steel.

F. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Stainless-Steel Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ABZ Valves and Controls; A div. of ABZ Manufacturing, Inc.
- b. American Valve, Inc.
- c. Bray.
- d. Conbraco Industries, Inc.; Apollo Valves.
- e. Cooper Cameron Valves; A div. of Cooper Cameron Corp.
- f. Crane Co.; Crane Valve Group; Jenkins Valves.
- g. Crane Co.; Crane Valve Group; Stockham Div.
- h. DeZurik Water Controls.
- i. Flo Fab Inc.
- j. Hammond Valve.
- k. Keystone/Tyco.
- l. Kitz Corporation.
- m. Legend Valve.
- n. Milwaukee Valve Company.

- o. Mueller Steam Specialty; a division of SPX Corporation.
- p. NIBCO INC.
- q. Norriseal; a Dover Corporation company.
- r. Red-White Valve Corporation.
- s. Spence Strainers International; a division of CIRCOR International, Inc.
- t. Sure Flow Equipment Inc.
- u. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- v. **<Insert manufacturer's name>**.
- w. or approved equal.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: **200 psig (1380 kPa)**.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: NBR.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Stainless steel.

2.7 IRON, GROOVED-END BUTTERFLY VALVES

A. 175 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Bray.
- b. Kennedy Valve; a division of McWane, Inc.
- c. Keystone/Tyco.
- d. NIBCO, Inc.
- e. Norris.
- f. Shurjoint Piping Products.
- g. Tyco Fire Products LP; Grinnell Mechanical Products.
- h. Victaulic Company.
- i. **<Insert manufacturer's name>**.
- j. or approved equal.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: **175 psig (1200 kPa)**.
- c. Body Material: Coated, ductile iron.
- d. Stem: Two-piece stainless steel.
- e. Disc: Coated, ductile iron.
- f. Seal: EPDM.

B. 300 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Bray.
 - c. Kennedy Valve; a division of McWane, Inc.
 - d. Keystone/Tyco.
 - e. Mueller Steam Specialty; a division of SPX Corporation.
 - f. NIBCO INC.
 - g. Norris.
 - h. Shurjoint Piping Products.
 - i. Tyco Fire Products LP; Grinnell Mechanical Products.
 - j. Victaulic Company.
 - k. **<Insert manufacturer's name>**.
 - l. or approved equal.

2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. **NPS 8 (DN 200)** and Smaller CWP Rating: **300 psig (2070 kPa)**.
 - c. **NPS 10 (DN 250)** and Larger CWP Rating: **200 psig (1380 kPa)**.
 - d. Body Material: Coated, ductile iron.
 - e. Stem: Two-piece stainless steel.
 - f. Disc: Coated, ductile iron.
 - g. Seal: EPDM.

2.8 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.

2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: **200 psig (1380 kPa)**.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

B. Class 125, Lift Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flo Fab Inc.
 - b. Hammond Valve.
 - c. Kitz Corporation.
 - d. Milwaukee Valve Company.
 - e. Mueller Steam Specialty; a division of SPX Corporation.
 - f. NIBCO INC.
 - g. Red-White Valve Corporation.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.

2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: **200 psig (1380 kPa)**.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: NBR, PTFE, or TFE.

2.9 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - l. Zy-Tech Global Industries, Inc.
 - m. **<Insert manufacturer's name>**.
 - n. or approved equal.

2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: **200 psig (1380 kPa)**.

- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Hammond Valve.
- e. Kitz Corporation.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Red-White Valve Corporation.
- i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- j. **<Insert manufacturer's name>**.
- k. or approved equal.

2. Description:

- a. Standard: MSS SP-80, Type 4.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: PTFE or TFE.

C. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. Kitz Corporation.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Red-White Valve Corporation.
- i. Zy-Tech Global Industries, Inc.
- j. **<Insert manufacturer's name>**.
- k. or approved equal.

2. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

D. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Hammond Valve.
- d. Milwaukee Valve Company.
- e. NIBCO INC.
- f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- g. <Insert manufacturer's name>.
- h. or approved equal.

2. Description:

- a. Standard: MSS SP-80, Type 4.
- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: PTFE or TFE.

2.10 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Hammond Valve.
- e. Kitz Corporation.
- f. Legend Valve.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Powell Valves.
- j. Red-White Valve Corporation.
- k. Sure Flow Equipment Inc.
- l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

- m. Zy-Tech Global Industries, Inc.
- n. **<Insert manufacturer's name>**.
- o. or approved equal.

2. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.

B. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Stockham Division.
- c. **<Insert manufacturer's name>**.
- d. or approved equal.

2. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Composition.
- g. Seat Ring: Bronze.
- h. Disc Holder: Bronze.
- i. Disc: PTFE or TFE.
- j. Gasket: Asbestos free.

C. Class 250, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Hammond Valve.
- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- h. **<Insert manufacturer's name>**.

i. or approved equal.

2. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 500 psig (3450 kPa).
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.

2.11 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. NIBCO INC.
- b. <Insert manufacturer's name>.
- c. or approved equal.

2. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.
- h. Closure Control: Factory-installed, exterior lever and spring.

B. Class 125, Iron Swing Check Valves with Lever- and Weight-Closure Control:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.Crane Co.; Crane Valve Group; Jenkins Valves.
- b. Crane Co.; Crane Valve Group; Stockham Division.
- c. Hammond Valve.
- d. Milwaukee Valve Company.
- e. NIBCO INC.
- f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- g. <Insert manufacturer's name>.
- h. or approved equal.

2. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.
- h. Closure Control: Factory-installed, exterior lever and weight.

2.12 IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP, Iron, Grooved-End Swing Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Shurjoint Piping Products.
 - c. Tyco Fire Products LP; Grinnell Mechanical Products.
 - d. Victaulic Company.
 - e. <Insert manufacturer's name>.
 - f. or approved equal.
2. Description:
 - a. CWP Rating: 300 psig (2070 kPa).
 - b. Body Material: ASTM A 536, ductile iron.
 - c. Seal: EPDM.
 - d. Disc: Spring-operated, ductile iron or stainless steel.

2.13 IRON, CENTER-GUIDED CHECK VALVES

A. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. APCO Willamette Valve and Primer Corporation.
 - c. Crispin Valve.
 - d. DFT Inc.
 - e. Flo Fab Inc.
 - f. GA Industries, Inc.
 - g. Hammond Valve.
 - h. Metraflex, Inc.
 - i. Milwaukee Valve Company.
 - j. Mueller Steam Specialty; a division of SPX Corporation.
 - k. NIBCO INC.

- I. Spence Strainers International; a division of CIRCOR International, Inc.
 - m. Sure Flow Equipment Inc.
 - n. Val-Matic Valve & Manufacturing Corp.
 - o. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - p. **<Insert manufacturer's name>**.
 - q. or approved equal.
 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: **200 psig (1380 kPa)**.
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Compact wafer.
 - e. Seat: Bronze.
- B. Class 125, Iron, Globe, Center-Guided Check Valves with Metal Seat:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. DFT Inc.
 - d. Flomatic Corporation.
 - e. Hammond Valve.
 - f. Metraflex, Inc.
 - g. Milwaukee Valve Company.
 - h. Mueller Steam Specialty; a division of SPX Corporation.
 - i. NIBCO INC.
 - j. Spence Strainers International; a division of CIRCOR International, Inc.
 - k. Sure Flow Equipment Inc.
 - l. Val-Matic Valve & Manufacturing Corp.
 - m. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - n. **<Insert manufacturer's name>**.
 - o. or approved equal.
 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: **200 psig (1380 kPa)**.
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: Bronze.
- C. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. APCO Willamette Valve and Primer Corporation.
- b. Crispin Valve.
- c. Val-Matic Valve & Manufacturing Corp.
- d. **<Insert manufacturer's name>**.
- e. or approved equal.

2. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- d. Style: Compact wafer.
- e. Seat: Bronze.

D. Class 150, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. APCO Willamette Valve and Primer Corporation.
- b. Crispin Valve.
- c. Val-Matic Valve & Manufacturing Corp.
- d. **<Insert manufacturer's name>**.
- e. or approved equal.

2. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- d. Style: Globe, spring loaded.
- e. Ends: Flanged.
- f. Seat: Bronze.

E. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. APCO Willamette Valve and Primer Corporation.
- b. Crispin Valve.
- c. DFT Inc.
- d. Flo Fab Inc.
- e. Hammond Valve.
- f. Metraflex, Inc.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Sure Flow Equipment Inc.
- j. Val-Matic Valve & Manufacturing Corp.
- k. **<Insert manufacturer's name>**.

- I. or approved equal.
2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Compact wafer, spring loaded.
 - e. Seat: Bronze.
- F. Class 250, Iron, Globe, Center-Guided Check Valves with Metal Seat:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. DFT Inc.
 - d. Flomatic Corporation.
 - e. Hammond Valve.
 - f. Metraflex, Inc.
 - g. Milwaukee Valve Company.
 - h. Mueller Steam Specialty; a division of SPX Corporation.
 - i. NIBCO INC.
 - j. Val-Matic Valve & Manufacturing Corp.
 - k. <Insert manufacturer's name>.
 - l. or approved equal.
 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: Bronze.
- G. Class 300, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
 - d. <Insert manufacturer's name>.
 - e. or approved equal.
 2. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 500 psig (3450 kPa).
- c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- d. Style: Compact wafer, spring loaded.
- e. Seat: Bronze.

H. Class 300, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. APCO Willamette Valve and Primer Corporation.
- b. Crispin Valve.
- c. Val-Matic Valve & Manufacturing Corp.
- d. <Insert manufacturer's name>.
- e. or approved equal.

2. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 500 psig (3450 kPa).
- c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- d. Style: Globe, spring loaded.
- e. Ends: Flanged.
- f. Seat: Bronze.

I. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. APCO Willamette Valve and Primer Corporation.
- b. Crispin Valve.
- c. DFT Inc.
- d. Flo Fab Inc.
- e. Hammond Valve.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Spence Strainers International; a division of CIRCOR International, Inc.
- i. Sure Flow Equipment Inc.
- j. Val-Matic Valve & Manufacturing Corp.
- k. <Insert manufacturer's name>.
- l. or approved equal.

2. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM A 126, gray iron.
- d. Style: Compact wafer.

e. Seat: **[EPDM] [or] [NBR] <Insert material>**.

J. Class 125, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Anvil International, Inc.
- b. APCO Willamette Valve and Primer Corporation.
- c. Crispin Valve.
- d. DFT Inc.
- e. GA Industries, Inc.
- f. Hammond Valve.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Sure Flow Equipment Inc.
- j. Val-Matic Valve & Manufacturing Corp.
- k. **<Insert manufacturer's name>**.
- l. or approved equal.

2. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: **200 psig (1380 kPa)**.
- c. Body Material: ASTM A 126, gray iron.
- d. Style: Globe, spring loaded.
- e. Ends: Flanged.
- f. Seat: **[EPDM] [or] [NBR] <Insert material>**.

K. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. APCO Willamette Valve and Primer Corporation.
- b. Crispin Valve.
- c. Val-Matic Valve & Manufacturing Corp.
- d. **<Insert manufacturer's name>**.
- e. or approved equal.

2. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: **300 psig (2070 kPa)**.
- c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- d. Style: Compact wafer.
- e. Seat: **[EPDM] [or] [NBR] <Insert material>**.

L. Class 150, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. DFT Inc.
 - d. Val-Matic Valve & Manufacturing Corp.
 - e. **<Insert manufacturer's name>**.
 - f. or approved equal.

2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: **300 psig (2070 kPa)**.
 - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: **[EPDM] [or] [NBR] <Insert material>**.

M. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. DFT Inc.
 - d. Flo Fab Inc.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Sure Flow Equipment Inc.
 - i. Val-Matic Valve & Manufacturing Corp.
 - j. **<Insert manufacturer's name>**.
 - k. or approved equal.

2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: **400 psig (2760 kPa)**.
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Compact wafer, spring loaded.
 - e. Seat: **[EPDM] [or] [NBR] <Insert material>**.

N. Class 250, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.

- b. Crispin Valve.
 - c. DFT Inc.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Val-Matic Valve & Manufacturing Corp.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.
 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: **400 psig (2760 kPa)**.
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: **[EPDM] [or] [NBR] <Insert material>**.
- O. Class 300, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: **500 psig (3450 kPa)**.
 - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - d. Style: Compact wafer, spring loaded.
 - e. Seat: **[EPDM] [or] [NBR] <Insert material>**.
- P. Class 300, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
 2. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 500 psig (3450 kPa).
- c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- d. Style: Globe, spring loaded.
- e. Ends: Flanged.
- f. Seat: [EPDM] [or] [NBR] <Insert material>.

2.14 IRON, PLATE-TYPE CHECK VALVES

A. Class 125, Iron, Dual-Plate Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Flomatic Corporation.
 - d. Mueller Steam Specialty; a division of SPX Corporation.
 - e. <Insert manufacturer's name>.
 - f. or approved equal.
2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Seat: Bronze.

B. Class 150, Iron, Dual-Plate Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Mueller Steam Specialty; a division of SPX Corporation.
 - d. Val-Matic Valve & Manufacturing Corp.
 - e. <Insert manufacturer's name>.
 - f. or approved equal.
2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - e. Seat: Bronze.

C. Class 250, Iron, Dual-Plate Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.

 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: **400 psig (2760 kPa)**.
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Seat: Bronze.
- D. Class 300, Iron, Dual-Plate Check Valves with Metal Seat:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Mueller Steam Specialty; a division of SPX Corporation.
 - d. Val-Matic Valve & Manufacturing Corp.
 - e. **<Insert manufacturer's name>**.
 - f. or approved equal.

 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: **500 psig (3450 kPa)**.
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - e. Seat: Bronze.
- E. Class 125, Iron, Single-Plate Check Valves with Resilient Seat:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flo Fab Inc.
 - b. Sure Flow Equipment Inc.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.

 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: **200 psig (1380 kPa)**.
 - c. Body Design: Wafer, spring-loaded plate.

- d. Body Material: ASTM A 126, gray iron.
- e. Seat: [EPDM] [or] [NBR] <Insert material>.

F. Class 125, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Cooper Cameron Valves TVB Techno.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. NIBCO INC.
 - f. Spence Strainers International; a division of CIRCOR International, Inc.
 - g. Sure Flow Equipment Inc.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - i. <Insert manufacturer's name>.
 - j. or approved equal.
2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Seat: [EPDM] [or] [NBR] <Insert material>.

G. Class 150, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Val-Matic Valve & Manufacturing Corp.
 - e. <Insert manufacturer's name>.
 - f. or approved equal.
2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - e. Seat: [EPDM] [or] [NBR] <Insert material>.

H. Class 250, Iron, Wafer, Single-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sure Flow Equipment Inc.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.

 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: **400 psig (2760 kPa)**.
 - c. Body Design: Wafer, spring-loaded plate.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Seat: **[EPDM] [or] [NBR] <Insert material>**.
- I. Class 250, Iron, Dual-Plate Check Valves with Resilient Seat:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Sure Flow Equipment Inc.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.

 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: **400 psig (2760 kPa)**.
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Seat: **[EPDM] [or] [NBR] <Insert material>**.
- J. Class 300, Iron, Dual-Plate Check Valves with Resilient Seat:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Val-Matic Valve & Manufacturing Corp.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.

 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: **500 psig (3450 kPa)**.
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - e. Seat: **[EPDM] [or] [NBR] <Insert material>**.

2.15 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. Hammond Valve.
- f. Jenkins.
- g. Kitz Corporation.
- h. Milwaukee Valve Company.
- i. NIBCO INC.
- j. Powell Valves.
- k. Red-White Valve Corporation.
- l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- m. Zy-Tech Global Industries, Inc.
- n. **<Insert manufacturer's name>**.
- o. or approved equal.

2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: **200 psig (1380 kPa)**.
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded[**or solder joint**].
- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron[, **bronze, or aluminum**].

B. Class 125, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. Hammond Valve.
- f. Jenkins.
- g. Kitz Corporation.
- h. Milwaukee Valve Company.
- i. NIBCO INC.
- j. Powell Valves.
- k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

- I. Zy-Tech Global Industries, Inc.
 - m. **<Insert manufacturer's name>**.
 - n. or approved equal.
 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: **200 psig (1380 kPa)**.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded[**or solder joint**].
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron[, **bronze, or aluminum**].
- C. Class 150, NRS Bronze Gate Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - b. Jenkins.
 - c. Kitz Corporation.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Powell Valves.
 - g. Red-White Valve Corporation.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: **300 psig (2070 kPa)**.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron[, **bronze, or aluminum**].
- D. Class 150, RS Bronze Gate Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.

- c. Hammond Valve.
- d. Jenkins.
- e. Kitz Corporation.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Powell Valves.
- i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- j. Zy-Tech Global Industries, Inc.
- k. **<Insert manufacturer's name>**.
- l. or approved equal.

2. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
- d. Ends: Threaded.
- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron[, **bronze, or aluminum**].

2.16 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Flo Fab Inc.
- e. Hammond Valve.
- f. Jenkins.
- g. Kitz Corporation.
- h. Legend Valve.
- i. Milwaukee Valve Company.
- j. NIBCO INC.
- k. Powell Valves.
- l. Red-White Valve Corporation.
- m. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- n. Zy-Tech Global Industries, Inc.
- o. **<Insert manufacturer's name>**.
- p. or approved equal.

2. Description:

- a. Standard: MSS SP-70, Type I.

- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

B. Class 125, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Flo Fab Inc.
- e. Hammond Valve.
- f. Jenkins.
- g. Kitz Corporation.
- h. Legend Valve.
- i. Milwaukee Valve Company.
- j. NIBCO INC.
- k. Powell Valves.
- l. Red-White Valve Corporation.
- m. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- n. Zy-Tech Global Industries, Inc.
- o. <Insert manufacturer's name>.
- p. or approved equal.

2. Description:

- a. Standard: MSS SP-70, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

C. Class 250, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Stockham Division.
- c. NIBCO INC.
- d. <Insert manufacturer's name>.
- e. or approved equal.

2. Description:

- a. Standard: MSS SP-70, Type I.
- b. CWP Rating: 500 psig (3450 kPa).
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

D. Class 250, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Stockham Division.
- c. Hammond Valve.
- d. Jenkins.
- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Powell Valves.
- h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- i. **<Insert manufacturer's name>**.
- j. or approved equal.

2. Description:

- a. Standard: MSS SP-70, Type I.
- b. CWP Rating: 500 psig (3450 kPa).
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

2.17 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Stockham Division.
- c. Hammond Valve.
- d. Jenkins.
- e. Kitz Corporation.
- f. Milwaukee Valve Company.

- g. NIBCO INC.
- h. Powell Valves.
- i. Red-White Valve Corporation.
- j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- k. Zy-Tech Global Industries, Inc.
- l. <Insert manufacturer's name>.
- m. or approved equal.

2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded[or solder joint].
- e. Stem and Disc: Bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron[, bronze, or aluminum].

B. Class 125, Bronze Globe Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Stockham Division.
- c. Jenkins.
- d. Milwaukee.
- e. NIBCO INC.
- f. Red-White Valve Corporation.
- g. <Insert manufacturer's name>.
- h. or approved equal.

2. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded[or solder joint].
- e. Stem: Bronze.
- f. Disc: PTFE or TFE.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron[, bronze, or aluminum].

C. Class 150, Bronze Globe Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Hammond Valve.

- c. Jenkins.
- d. Kitz Corporation.
- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Powell Valves.
- h. Red-White Valve Corporation.
- i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- j. Zy-Tech Global Industries, Inc.
- k. **<Insert manufacturer's name>**.
- l. or approved equal.

2. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: **300 psig (2070 kPa)**.
- c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
- d. Ends: Threaded.
- e. Stem: Bronze.
- f. Disc: PTFE or TFE.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron[, **bronze, or aluminum**].

2.18 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Hammond Valve.
- e. Jenkins.
- f. Kitz Corporation.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Powell Valves.
- j. Red-White Valve Corporation.
- k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- l. Zy-Tech Global Industries, Inc.
- m. **<Insert manufacturer's name>**.
- n. or approved equal.

2. Description:

- a. Standard: MSS SP-85, Type I.
- b. CWP Rating: **200 psig (1380 kPa)**.
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.

- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Packing and Gasket: Asbestos free.

B. Class 250, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Hammond Valve.
- e. Jenkins.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- i. **<Insert manufacturer's name>**.
- j. or approved equal.

2. Description:

- a. Standard: MSS SP-85, Type I.
- b. CWP Rating: **500 psig (3450 kPa)**.
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Packing and Gasket: Asbestos free.

2.19 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Nordstrom Valves, Inc.
- b. **<Insert manufacturer's name>**.
- c. or approved equal.

2. Description:

- a. Standard: MSS SP-78, Type II.
- b. CWP Rating: **200 psig (1380 kPa)**.
- c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
- d. Pattern: [**Regular or short**] [**Venturi**] **<Insert pattern>**.
- e. Plug: Cast iron or bronze with sealant groove.

B. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nordstrom Valves, Inc.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.

 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: **200 psig (1380 kPa)**.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: **[Regular or short] [Venturi] <Insert pattern>**.
 - e. Plug: Cast iron or bronze with sealant groove.
- C. Class 125, Cylindrical, Lubricated Plug Valves with Threaded Ends:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.

 2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: **200 psig (1380 kPa)**.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: **[Regular or short] [Venturi] <Insert pattern>**.
 - e. Plug: Cast iron or bronze with sealant groove.
- D. Class 125, Cylindrical, Lubricated Plug Valves with Flanged Ends:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.

 2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: **200 psig (1380 kPa)**.

- c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
- d. Pattern: [**Regular or short**] [**Venturi**] <Insert pattern>.
- e. Plug: Cast iron or bronze with sealant groove.

E. Class 250, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nordstrom Valves, Inc.
 - b. <Insert manufacturer's name>.
 - c. or approved equal.
- 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: [**Regular or short**] [**Venturi**] <Insert pattern>.
 - e. Plug: Cast iron or bronze with sealant groove.

F. Class 250, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nordstrom Valves, Inc.
 - b. <Insert manufacturer's name>.
 - c. or approved equal.
- 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: [**Regular or short**] [**Venturi**] <Insert pattern>.
 - e. Plug: Cast iron or bronze with sealant groove.

G. Class 250, Cylindrical, Lubricated Plug Valves with Threaded Ends:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
 - d. <Insert manufacturer's name>.
 - e. or approved equal.

2. Description:

- a. Standard: MSS SP-78, Type IV.
- b. CWP Rating: 400 psig (2760 kPa).
- c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
- d. Pattern: [**Regular or short**] [**Venturi**] <Insert pattern>.
- e. Plug: Cast iron or bronze with sealant groove.

H. Class 250, Cylindrical, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Homestead Valve; a division of Olson Technologies, Inc.
- b. Milliken Valve Company.
- c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
- d. <Insert manufacturer's name>.
- e. or approved equal.

2. Description:

- a. Standard: MSS SP-78, Type IV.
- b. CWP Rating: 400 psig (2760 kPa).
- c. Body Material: ASTM A 48/A 48M or ASTM A 126, Grade 40 cast iron with lubrication-sealing system.
- d. Pattern: [**Regular or short**] [**Venturi**] <Insert pattern>.
- e. Plug: Cast iron or bronze with sealant groove.

2.20 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries.
3. Trumbull Industries.
4. <Insert manufacturer's name>.
5. or approved equal.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to [**ball**] [**butterfly**] [**and**] [**plug**] valve stems.
3. Sprocket Rim with Chain Guides: [**Ductile iron**] [**Ductile or cast iron**] [**Cast iron**] [**Aluminum**] [**Bronze**], of type and size required for valve. [**Include zinc coating.**]
4. Chain: [**Hot-dip, galvanized steel**] [**Brass**] [**Stainless steel**], of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Do not install valves with stems inverted.
- F. Install chainwheels on operators for **[ball] [butterfly] [gate] [globe] [and] [plug]** valves **[NPS 4 (DN 100)] <Insert size>** and larger and more than **[96 inches (2400 mm)] <Insert dimension>** above floor. Extend chains to **[60 inches (1520 mm)] <Insert dimension>** above finished floor.
- G. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. **[Center-Guided] [and] [Plate-Type]** Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
1. Shutoff Service: Ball, butterfly[, **or gate**] [, **gate, or plug**] valves.
 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 3. Throttling Service: [**Globe**] [**Globe or angle**] [**or ball**] [**or butterfly**] [, **ball, or butterfly**] valves.
 4. Pump-Discharge Check Valves:
 - a. **NPS 2 (DN 50)** and Smaller: Bronze swing check valves with [**bronze**] [**or nonmetallic**] disc.
 - b. **NPS 2-1/2 (DN 65)** and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, [**metal**] [**or resilient**]-seat check valves.
 - c. **NPS 2-1/2 (DN 65)** and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
1. For Copper Tubing, **NPS 2 (DN 50)** and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 2. For Copper Tubing, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 3. For Copper Tubing, **NPS 5 (DN 125)** and Larger: Flanged ends.
 4. For Steel Piping, **NPS 2 (DN 50)** and Smaller: Threaded ends.
 5. For Steel Piping, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 6. For Steel Piping, **NPS 5 (DN 125)** and Larger: Flanged ends.
 7. For Grooved-End [**Copper Tubing**] [**and**] [**Steel Piping**]: Valve ends may be grooved.
- D. Provide and install unions downstream of valves and at equipment or apparatus connections.
- E. Provide and install ball or butterfly valves for shut-off and to isolate all equipment, isolate connections to existing piping mains, part of systems as indicated, and/or vertical risers.
- F. Provide and install [**globe**] [**ball**] [**butterfly**] valves for throttling, bypass, or manual

flow control services.

- G. Provide and install spring loaded check valves on discharge of water pumps.

3.5 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG (1035 kPa) OR LESS)

- A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze[**and Brass**] Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: [One] [Two] [Three] piece, [full] [regular] [reduced] port, [brass] [or] [bronze] with [brass] [bronze] [stainless-steel] trim.
3. Bronze Lift Check Valves: Class 125, [bronze] [nonmetallic] disc.
4. Bronze Swing Check Valves: [Class 125] [Class 150], [bronze] [nonmetallic] disc.
5. Bronze Gate Valves: [Class 125] [Class 150], [NRS] [RS].

- B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, [aluminum-bronze] [ductile-iron] [stainless-steel] disc.
3. Iron Swing Check Valves: [Class 125] [Class 250], [metal] [nonmetallic-to-metal] seats.
4. Iron, Center-Guided Check Valves: [Class 125] [Class 150] [Class 250] [Class 300], [compact-wafer] [globe], [metal] [resilient] seat.
5. Iron, Plate-Type Check Valves: [Class 125] [Class 150] [Class 250] [Class 300]; [single] [dual] plate; [metal] [resilient] seat.

3.6 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG (1035 TO 1380 kPa))

- A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze[**and Brass**] Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: [One] [Two] [Three] piece, [full] [regular] [reduced] port, [brass] [or] [bronze] with [brass] [bronze] [stainless-steel] trim.
3. Bronze Lift Check Valves: Class 125, [bronze] [nonmetallic] disc.
4. Bronze Swing Check Valves: [Class 125] [Class 150], [bronze] [nonmetallic] disc.

- B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.

2. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, [aluminum-bronze] [ductile-iron] [stainless-steel] disc.
3. Iron Swing Check Valves: [Class 125] [Class 250], [metal] [nonmetallic-to-metal] seats.
4. Iron, Center-Guided Check Valves: [Class 125] [Class 150] [Class 250] [Class 300], [compact-wafer] [globe], [metal] [resilient] seat.
5. Iron, Plate-Type Check Valves: [Class 125] [Class 150] [Class 250] [Class 300]; [single] [dual] plate; [metal] [resilient] seat.

3.7 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze[and Brass] Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: [Class 125] [Class 150], [bronze] [nonmetallic] disc.
3. Ball Valves: [One] [Two] [Three] piece, [full] [regular] [reduced] port, [brass] [or] [bronze] with [brass] [bronze] [stainless-steel] trim.
4. Bronze Swing Check Valves: [Class 125] [Class 150], [bronze] [nonmetallic] disc.
5. Bronze Globe Valves: [Class 125] [Class 150], [bronze] [nonmetallic] disc.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves: Class 150.
3. Iron, Single-Flange Butterfly Valves: 200 CWP, [EPDM] [NBR] seat, [aluminum-bronze] [ductile-iron] [stainless-steel] disc.
4. Iron Swing Check Valves: [Class 125] [Class 250], [metal] [nonmetallic-to-metal] seats.
5. Iron Swing Check Valves with Closure Control: Class 125, lever and [spring] [weight].
6. Iron, Center-Guided Check Valves: [Class 125] [Class 150] [Class 250] [Class 300], [compact-wafer] [globe], [metal] [resilient] seat.
7. Iron, Plate-Type Check Valves: [Class 125] [Class 150] [Class 250] [Class 300]; [single] [dual] plate; [metal] [resilient] seat.
8. Iron Gate Valves: [Class 125] [Class 250], [NRS] [OS&Y].
9. Iron Globe Valves: [Class 125] [Class 250].

3.8 [SANITARY-WASTE] [AND] [STORM-DRAINAGE] VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze[and Brass] Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: [Class 125] [Class 150], [bronze] [nonmetallic] [stainless-steel] disc.

3. Ball Valves: [One] [Two] [Three] piece, [full] [regular] [reduced] port, [brass] [or] [bronze] with [brass] [bronze] [stainless-steel] trim.
4. Bronze Swing Check Valves: [Class 125] [Class 150], [bronze] [nonmetallic] disc.
5. Bronze Gate Valves: [Class 125] [Class 150], [NRS] [RS].
6. Bronze Globe Valves: [Class 125] [Class 150], [bronze] [nonmetallic] disc.

B. Pipe **NPS 2-1/2 (DN 65)** and Larger:

1. Iron Valves, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves: Class 150.
3. Iron Swing Check Valves: [Class 125] [Class 250], [metal] [nonmetallic-to-metal] seats.
4. Iron Swing Check Valves with Closure Control: Class 125, lever and [spring] [weight].
5. Iron, Grooved-End Swing Check Valves: 300 CWP.
6. Iron Gate Valves: [Class 125] [Class 250], [NRS] [OS&Y].
7. Iron Globe Valves: [Class 125] [Class 250].
8. Lubricated Plug Valves: [Class 125] [Class 250], [regular gland] [cylindrical], [threaded] [flanged].

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Fiberglass strut systems.
6. Thermal-hanger shield inserts.
7. Fastener systems.
8. Pipe stands.
9. Pipe positioning systems.
10. Equipment supports.

- B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
3. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 WORK FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Furnish hanger and support [**inserts**] [**sleeves**] to Division 03 contractor for placement into formwork.
- B. Placement of roofing [**pipe**] [**duct**] supports.
- C. Placement of equipment roof supports.

- D. Placement of roof sleeves, vents, and curbs.

1.4 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Roofing [**pipe**] [**duct**] [**equipment**] supports for placement by this Section.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.5 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

1.6 REFERENCES

- A. Materials and workmanship shall conform to the latest issue of all industry standards, publications, or regulations referenced in this section and with the following references as applicable. Refer to Section 014200 "References" for listing of issuing organizations or agencies.
- B. Applicable Standards:
1. American Welding Society (AWS):
 - a. D1.1 - Structural Welding Code - Steel.
 - b. D1.2 - Structural Welding Code - Aluminum.
 - c. D1.3 - Structural Welding Code - Sheet Steel.
 - d. D1.4 - Structural Welding Code - Reinforcing Steel.
 2. ASME International (ASME):
 - a. B31.1 - Power Piping.
 - b. B31.9 - Building Services Piping.
 3. Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualification".
 4. ASTM International (ASTM):
 - a. A36/A37M - Carbon Structural Steel.
 - b. A780 - Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - c. C533 - Calcium Silicate Block and Pipe Thermal Insulation.
 - d. C552 - Cellular Glass Thermal Insulation.
 - e. C1107 - Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
 5. The International Association of Plumbing and Mechanical Officials (IAPMO):

- a. PS42 - Pipe Alignment and Secondary Support Systems.
6. International Fire Code (IFC) with the Denver Amendments
7. International Building Code (IBC) with the Denver Amendments.
8. Manufacturers Standardization Society of The Valve and Fittings Industry Inc. (MSS SP):
 - a. 58 - Pipe Hangers and Supports - Materials, Design and Manufacture.
 - b. 69 - Pipe Hangers and Supports - Selection and Application.
 - c. 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
 - d. 90 - Guidelines on Terminology for Pipe Hangers and Supports.
9. Metal Framing Manufacturers Association (MFMA):
 - a. 3 - Metal Framing Standards Publication.
 - b. 102 - Guidelines for the Use of Metal Framing.
10. National Fire Protection Association (NFPA)
 - a. NFPA 13 - Installation of Sprinkler Systems.
 - b. NFPA 14 - Installation of Standpipe and Hose Systems.
11. The Society for Protective Coatings (SSPC):
 - a. PA1 - Paint Application Specification No. 1: Shop, Field , and Maintenance Painting of Steel.
12. Underwriters' Laboratories (UL):
 - a. UL 203 - Pipe Hanger Equipment for Fire Protection Service.

1.7 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to **[ASCE/SEI 7] <Insert requirement>**.
 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 3. Design seismic-restraint hangers and supports for piping and equipment[**and obtain approval from authorities having jurisdiction**].

1.8 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, and as follows:
1. Steel pipe hangers and supports.
 2. Thermal-hanger shield inserts.
 3. Powder-actuated fastener systems.
 4. Pipe positioning systems.
 5. Include data substantiating that materials comply with requirements.
- B. Shop Drawings:[**Signed and sealed by a qualified professional engineer.**] Show fabrication and installation details and include calculations for the following; include Product Data for all components:
1. Trapeze pipe hangers.
 2. Metal framing systems.
 3. Fiberglass strut systems.
 4. Pipe stands.
 5. Equipment supports.
- C. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- D. Refer to Section 220400 "Basic Plumbing Requirements" for coordination requirements.
- E. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of trapeze hangers.
 2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.9 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.10 CLOSEOUT SUBMITTALS

- A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.11 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1. Retain applicable standards below. At a minimum AWS D1.1 is required.
 - a. AWS D1.2.
 - b. AWS D1.3.
 - c. AWS D1.4.

- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 STEEL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

- B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

- C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of **[copper-coated steel] [stainless steel] <Insert material>**.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 FIBERGLASS PIPE HANGERS

A. Clevis-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 1, steel pipe hanger except hanger is made of fiberglass or fiberglass-reinforced resin.
2. Hanger Rods: Continuous-thread rod, washer, and nuts made of **[fiberglass]** **[polyurethane]** **[or]** **[stainless steel]** **<Insert material>**.

B. Strap-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 9 or Type 10, steel pipe hanger except hanger is made of fiberglass-reinforced resin.
2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of **[stainless steel]** **<Insert material>**.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut Corporation; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturred lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Manufacturer's standard finish, unless bare metal surfaces are indicated.
8. Metallic Coating: **[Electroplated zinc]** **[Hot-dipped galvanized]** **[Mill galvanized]** **[In-line, hot galvanized]** **[Mechanically-deposited zinc]**.
9. Paint Coating: **[Vinyl]** **[Vinyl alkyd]** **[Epoxy]** **[Polyester]** **[Acrylic]** **[Amine]** **[Alkyd]** **<Insert paint type>**.
10. Plastic Coating: **[PVC]** **[Polyurethane]** **[Epoxy]** **[Polyester]** **<Insert plastic type>**.
11. Combination Coating: **<Insert coating materials in order of application>**.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International; a subsidiary of Mueller Water Products Inc.
 - b. Empire Industries, Inc.
 - c. ERICO International Corporation.
 - d. Haydon Corporation; H-Strut Division.
 - e. NIBCO INC.
 - f. PHD Manufacturing, Inc.
 - g. PHS Industries, Inc.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.
2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of [**carbon steel**] [**stainless steel**] **<Insert material>**.
7. Coating: [**Zinc**] [**Paint**] [**PVC**] **<Insert coating>**.

2.5 FIBERGLASS STRUT SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Tube & Conduit.
2. Champion Fiberglass, Inc.
3. Cooper B-Line, Inc.
4. SEASAFE, INC.; a Gibraltar Industries Company.
5. **<Insert manufacturer's name>**.
6. or approved equal.

B. Description: Shop- or field-fabricated pipe-support assembly similar to MFMA-4 for supporting multiple parallel pipes.

1. Channels: Continuous slotted fiberglass[**or other plastic**] channel with inturned lips.
2. Channel Nuts: Fiberglass nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of [**fiberglass**] [**stainless steel**] **<Insert material>**.

2.6 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carpenter & Paterson, Inc.
 2. Clement Support Services.
 3. ERICO International Corporation.
 4. National Pipe Hanger Corporation.
 5. PHS Industries, Inc.
 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 7. Piping Technology & Products, Inc.
 8. Rilco Manufacturing Co., Inc.
 9. Value Engineered Products, Inc.
 10. **<Insert manufacturer's name>**.
 11. or approved equal.
- C. Insulation-Insert Material for Cold Piping: [**ASTM C 552, Type II cellular glass with 100-psig (688-kPa)**] [or] [**ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa)**] minimum compressive strength and vapor barrier.
- D. Insulation-Insert Material for Hot Piping: [**Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa)**] [**ASTM C 552, Type II cellular glass with 100-psig (688-kPa)**] [or] [**ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa)**] minimum compressive strength.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend **2 inches (50 mm)** beyond sheet metal shield for piping operating below ambient air temperature.

2.7 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. **<Insert manufacturer>**

- d. or approved equal.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, [**zinc-coated**] [**stainless-**] steel anchors, for use in hardened Portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Hilti, Inc.
 - c. ITW Ramset/Red Head.
 - d. **<Insert manufacturer>**
 - e. or approved equal.

2.8 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.
 - c. **<Insert manufacturer>**
 - d. or approved equal.
- C. Low-Type, Single-Pipe Stand: One-piece [**plastic**] [**stainless-steel**] base unit with plastic roller, for roof installation without membrane penetration.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIRO Industries.
 - b. **<Insert manufacturer>**
 - c. or approved equal.
- D. High-Type, Single-Pipe Stand:
 - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 2. Base: [**Plastic**] [**Stainless steel**].
 - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.

4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
5. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.
 - c. Portable Pipe Hangers.
 - d. **<Insert manufacturer>**
 - e. or approved equal.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
6. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Portable Pipe Hangers.
 - b. **<Insert manufacturer>**
 - c. or approved equal.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.9 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & S Mfg. Corp.
 - b. HOLDRITE Corp.; Hubbard Enterprises.
 - c. Samco Stamping, Inc.
 - d. **<Insert manufacturer>**
 - e. or approved equal.

2.10 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.11 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as required and in accordance with spans and hanger rod sizes based on MSS SP-69 recommendations. Hanger rod sizes are based on single-rod hangers using ASTM A36-81A or ASTM A575-81 Gr 1020 steel.
1. If local codes or special design considerations necessitate shorter spans or larger rod sizes, they shall govern. Contractor shall adjust requirements as necessary for conditions such as increase in loading caused by valves, fittings, or other conditions.
- B. Space steel piping supports to permit normal pitch of pipe lines with deflection and bending stress maintained at a minimum. Except as otherwise required by applicable codes, do not exceed the following support spacings:

Nominal Pipe Size (inches)	Water Service Spacing (feet)	Gas, or Air Service Spacing (feet)	Hanger Rod Min. Diameter (inches)
1/2 and smaller	7	8	3/8
3/4 through 1-1/4	7	9	3/8
1-1/2	9	12	3/8
2	10	13	3/8
3	12	15	1/2
4	14	17	5/8
6	17	21	3/4
8	20	26	7/8
10	21	27	7/8
12	23	30	7/8
14	25	32	1
16	27	35	1

18	28	37	1-1/8
20	30	39	1-1/4
24	32	42	1-1/4
30	33	44	1-1/2

- C. Support cast iron piping at each joint and in accordance with applicable codes and standards.
- D. The maximum support spacing for thin wall aluminum, stainless steel, or copper lines is as follows:

Nominal Pipe Size (inches)	Water Service Spacing (feet)	Gas, or Air Service Spacing (feet)	Hanger Rod Min. Diameter (inches)
1/2 through 3/4	5	6	3/8
1 through 1-1/2	6	8	3/8
2	8	11	3/8
3	10	14	1/2
4	12	16	1/2
6	14	20	5/8
8	16	23	3/4
10	18	23	3/4
12	20	25	3/4

- E. Support PVC piping system per the following requirements:
 1. Distance Between Supports (feet):

Size (in.)	Temp deg F		Sched							
	60	80	80	100	100	120	120	140	140	80
1	5.5	6.0	5.0	5.5	3.5	4.5	3.0	3.0	2.5	3.0
1-1/2	6.0	6.5	5.5	6.5	5.0	5.5	3.5	3.5	3.0	3.5
2	6.0	7.0	5.5	6.5	5.0	6.0	3.5	4.0	3.0	3.5
3	7.0	8.0	7.0	7.5	6.0	7.0	4.0	4.5	3.5	4.0
4	7.5	9.0	7.0	8.5	6.5	7.5	4.5	5.0	4.0	4.5
6	8.5	10.0	8.0	9.5	7.5	9.0	5.0	6.0	4.5	5.0
8	9.0	11.0	8.5	10.5	8.0	9.5	5.0	6.5	6.5	8
10	10.0	11.5	9.0	11.0	8.5	10.5	5.0	9.5	5.0	8.0
12	11.5	12.5	10.5	12.0	9.5	11.5	6.5	10.5	5.5	8.5

- F. Space CPVC piping supports per the following requirements:

1. Distance Between Supports (feet) Schedule 80:

Size (inches)	Temp (deg F)						
	80	100	120	140	160	180	200
1/2	5	4.75	4.5	4.25	3.66	3.25	2.5
1	5.75	5.5	5.25	4.66	4.33	3.5	2.66
1-1/2	6.5	6.25	5.75	5.25	4.75	4.0	3.25
2	7.25	6.75	6.33	5.66	5.25	4.25	3.25
3	8.5	8.0	7.5	6.75	5.66	5.0	3.33
4	9.25	8.75	8.25	8.25	6.5	5.33	4.0
6	10.0	9.33	8.75	8.75	7.0	6.0	4.75
8	10.5	10.0	9.33	9.33	7.75	6.5	5.25

G. Support PVDF piping per the following requirements based on pipe rated at 230 psi for diameters 2-inch through 2-1/2-inch, and 150 psi for diameters 3-inch and larger, at 68 degrees F:

1. Maximum Distance Between Supports (feet):

Pipe Size (inches)	Temp (deg F)			
	68	86	122	Over 140
1/2	3.0	2.5	2.0	Contin. support
3/4	3.0	3.0	3.0	Contin. support
1	3.5	3.0	3.0	Contin. support
1-1/2	4.0	3.5	3.0	Contin. support
2	4.5	4.0	3.5	Contin. support
2-1/2	5.0	4.5	4.0	Contin. support
3	5.5	5.0	4.0	Contin. support
4	6.0	5.0	4.5	Contin. support
6	7.0	6.0	5.0	Contin. support

H. Support Polypropylene piping per the following requirements based on pipe rated at 45 and 150 psi at 68 degrees F:

1. Maximum Distance Between Supports (feet):

Size (inches)	Temp (deg F)			
	68 Rated	86	104	122

	press- ure	45	150	45	150	45	150	45	150
1/2	N/A	3.0	N/A	2.5	N/A	2.5	N/A	2.0	2.0
3/4	N/A	3.0	N/A	3.0	N/A	2.5	N/A	2.5	2.5
1	N/A	3.5	N/A	3.0	N/A	3.0	N/A	3.0	3.0
1-1/2	N/A	4.0	N/A	3.5	N/A	3.0	N/A	3.0	3.0
2	2.5	4.5	2.25	4.0	2.25	4.0	2.0	3.5	3.5
2-1/2	2.75	5.0	2.5	4.5	2.25	4.0	2.25	4.0	4.0
3	3.0	5.5	2.75	5.0	2.25	4.0	2.25	4.0	4.0
4	3.5	6.0	2.75	5.0	2.75	5.0	2.25	4.0	4.0
6	4.0	7.0	3.5	6.0	3.5	6.0	2.75	5.0	5.0
8	4.0	7.5	4.0	7.5	3.5	6.0	3.5	6.0	6.0

- I. Support distances for PVC, CPVC, PVDF, and PP systems are based on fluid specific gravity of 1.0. For fluids at higher density, multiply distances by following factors:

SP Grav.	1.0	1.1	1.2	1.4	1.6	2.0	2.5
Factor	1.0	0.98	0.96	0.93	0.90	0.85	0.80

- J. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- K. Place a hanger within 12 inches of each horizontal elbow.
- L. Use hangers with 1-1/2 inch minimum vertical adjustment.
- M. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 2. NPS 3: 60 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 4. NPS 6: 60 inches with 3/4-inch rod.
 5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
 6. NPS 15: 60 inches with 1-inch rod.
 7. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- N. Support vertical piping at every floor. Support vertical cast iron pipe at each floor and at each hub.
- O. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- P. Support riser piping independently of connected horizontal piping.
- Q. At changes in pipe flow direction, install piping sufficiently spaced to allow pipe

movement without crushing insulation.

- R. Mechanical systems shall not share supports and/or hangers with any other systems.
- S. Fireproofing: Where hangers require removal of fire proofing, remove minimum amount of fireproofing for hanger attachment. Repair fireproofing per Division 07 Sections.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Insert wedge type expansion shell or shield should be flush with concrete surface in which it is set. This requires the hole in the concrete to be of sufficient depth to accommodate total insertion. Install fasteners according to manufacturer's written instructions.

- H. Pipe Stand Installation:
1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- I. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Reference other Division 22 Sections for plumbing fixtures.
- J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- L. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- M. Install lateral bracing with pipe hangers and supports to prevent swaying.
- N. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, [NPS 2-1/2 (DN 65)] <Insert size> and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- O. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- Q. Insulated Piping:
1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

- a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe **NPS 4 (DN 100)** and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe **NPS 4 (DN 100)** and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
 - a. **NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.**
 - b. **NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.**
 - c. **NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.**
 - d. **NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.**
 - e. **NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.**
5. Pipes **NPS 8 (DN 200)** and Larger: Include wood inserts of length at least as long as protective shield.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for [**trapeze pipe hangers**] [**and equipment supports**].
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to [1-1/2 inches (40 mm)] <Insert dimension>.

3.6 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in [Section 099113 "Exterior Painting."] [Section 099123 "Interior Painting."] [Section 099600 "High-Performance Coatings."]
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.7 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel [**pipe hangers and supports**] [**metal trapeze pipe hangers**] [**and**] [**metal framing systems**] and attachments for general service applications.
- F. Use [**stainless-steel pipe hangers**] [**and**] [**fiberglass pipe hangers**] [**and**] [**fiberglass strut systems**] and [**stainless-steel**] [**or**] [**corrosion-resistant**] attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and [**copper**] [**or**] [**stainless-steel**] attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes **NPS 1/2 to NPS 30 (DN 15 to DN 750)**.
 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 deg F (49 deg C) to **450 deg F (232 deg C)**, pipes **NPS 4 to NPS 24 (DN 100 to DN 600)**, requiring up to **4 inches (100 mm)** of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes **NPS 3/4 to NPS 36 (DN 20 to DN 900)**, requiring clamp flexibility and up to **4 inches (100 mm)** of insulation.
 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes **NPS 1/2 to NPS 24 (DN 15 to DN 600)** if little or no insulation is required.
 5. Pipe Hangers (MSS Type 5): For suspension of pipes **NPS 1/2 to NPS 4 (DN 15 to DN 100)**, to allow off-center closure for hanger installation before pipe erection.
 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes **NPS 3/4 to NPS 8 (DN 20 to DN 200)**.
 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8 (DN 15 to DN 200)**.
 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8 (DN 15 to DN 200)**.
 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 2 (DN 15 to DN 50)**.
 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 8 (DN 10 to DN 200)**.
 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 3 (DN 10 to DN 80)**.
 12. U-Bolts (MSS Type 24): For support of heavy pipes **NPS 1/2 to NPS 30 (DN 15 to DN 750)**.

13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes **NPS 4 to NPS 36 (DN 100 to DN 900)**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes **NPS 4 to NPS 36 (DN 100 to DN 900)**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes **NPS 2-1/2 to NPS 36 (DN 65 to DN 900)** if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes **NPS 1 to NPS 30 (DN 25 to DN 750)**, from two (2) rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes **NPS 2-1/2 to NPS 24 (DN 65 to DN 600)**, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes **NPS 2 to NPS 42 (DN 50 to DN 1050)** if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes **NPS 2 to NPS 24 (DN 50 to DN 600)** if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes **NPS 2 to NPS 30 (DN 50 to DN 750)** if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers **NPS 3/4 to NPS 20 (DN 24 to DN 500)**.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers **NPS 3/4 to NPS 20 (DN 20 to DN 500)** if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to **6 inches (150 mm)** for heavy loads.
 2. Steel Clevises (MSS Type 14): For **120 to 450 deg F (49 to 232 deg C)** piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For **120 to 450 deg F (49 to 232 deg C)** piping installations.

- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed **1-1/4 inches (32 mm)**.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use [**powder-actuated fasteners**] [**or**] [**mechanical-expansion anchors**] instead of building attachments where required in concrete construction.
- S. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 220529

SECTION 220533 - HEAT TRACING FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes plumbing piping heat tracing for freeze prevention, domestic hot-water-temperature maintenance, and snow and ice melting on roofs and in gutters and downspouts with the following electric heating cables:
 - 1. Plastic insulated, series resistance.
 - 2. Self-regulating, parallel resistance.
 - 3. Constant wattage.
- B. Related Requirements:
 - 1. Section 210533 "Heat Tracing for Fire-Suppression Piping."
 - 2. Section 230533 "Heat Tracing for HVAC Piping."
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
 - 2. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.
 - 3. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For electric heating cable.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".
 - 1. Record actual locations of components.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Minimum [**three (3)**] [**five (5)**] <Insert number> years from date of Substantial Completion.

1.7 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PLASTIC-INSULATED, SERIES-RESISTANCE HEATING CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Delta-Therm Corporation.
 - 2. Easy Heat; a division of EGS Electrical Group LLC.
 - 3. Orbit Manufacturing.
 - 4. Pyrotenax; a brand of Tyco Thermal Controls LLC.
 - 5. Raychem; a brand of Tyco Thermal Controls LLC.
 - 6. WarmlyYours Inc.
 - 7. Watts Radiant, Inc.; a subsidiary of Watts Water Technologies, Inc.
 - 8. <Insert manufacturer's name>.

9. or approved equal.
- B. Comply with IEEE 515.1.
- C. Heating Element: Single- or dual-stranded resistor wire. Terminate with waterproof, factory-assembled, nonheating leads with connectors at both ends.
- D. Electrical Insulating Jacket: Minimum 4.0-mil (0.10-mm) Kapton with silicone, Tefzel, or polyolefin.
- E. Cable Cover: Aluminum braid[**and silicone or Hylar outer jacket**].
- F. Maximum Operating Temperature (Power On): [300 deg F (150 deg C)] **<Insert temperature>**.
- G. Maximum Exposure Temperature (Power Off): [185 deg F (85 deg C)] **<Insert temperature>**.
- H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. Capacities and Characteristics:
 1. Maximum Heat Output: [6 W/ft. (19.7 W/m)] [7.5 W/ft. (24.6 W/m)] **<Insert value>**.
 2. Piping Diameter: **<Insert NPS (DN)>**.
 3. Number of Parallel Cables: **<Insert number>**.
 4. Spiral Wrap Pitch: **<Insert inches (mm)>**.
 5. Electrical Characteristics for Single-Circuit Connection:
 - a. Volts: [120] [208] [240] [277] [480] **<Insert value>**.
 - b. Phase: **<Insert value>**.
 - c. Hertz: **<Insert value>**.
 - d. Full-Load Amperes: **<Insert value>**.
 - e. Minimum Circuit Ampacity: **<Insert value>**.
 - f. Maximum Overcurrent Protection: **<Insert amperage>**.

2.2 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. BriskHeat.
 2. Chromalox.
 3. Delta-Therm Corporation.
 4. Easy Heat; a division of EGS Electrical Group LLC.
 5. Nelson Heat Trace; a division of EGS Electrical Group LLC.
 6. Pyrotenax; a brand of Tyco Thermal Controls LLC.
 7. Raychem; a brand of Tyco Thermal Controls LLC.

8. Thermon Americas Inc.
 9. Trasor Corp.
 10. **<Insert manufacturer's name>**.
 11. or approved equal.
- B. Comply with IEEE 515.1.
- C. Heating Element: Pair of parallel **[No. 16] [No. 18]** AWG, **[tinned] [nickel-coated]**, stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.
- D. Electrical Insulating Jacket: Flame-retardant polyolefin.
- E. Cable Cover: **[Tinned-copper] [Stainless-steel]** braid **[and polyolefin outer jacket with ultraviolet inhibitor]**.
- F. Maximum Operating Temperature (Power On): **[150 deg F (65 deg C)] <Insert temperature>**.
- G. Maximum Exposure Temperature (Power Off): **[185 deg F (85 deg C)] <Insert temperature>**.
- H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. Capacities and Characteristics:
1. Maximum Heat Output: **[3 W/ft. (9.8 W/m)] [5 W/ft. (16.4 W/m)] [8 W/ft. (26 W/m)] [10 W/ft. (32.8 W/m)] [12 W/ft. (39.4 W/m)] <Insert value>**.
 2. Piping Diameter: **<Insert NPS (DN)>**.
 3. Number of Parallel Cables: **<Insert number>**.
 4. Spiral Wrap Pitch: **<Insert inches (mm)>**.
 5. Electrical Characteristics for Single-Circuit Connection:
 - a. Volts: **[120] [208] [240] [277] [480] <Insert value>**.
 - b. Phase: **<Insert value>**.
 - c. Hertz: **<Insert value>**.
 - d. Full-Load Amperes: **<Insert value>**.
 - e. Minimum Circuit Ampacity: **<Insert value>**.
 - f. Maximum Overcurrent Protection: **<Insert amperage>**.

2.3 CONSTANT-WATTAGE HEATING CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. BriskHeat.
 2. Chromalox.
 3. Delta-Therm Corporation.
 4. Easy Heat; a division of EGS Electrical Group LLC.
 5. Nelson Heat Trace; a division of EGS Electrical Group LLC.
 6. Pyrotenax; a brand of Tyco Thermal Controls LLC.
 7. Raychem; a brand of Tyco Thermal Controls LLC.
 8. Thermon Americas Inc.
 9. Trasor Corp.
 10. **<Insert manufacturer's name>**.
 11. or approved equal.
- B. Comply with IEEE 515.1.
- C. Heating Element: Pair of parallel **[No. 12] <Insert gage>** AWG, **[tinned]** **[nickel-coated]**, stranded copper bus wires with single-stranded resistor wire connected between bus wires. Terminate with waterproof, factory-assembled, nonheating leads with connectors at one end, and seal the opposite end watertight.
- D. Electrical Insulating Jacket: Flame-retardant fluoropolymer.
- E. Cable Cover: **[Tinned-copper]** **[Stainless-steel]** braid **[and polyolefin outer jacket with ultraviolet inhibitor]**.
- F. Maximum Operating Temperature (Power On): **[392 deg F (200 deg C)] <Insert temperature>**.
- G. Maximum Exposure Temperature (Power Off): **[185 deg F (85 deg C)] <Insert temperature>**.
- H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. Capacities and Characteristics:
1. Maximum Heat Output: **[4 W/ft. (13.1 W/m)] [8 W/ft. (26 W/m)] [12 W/ft. (39.4 W/m)] <Insert value>**.
 2. Electrical Characteristics for Single-Circuit Connection:
 - a. Volts: **[120] [208] [240] [277] [480] <Insert value>**.
 - b. Phase: **<Insert value>**.
 - c. Hertz: **<Insert value>**.
 - d. Full-Load Amperes: **<Insert value>**.
 - e. Minimum Circuit Ampacity: **<Insert value>**.
 - f. Maximum Overcurrent Protection: **<Insert amperage>**.

2.4 CONTROLS

- A. Pipe-Mounted Thermostats for Freeze Protection:

1. Remote bulb unit with adjustable temperature range from [30 to 50 deg F (minus 1 to plus 10 deg C)] <Insert temperature range>.
2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
3. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
4. Corrosion-resistant, waterproof control enclosure.

B. Precipitation and Temperature Sensor for Snow Melting on Roofs and in Gutters:

1. **[Microprocessor-based] [Automatic]** control with manual on, automatic, and standby/reset switch.
2. Precipitation and temperature sensors shall sense the surface conditions of roof and gutters and shall be programmed to energize the cable as follows:
 - a. Temperature Span: [34 to 44 deg F (1 to 7 deg C)] <Insert temperature range>.
 - b. Adjustable Delay-Off Span: [30 to 90] <Insert time> minutes.
 - c. Energize Cables: Following [two] <Insert time>-minute delay if ambient temperature is below set point and precipitation is detected.
 - d. De-Energize Cables: On detection of a dry surface plus time delay.
3. Corrosion-proof and waterproof enclosure suitable for outdoor mounting, for controls and precipitation and temperature sensors.
4. Minimum 30-A contactor to energize cable or close other contactors.
5. Precipitation sensor shall be freestanding.
6. Provide relay with contacts to indicate operational status, on or off, for interface with central HVAC control-system workstation.

C. Programmable Timer for Domestic Hot-Water-Temperature Maintenance:

1. Microprocessor based.
2. Minimum of four separate schedules.
3. Minimum 24-hour battery carryover.
4. On-off-auto switch.
5. 365-day calendar with 20 programmable holidays.
6. Relays with contacts to indicate operational status, on or off, and for interface with central HVAC control-system workstation.

2.5 ACCESSORIES

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.
- B. Warning Labels: Refer to Section 220553 "Identification for Plumbing Piping and Equipment."

- C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least **3 mils (0.08 mm)** thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
 - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than **6 Inches (150 mm)**: **3/4 inch (19 mm)** minimum.
 - 2. Width for Markers on Pipes with OD, Including Insulation, **6 Inches (150 mm)** or Larger: **1-1/2 inches (38 mm)** minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Install the following types of electric heating cable for the applications described:
 - 1. Snow and Ice Melting on Roofs and in Gutters and Downspouts: **[Plastic-insulated, series-resistance] [Self-regulating, parallel-resistance] [Constant-wattage]** heating cable.
 - 2. Temperature Maintenance for Domestic Hot Water: Self-regulating, parallel-resistance heating cable.

3.3 INSTALLATION

- A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.
- B. Electric Heating-Cable Installation for Snow and Ice Melting on Roofs and in Gutters and Downspouts:
 - 1. Install on roof and in gutters and downspouts with clips furnished by manufacturer that are compatible with roof, gutters, and downspouts.
- C. Electric Heating-Cable Installation for Freeze Protection for Piping:
 - 1. Install electric heating cables after piping has been tested and before insulation is installed.
 - 2. Install electric heating cables according to IEEE 515.1.

3. Install insulation over piping with electric cables according to Section 220719 "Plumbing Piping Insulation."
4. Install warning tape on piping insulation where piping is equipped with electric heating cables.

D. Electric Heating-Cable Installation for Temperature Maintenance for Domestic Hot Water:

1. Install electric heating cables after piping has been tested and before insulation is installed.
2. Install insulation over piping with electric heating cables according to Section 220719 "Plumbing Piping Insulation."
3. Install warning tape on piping insulation where piping is equipped with electric heating cables.

E. Set field-adjustable switches and circuit-breaker trip ranges.

3.4 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections[**with the assistance of a factory-authorized service representative**]:
 1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
 2. Test cables for electrical continuity and insulation integrity before energizing.
 3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- D. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.
- E. Cables will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

- G. Replace all damaged or defective components of heat tracing system, and re-test to verify function and compliance with specifications and project requirements.

3.6 PROTECTION

- A. Protect installed heating cables, including nonheating leads, from damage during construction.
- B. Remove and replace damaged heat-tracing cables.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 220533

SECTION 220548.13 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Inertia bases.
2. Elastomeric isolation pads.
3. Elastomeric isolation mounts.
4. Restrained elastomeric isolation mounts.
5. Open-spring isolators.
6. Housed-spring isolators.
7. Restrained-spring isolators.
8. Housed-restrained-spring isolators.
9. Pipe-riser resilient supports.
10. Resilient pipe guides.
11. Elastomeric hangers.
12. Spring hangers.

- B. Related Requirements:

1. Section 210548.13 "Vibration Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
2. Section 230548.13 "Vibration Controls for HVAC" for devices for HVAC equipment and systems.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.

3. Include data substantiating that materials comply with requirements.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.
2. Indicate inertia bases and locate vibration isolators, with static and dynamic load on each.

C. Delegated-Design Submittal: For each vibration isolation device.

1. Include design calculations for selecting vibration isolators.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For testing agency.

C. Welding certificates.

D. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data[**performed by an independent agency**].

1.5 CLOSE-OUT SUBMITTALS

A. "As Built" Plans shall be provided in the same format and manner as described above. Each set shall be equipped with a plan holder equal to "Stacor Plan Clamps" for the appropriate size drawings.

B. Record actual locations of hangers including attachment points.

1.6 REFERENCES

A. Materials and workmanship shall conform to the latest issue of all industry standards, publications, or regulations referenced in this section and with the following references as applicable.

B. Applicable Standards:

1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
2. ASHRAE - Guide to Average Noise Criteria Curves.
3. International Building Code (IBC) with the Denver Amendments.
4. International Fire Code (IFC) with the Denver Amendments.

1.7 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.8 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 INERTIA BASES

A. Structural Bases:

1. Design: Sufficiently rigid to prevent misalignment or undue stress on machine, and to transmit design loads to isolators and snubbers.
2. Construction: Welded structural steel with gusseted brackets, supporting equipment and motor with motor slide rails.

B. Concrete Inertia Bases:

1. Mass: Minimum of 1.5 times weight of isolated equipment.
2. Construction: Structured steel channel perimeter frame, with gusseted brackets and anchor bolts, adequately reinforced, concrete filled.
3. Connecting Point: Reinforced to connect isolators and snubbers to base.
4. Concrete: Reinforced 3,000 psi concrete.

2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads: <Insert drawing designation>.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

- a. [Ace Mountings Co., Inc.](#)
- b. [California Dynamics Corporation.](#)
- c. [Isolation Technology, Inc.](#)
- d. [Kinetics Noise Control, Inc.](#)
- e. [Mason Industries, Inc.](#)
- f. [Vibration Eliminator Co., Inc.](#)
- g. [Vibration Isolation.](#)
- h. [Vibration Mountings & Controls, Inc.](#)
- i. <Insert manufacturer's name>.

- j. or approved equal.
- 2. Fabrication: Single layer of sufficient durometer stiffness for uniform loading over pad area.
 - a. **[30] [40]** durometer.
- 3. Size: Factory or field cut to match requirements of supported equipment.
 - a. Minimum 1/2 inch thick.
 - b. Maximum loading 40 psi.
 - c. Height of ribs shall not exceed 0.7 times width.
- 4. Pad Material: Oil and water resistant with elastomeric properties.
- 5. Surface Pattern: -**[Waffle]** pattern.
- 6. Infused nonwoven cotton or synthetic fibers.
- 7. Load-bearing metal plates adhered to pads.
- 8. Sandwich-Core Material: **[Resilient] [and] [elastomeric] <Insert compound>**.
 - a. Surface Pattern: **[Smooth] [Ribbed] [Waffle]** pattern.
 - b. Infused nonwoven cotton or synthetic fibers.

2.3 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts: **<Insert drawing designation>**.

- 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
- 2. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded[**with threaded studs or bolts**].
 - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
- 3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts: <Insert drawing designation>.

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. [Ace Mountings Co., Inc.](#)
- b. [California Dynamics Corporation.](#)
- c. [Isolation Technology, Inc.](#)
- d. [Kinetics Noise Control, Inc.](#)
- e. [Mason Industries, Inc.](#)
- f. [Vibration Eliminator Co., Inc.](#)
- g. [Vibration Isolation.](#)
- h. [Vibration Mountings & Controls, Inc.](#)
- i. **<Insert manufacturer's name>.**
- j. or approved equal.

2. Description: All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

- a. Housing: Cast-ductile iron or welded steel.
- b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.5 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators: <Insert drawing designation>.

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. [Ace Mountings Co., Inc.](#)
- b. [California Dynamics Corporation.](#)
- c. [Isolation Technology, Inc.](#)
- d. [Kinetics Noise Control, Inc.](#)
- e. [Mason Industries, Inc.](#)
- f. [Vibration Eliminator Co., Inc.](#)
- g. [Vibration Isolation.](#)
- h. [Vibration Mountings & Controls, Inc.](#)
- i. **<Insert manufacturer's name>.**
- j. or approved equal.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.6 HOUSED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing: <Insert drawing designation>.
- B. Spring Isolators:
 1. For exterior and humid areas, provide hot dipped galvanized housings and neoprene coated springs.
 2. Code: Color code springs for load carrying capacity.
 3. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)
 - i. <Insert manufacturer's name>.
 - j. or approved equal.
 4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 8. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
 - b. Top housing with [attachment and leveling bolt] [threaded mounting holes and internal leveling device] [elastomeric pad].
 - c. Provide neoprene side stabilizers with minimum 0.25 inch clearance.

2.7 RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint: **<Insert drawing designation>**.
- B. Spring Isolators:
1. For exterior and humid areas, provide hot dipped galvanized housings and neoprene coated springs.
 2. Code: Color code springs for load carrying capacity.
 3. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
 4. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
 - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
 - b. Top plate with **[threaded mounting holes] [elastomeric pad]**.
 - c. Internal leveling bolt that acts as blocking during installation.
 - d. Provide neoprene side stabilizers with minimum 0.25 inch clearance.
 5. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
 6. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 7. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 8. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 9. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.8 HOUSED-RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint: **<Insert drawing designation>**.
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)
 - i. **<Insert manufacturer's name>.**
 - j. or approved equal.
2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with **[adjustable]** **[non-adjustable]** snubbers to limit vertical movement.
- a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
 - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.9 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- (13-mm-) thick neoprene **<Insert drawing designation>**.
1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 2. Maximum Load Per Support: 500 psig (3.45 MPa) on isolation material providing equal isolation in all directions.

2.10 RESILIENT PIPE GUIDES

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- (13-mm-) thick neoprene **<Insert drawing designation>**.
1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.11 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: <Insert drawing designation>.

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Mountings & Controls, Inc.](#)
 - h. <Insert manufacturer's name>.
 - i. or approved equal.
2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.12 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression: <Insert drawing designation>.

B. Spring Isolators:

1. For exterior and humid areas, provide hot dipped galvanized housings and neoprene coated springs.
2. Code: Color code springs for load carrying capacity.
3. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Kinetics Noise Control, Inc.](#)
 - d. [Mason Industries, Inc.](#)
 - e. [Vibration Eliminator Co., Inc.](#)
 - f. [Vibration Isolation.](#)
 - g. [Vibration Mountings & Controls, Inc.](#)
 - h. <Insert manufacturer's name>.
 - i. or approved equal.

4. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
5. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
6. Minimum Additional Travel: 50 percent of the required deflection at rated load.
7. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
8. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
9. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
10. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
11. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
12. Misalignment: Capable of 20 degree hanger rod misalignment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 VIBRATION CONTROL DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in [**Section 033000 "Cast-in-Place Concrete."**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete."**]
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Install in accordance with manufacturer's instructions.
- D. Install isolation for motor driven equipment.
- E. Bases:

1. Set steel bases for one-inch clearance between housekeeping pad and base.
 2. Set concrete inertia bases for 2-inch clearance between housekeeping pad and base.
 3. Adjust equipment level.
- F. Install spring hangers without binding.
- G. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- H. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- I. Support piping connections to isolated equipment resiliently **[for scheduled distance.] [to nearest flexible pipe connector.] [as follows:]**
1. Up to 4 Inch Diameter: First three points of support.
 2. 5 to 8 Inch Diameter: First four points of support.
 3. 10 inch Diameter and Over: First six points of support.
 4. Select three hangers closest to vibration source for minimum 1.0-inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0-inch static deflection or 1/2 static deflection of isolated equipment.
- J. Connect wiring to isolated equipment with flexible hanging loop.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Inspect isolated equipment after installation and submit report. Include static deflections.

3.4 PIPE ISOLATION SCHEDULE

Pipe Size (inches)	Isolated Distance from Equipment (pipe diameters)
1	120
2	90
3	80
4	75
6	60
8	60
10	54
12	50
16	45
24	38

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION **220548.13**

SECTION 220548.13 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Inertia bases.
2. Elastomeric isolation pads.
3. Elastomeric isolation mounts.
4. Restrained elastomeric isolation mounts.
5. Open-spring isolators.
6. Housed-spring isolators.
7. Restrained-spring isolators.
8. Housed-restrained-spring isolators.
9. Pipe-riser resilient supports.
10. Resilient pipe guides.
11. Elastomeric hangers.
12. Spring hangers.

- B. Related Requirements:

1. Section 210548.13 "Vibration Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
2. Section 230548.13 "Vibration Controls for HVAC" for devices for HVAC equipment and systems.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.
3. Include data substantiating that materials comply with requirements.

- B. Shop Drawings:
 - 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.
 - 2. Indicate inertia bases and locate vibration isolators, with static and dynamic load on each.
- C. Delegated-Design Submittal: For each vibration isolation device.
 - 1. Include design calculations for selecting vibration isolators.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For testing agency.
- C. Welding certificates.
- D. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data[**performed by an independent agency**].

1.5 CLOSE-OUT SUBMITTALS

- A. "As Built" Plans shall be provided in the same format and manner as described above. Each set shall be equipped with a plan holder equal to "Stacor Plan Clamps" for the appropriate size drawings.
- B. Record actual locations of hangers including attachment points.

1.6 REFERENCES

- A. Materials and workmanship shall conform to the latest issue of all industry standards, publications, or regulations referenced in this section and with the following references as applicable.
- B. Applicable Standards:
 - 1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
 - 2. ASHRAE - Guide to Average Noise Criteria Curves.
 - 3. International Building Code (IBC) with the Denver Amendments.
 - 4. International Fire Code (IFC) with the Denver Amendments.

1.7 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.8 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 INERTIA BASES

A. Structural Bases:

1. Design: Sufficiently rigid to prevent misalignment or undue stress on machine, and to transmit design loads to isolators and snubbers.
2. Construction: Welded structural steel with gusseted brackets, supporting equipment and motor with motor slide rails.

B. Concrete Inertia Bases:

1. Mass: Minimum of 1.5 times weight of isolated equipment.
2. Construction: Structured steel channel perimeter frame, with gusseted brackets and anchor bolts, adequately reinforced, concrete filled.
3. Connecting Point: Reinforced to connect isolators and snubbers to base.
4. Concrete: Reinforced 3,000 psi concrete.

2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads: **<Insert drawing designation>**.

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following :**

- a. [Ace Mountings Co., Inc.](#)
- b. [California Dynamics Corporation.](#)
- c. [Isolation Technology, Inc.](#)
- d. [Kinetics Noise Control, Inc.](#)
- e. [Mason Industries, Inc.](#)
- f. [Vibration Eliminator Co., Inc.](#)
- g. [Vibration Isolation.](#)
- h. [Vibration Mountings & Controls, Inc.](#)
- i. **<Insert manufacturer's name>**.
- j. or approved equal.

2. Fabrication: Single layer of sufficient durometer stiffness for uniform loading over pad area.
 - a. **[30] [40]** durometer.
3. Size: Factory or field cut to match requirements of supported equipment.
 - a. Minimum 1/2 inch thick.
 - b. Maximum loading 40 psi.
 - c. Height of ribs shall not exceed 0.7 times width.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: -**[Waffle]** pattern.
6. Infused nonwoven cotton or synthetic fibers.
7. Load-bearing metal plates adhered to pads.
8. Sandwich-Core Material: **[Resilient] [and] [elastomeric] <Insert compound>**.
 - a. Surface Pattern: **[Smooth] [Ribbed] [Waffle]** pattern.
 - b. Infused nonwoven cotton or synthetic fibers.

2.3 ELASTOMERIC ISOLATION MOUNTS

- A. Double-Deflection, Elastomeric Isolation Mounts: **<Insert drawing designation>**.
 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
 2. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded[**with threaded studs or bolts**].
 - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
 3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts: **<Insert drawing designation>**.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
2. **Description:** All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - a. **Housing:** Cast-ductile iron or welded steel.
 - b. **Elastomeric Material:** Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.5 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators: **<Insert drawing designation>**.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
2. **Outside Spring Diameter:** Not less than 80 percent of the compressed height of the spring at rated load.
3. **Minimum Additional Travel:** 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to **500 psig** (3447 kPa).
7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.6 HOUSED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing: **<Insert drawing designation>**.
- B. Spring Isolators:
 1. For exterior and humid areas, provide hot dipped galvanized housings and neoprene coated springs.
 2. Code: Color code springs for load carrying capacity.
 3. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
 4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 8. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to **500 psig** (3447 kPa).
 - b. Top housing with **[attachment and leveling bolt] [threaded mounting holes and internal leveling device] [elastomeric pad]**.
 - c. Provide neoprene side stabilizers with minimum 0.25 inch clearance.

2.7 RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint: **<Insert drawing designation>**.
- B. Spring Isolators:
1. For exterior and humid areas, provide hot dipped galvanized housings and neoprene coated springs.
 2. Code: Color code springs for load carrying capacity.
 3. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
 4. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
 - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to **500 psig** (3447 kPa).
 - b. Top plate with **[threaded mounting holes]** **[elastomeric pad]**.
 - c. Internal leveling bolt that acts as blocking during installation.
 - d. Provide neoprene side stabilizers with minimum 0.25 inch clearance.
 5. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
 6. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 7. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 8. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 9. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.8 HOUSED-RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint: **<Insert drawing designation>**.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)
 - i. **<Insert manufacturer's name>.**
 - j. or approved equal.
2. **Two-Part Telescoping Housing:** A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with **[adjustable]** **[non-adjustable]** snubbers to limit vertical movement.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to **500 psig** (3447 kPa).
 - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
3. **Outside Spring Diameter:** Not less than 80 percent of the compressed height of the spring at rated load.
4. **Minimum Additional Travel:** 50 percent of the required deflection at rated load.
5. **Lateral Stiffness:** More than 80 percent of rated vertical stiffness.
6. **Overload Capacity:** Support 200 percent of rated load, fully compressed, without deformation or failure.

2.9 PIPE-RISER RESILIENT SUPPORT

- A. **Description:** All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum **1/2-inch-** (13-mm-) thick neoprene **<Insert drawing designation>**.
 1. **Vertical-Limit Stops:** Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 2. **Maximum Load Per Support:** **500 psig** (3.45 MPa) on isolation material providing equal isolation in all directions.

2.10 RESILIENT PIPE GUIDES

- A. **Description:** Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum **1/2-inch-** (13-mm-) thick neoprene **<Insert drawing designation>**.

1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.11 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: **<Insert drawing designation>**.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Mountings & Controls, Inc.](#)
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.
2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.12 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression: **<Insert drawing designation>**.

B. Spring Isolators:

1. For exterior and humid areas, provide hot dipped galvanized housings and neoprene coated springs.
2. Code: Color code springs for load carrying capacity.
3. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Kinetics Noise Control, Inc.](#)
 - d. [Mason Industries, Inc.](#)
 - e. [Vibration Eliminator Co., Inc.](#)
 - f. [Vibration Isolation.](#)

- g. [Vibration Mountings & Controls, Inc.](#)
 - h. <Insert manufacturer's name>.
 - i. or approved equal.
- 4. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - 5. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 6. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 7. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 8. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 9. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 - 10. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 - 11. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
 - 12. Misalignment: Capable of 20 degree hanger rod misalignment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 VIBRATION CONTROL DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in [**Section 033000 "Cast-in-Place Concrete."**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete."**]
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Install in accordance with manufacturer's instructions.

- D. Install isolation for motor driven equipment.
- E. Bases:
 - 1. Set steel bases for one-inch clearance between housekeeping pad and base.
 - 2. Set concrete inertia bases for 2-inch clearance between housekeeping pad and base.
 - 3. Adjust equipment level.
- F. Install spring hangers without binding.
- G. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- H. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- I. Support piping connections to isolated equipment resiliently [**for scheduled distance.**] [**to nearest flexible pipe connector.**] [**as follows:**]
 - 1. Up to 4 Inch Diameter: First three points of support.
 - 2. 5 to 8 Inch Diameter: First four points of support.
 - 3. 10 inch Diameter and Over: First six points of support.
 - 4. Select three hangers closest to vibration source for minimum 1.0-inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0-inch static deflection or 1/2 static deflection of isolated equipment.
- J. Connect wiring to isolated equipment with flexible hanging loop.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Inspect isolated equipment after installation and submit report. Include static deflections.

3.4 PIPE ISOLATION SCHEDULE

Pipe Size (inches)	Isolated Distance from Equipment (pipe diameters)
1	120
2	90
3	80
4	75
6	60
8	60
10	54

12
16
24

50
45
38

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 220548.13

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 REFERENCES

- A. Materials and workmanship shall conform to the latest issue of all industry standards, publications, or regulations referenced in this section and with the following references as applicable. Refer to Section 014200 "References" for listing of issuing organizations or agencies.
- B. Applicable Standards:
 - 1. American Society of Mechanical Engineers (ASME).
 - 2. ASME A13.1 - Scheme for the Identification of Piping Systems.
 - 3. International Building Code (IBC) with the Denver Amendments.
 - 4. International Fire Code (IFC) with the Denver Amendments.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Provide manufacturers catalog literature for each product required.
 - 1. Include data substantiating that materials comply with requirements.

- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
 - 1. Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.
 - 1. Include valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

1.5 CLOSEOUT SUBMITTALS

- A. "As Built" Plans shall be provided in the same format and manner as described above. Each set shall be equipped with a plan holder equal to "Stacor Plan Clamps" for the appropriate size drawings.
 - 1. Record actual locations of all tagged valves.

1.6 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

1.7 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of

the following:

1. W.H. Brady Co.
2. Panduit Corp.
3. Seton Name Plate Corp.
4. Marking Services, Inc.
5. or approved equal.

2.2 MATERIALS

- A. Color: Unless specified otherwise, conform with ASME A13.1.
- B. Plastic Nameplates: Laminated three-layer plastic with engraved black letters on light contrasting background color.
- C. Metal Tags: Brass or aluminum, with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- D. Chart: Typewritten letter size list in anodized aluminum frame.
- E. Stencils: With clean cut symbols and letters of 2-1/2 inch size.
- F. Stencil Paint: In accordance with Division 09 sections, semi-gloss enamel.
- G. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and fluid being conveyed.
- H. Underground Plastic Pipe Markers:
 1. Bright colored continuously printed plastic ribbon tape of not less than 6 inch wide by 4 mil thick, manufactured for direct burial service.
 2. For non-metallic buried piping, provide printed foil type tape as manufactured by Marking Services Inc., enabling locating of runs by use of a metal detector.

2.3 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 1. Material and Thickness: **Brass, 0.032-inch (0.8-mm)** [**Stainless steel, 0.025-inch (0.64-mm)**] [**Aluminum, 0.032-inch (0.8-mm)**] [**or**] [**anodized aluminum, 0.032-inch (0.8-mm)**] minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch (64 by 19 mm)** or 1-1/2 inch diameter with smooth edges.
 3. Minimum Letter Size: **1/4 inch (6.4 mm)** for name of units if viewing distance is less than **24 inches (600 mm)**, **1/2 inch (13 mm)** for viewing distances up to **72**

inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

4. Fasteners: Stainless-steel [**rivets**] [**rivets or self-tapping screws**] [**self-tapping screws**].
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, [**1/16 inch** (1.6 mm)] [**1/8 inch** (3.2 mm)] <Insert dimension> thick, and having predrilled holes for attachment hardware.
2. Letter Color: [**Black**] [**Blue**] [**Red**] [**White**] [**Yellow**] <Insert color>.
3. Background Color: [**Black**] [**Blue**] [**Red**] [**White**] [**Yellow**] <Insert color>.
4. Maximum Temperature: Able to withstand temperatures up to **160 deg F** (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch** (64 by 19 mm).
6. Minimum Letter Size: **1/4 inch** (6.4 mm) for name of units if viewing distance is less than **24 inches** (600 mm), **1/2 inch** (13 mm) for viewing distances up to **72 inches** (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel [**rivets**] [**rivets or self-tapping screws**] [**self-tapping screws**].
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on **8-1/2-by-11-inch** (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.4 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, [**1/16 inch** (1.6 mm)] [**1/8 inch** (3.2 mm)] <Insert dimension> thick, and having predrilled holes for attachment hardware.
- B. Letter Color: [**Black**] [**Blue**] [**Red**] [**White**] [**Yellow**] <Insert color>.
- C. Background Color: [**Black**] [**Blue**] [**Red**] [**White**] [**Yellow**] <Insert color>.

- D. Maximum Temperature: Able to withstand temperatures up to **160 deg F** (71 deg C).
- E. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch** (64 by 19 mm).
- F. Minimum Letter Size: **1/4 inch** (6.4 mm) for name of units if viewing distance is less than **24 inches** (600 mm), **1/2 inch** (13 mm) for viewing distances up to **72 inches** (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel [**rivets**] [**rivets or self-tapping screws**] [**self-tapping screws**].
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.5 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to [**partially cover**] [**cover full**] circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least **1-1/2 inches** (38 mm) high.

2.6 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of **3/4 inch** (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. Stencil Material: [**Aluminum**] [**Brass**] [**Fiberboard**] [**Fiberboard or metal**] [**<Insert material>**].

2. Stencil Paint: Exterior, gloss, [**alkyd enamel**] [**acrylic enamel**] <Insert paint type> black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, [**alkyd enamel**] [**acrylic enamel**] <Insert paint type> in colors according to ASME A13.1 unless otherwise indicated.

2.7 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
 1. Tag Material: [**Brass, 0.032-inch (0.8-mm)**] [**Stainless steel, 0.025-inch (0.64-mm)**] [**Aluminum, 0.032-inch (0.8-mm)**] [**or**] [**anodized aluminum, 0.032-inch (0.8-mm)**] minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Fasteners: Brass [**wire-link or beaded chain; or S-hook**] [**wire-link chain**] [**beaded chain**] [**S-hook**].
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 1. Valve-tag schedule shall be included in operation and maintenance data.

2.8 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 1. Size: [**3 by 5-1/4 inches (75 by 133 mm) minimum**] [**Approximately 4 by 7 inches (100 by 178 mm)**] <Insert size>.
 2. Fasteners: [**Brass grommet and wire**] [**Reinforced grommet and wire or string**].
 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 4. Color: Yellow background with black lettering.

2.9 CEILING TACKS

- A. Description: Steel with 3/4 inch diameter color coded head.
- B. Color code as follows:
 1. Yellow - HVAC equipment.
 2. Red - Fire dampers/smoke dampers.

3. Green - Plumbing valves.
4. Blue - Heating/cooling valves.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.
- B. Prepare surfaces in accordance with Division 09 for stencil painting.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
 1. Plastic Nameplates: Install with corrosive-resistant mechanical fasteners and adhesive.
 2. Metal Tags: Install with corrosive-resistant chain.
 3. Stencil Painting: Apply in accordance with Division 09.
- B. Locate equipment labels where accessible and visible.
- C. Equipment: Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates or stencil painting. Small devices, such as in-line pumps, may be identified with metal tags. At a minimum, the nameplate shall contain the following information:
 1. Equipment tag.
 2. Equipment location.
 3. Service area.
 4. Flowrate (cfm/gpm).
 5. Capacity (btuh/kw).
 6. **<Equipment Owner>**
- D. Equipment and terminal devices above ceiling:
 1. Provide adhesive backed plastic nameplate on ceiling grid support directly below equipment identifying unit tag and temperature control node number.

3.3 CONTROLS

- A. Identify control panels and major control components outside panels with plastic nameplates.

- B. Key to control schematics.

3.4 PIPE LABEL INSTALLATION

- A. Identify piping, concealed or exposed, with plastic pipe markers. Tags may be used on ½" or smaller diameter non-insulated piping. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping.
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Each side of penetrations through walls, floors, ceilings, inaccessible enclosures, and at each obstruction.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of [20 feet (6 m)] along each run.

3.5 VALVE-TAG IDENTIFICATION AND INSTALLATION

- A. Install tags on valves and control devices in piping systems, except faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Use metal tags secured with brass 'S' hooks or brass chains.
- C. Stamp tags with a unique prefix to identify system to which applied, followed by a number (example: CW-1, CW-2, etc.). In general, prefix shall match system abbreviations used on drawings where applicable.
- D. Provide a typewritten listing of valves including: Valve identification number, location, function, normal position, service, and area served. Mount list as specified and directed. Include additional copy in operation and maintenance manuals.
- E. Show valve tag designations on the project record document drawings, including schematic flow diagrams where included with construction documents.
- F. Contractor shall prepare and install where directed, in aluminum frames with clear plastic protective cover, a valve location diagram in the form of a series of flow diagrams with each automatic or manually actuated control or shut-off valve clearly identified in sequence with its individual valve tag number. Automatic control valves shall be tagged to match designations shown on the temperature control drawings, and the specified valve charts shall be installed adjacent to valve location diagrams

G. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

- a. Cold Water: [1-1/2 inches (38 mm)] minimum , [round]
- b. Hot Water: [1-1/2 inches (38 mm)] minimum [round].
- c. Low-Pressure Compressed Air: [1-1/2 inches (38 mm)] minimum round .
- d. High-Pressure Compressed Air: [1-1/2 inches (38 mm)] minimum [round].

2. Valve-Tag Color:

- a. Cold Water: [Natural] [Green] <Insert color>.
- b. Hot Water: [Natural] [Green] <Insert color>.
- c. Low-Pressure Compressed Air: [Natural] [Green] <Insert color>.
- d. High-Pressure Compressed Air: [Natural] [Green] <Insert color>.

3. Letter Color:

- a. Cold Water: [Black] <Insert color>.
- b. Hot Water: [Black] <Insert color>.
- c. Low-Pressure Compressed Air: [Black] <Insert color>.
- d. High-Pressure Compressed Air: [Black] <Insert color>.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.7 VALVE CHART AND SCHEDULE

A. Provide valve chart and schedule in aluminum frame with clear plastic shield. Install at location as directed by DEN Project Manager. For HVAC piping identification schedule, reference Section 230553 "Identification for HVAC Piping and Equipment":

3.8 PIPING IDENTIFICATION SCHEDULE

A. Pipe identification and color coding for general-use piping systems shall be in accordance with the following schedule:

Classification:	Band Color:	Stenciled Legend:
Domestic Hot Water	Yellow	Domestic Hot Water
Domestic Cold Water	Green	Domestic Cold Water
Domestic Hot Water Circ.	Yellow	Domestic H. W. Circ.
Chilled Drinking Water	Green	Ch. Drink Water
Chilled Water Supply	Green	Ch. Water Suppl.
Chilled Water Return	Green	Ch. Water Ret.

Condenser Water Supply	Green	Cond. Water Supp.
Condenser Water Return	Green	Cond. Water Ret.
Non-Potable Water	Yellow	Non-Potable Water
Natural Gas*	Yellow	Nat. Gas
L.P. Gas*	Yellow	L.P. Gas
Gas Vent*	Yellow	Gas Vent
Hot Water Heating Supply	Yellow	H.W. Htg. Supp.
Hot Water Heating Return	Yellow	H.W. Htg. Ret.
Soil and Waste Piping	Green	Soil & Waste
Plumbing Vent	Green	Vent
Plumbing Drain	Green	Drain
Roof Drain	Green	Roof Drain
Compressed Air	Blue	Comp. Air
Snow Melting Supply	Yellow	Snow Melt Supp.
Snow Melting Return	Yellow	Snow Melt Ret.
Blow Down	Yellow	Blow Dn.
Refrigerant Hot Gas	Green	Refr. Hot Gas
Refrigerant Liquid	Green	Refr. Liq.
Refrigerant Suction	Green	Refr. Suction
Water Treatment	Green	Water Trtmt.
Humidifier	Green	Humidifier
Expansion Tank No.	Yellow	Exp. Tank No.
Fire Hose Cabinets:		
Outside Trim & Hose Brckt.	Red Enamel	
Interior	White Enamel	
Fire Protection Piping	Red	Fire Line
Fire Sprinkler Piping	Red	Fire Sprklr.Line
Gasoline	Yellow	Gasoline
Gasoline Vent	Yellow	Gasoline Vent
Fuel Oil (heating)	Yellow	Fuel Oil Htg.
Fuel Oil (generator)	Yellow	Fuel Oil Gen.
Diesel Exhaust	Yellow	Engine Exh.
Soft Water	Green	Soft Water
Refrigerant Relief	Yellow	Refr. Relief
Condensate Return	Yellow	Cond. Ret.
Lawn Sprinkler Supply	Green	Lawn Spr. Supp.

1. *Paint entire pipe color indicated except, for vent piping exposed on exterior of building, paint pipe to match wall color. Certain locations may be exempt by direction of DEN Project Manager.

B. Overflow condensate drain termination shall have a minimum 6"x6" placard that reads as follows:

1. "If water is observed from the pipe below, immediately contact Maintenance Control at (303) 342-2800".
2. Placard shall have white background with red lettering.
3. Minimum lettering height shall be ½".

4. Mount placard a minimum of 48" above finish floor.
- C. Paint exterior piping and duct systems to match wall colors.
- D. For fuel piping systems, piping identification shall conform to the following schedule:

Fuel Type:

Jet A
Jet A-1
JP-4 (Jet B)
Avgas 115
Avgas 100
Avgas 100LL
Avgas 80

Band Colors:

Black/Black Band
Black/2 Black Bands
Black/3 Yellow Bands
Red/Purple Band
Red/Green Band
Red/Blue Band
Red/Red Band

Stenciled Legend:

Jet A
Jet A-1
JP-4
Avgas 115
Avgas 100
Avgas 100LL
Avgas 80

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 220553

SECTION 220716 - PLUMBING EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes insulating the following plumbing equipment:
 - 1. Domestic water boiler breechings.
 - 2. Domestic water heat exchangers.
 - 3. Domestic water converters.
 - 4. Domestic water, [**hot-water**] [**cold-water**] [**and**] [**chilled-water**] pumps.
 - 5. Domestic water storage tanks.
 - 6. Domestic water filter housings.
 - 7. Other equipment insulation.
- B. Related Sections:
 - 1. Section 220719 "Plumbing Piping Insulation."
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 REFERENCES

- A. Materials and workmanship shall conform to the latest issue of all industry standards, publications, or regulations referenced in this section and with the following references as applicable. Refer to Section 014200 "References" for listing of issuing organizations or agencies.
- B. Applicable Standards:
 - 1. American Society for Testing of Materials (ASTM).
 - a. ASTM E 84 - Surface Burning Characteristics of Building Materials.
 - b. ASTM B 209 - Aluminum and Aluminum-Alloy Sheet and Plate.
 - c. ASTM C 177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
 - d. ASTM C 195 - Mineral Fiber Thermal Insulation Cement.
 - e. ASTM C 335 - Steady-State Heat Transfer Properties of Horizontal Pipe

- Insulation.
- f. ASTM C 449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.
 - g. ASTM C 518 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - h. ASTM C 533 - Calcium Silicate Block and Pipe Thermal Insulation.
 - i. ASTM C 534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - j. ASTM C 552 - Cellular Glass Block and Pipe Thermal Insulation.
 - k. ASTM C 553 - Mineral Fiber Blanket and Felt Insulation.
 - l. ASTM C 612 - Mineral Fiber Block and Board Thermal Insulation.
 - m. ASTM C 640 - Corkboard and Cork Pipe Thermal Insulation.
 - n. ASTM C 921 - Properties of Jacketing Materials for Thermal Insulation.
 - o. ASTM D 1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
 - p. ASTM E 96 - Water Vapor Transmission of Materials.
2. International Building Code (IBC) with the Denver Amendments.
 3. International Fire Code (IFC) with the Denver Amendments.

1.4 ACTION SUBMITTALS

- A. Submit product description, list of materials and thickness for each service, and locations.
- B. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied, if any).
 1. Include data substantiating that materials comply with requirements.
- C. LEED Submittals:
 1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
 2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that product complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 2. Detail attachment and covering of heat tracing inside insulation.
 3. Detail removable insulation at equipment connections and access panels.
 4. Detail application of field-applied jackets.
 5. Detail application at linkages of control devices.
 6. Detail field application for each equipment type.

- E. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
 - 1. Sheet Form Insulation Materials: 12 inches (300 mm) square.
 - 2. Sheet Jacket Materials: 12 inches (300 mm) square.
 - 3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.
- D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. "As Built" Plans shall be provided in the same format and manner as described above. Each set shall be equipped with a plan holder equal to "Stacor Plan Clamps" for the appropriate size drawings.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by DEN Project Manager. Use materials indicated for the completed Work.

1. Equipment Mockups: One tank or vessel, **[pump,]** <List additional equipment>.
2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
3. Notify DEN Project Manager seven (7) days in advance of dates and times when mockups will be constructed.
4. Obtain DEN Project Manager's approval of mockups before starting insulation application.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.
- B. Deliver, store, protect, and handle products under provisions of Section 220400 "Basic Plumbing Requirements" and Division 01.
- C. Store insulation in original wrapping and protect from weather and construction traffic.
- D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.9 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with equipment Installer for equipment insulation application.
- C. Coordinate installation and testing of heat tracing.

1.10 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Domestic Water Boiler Breeching Insulation Schedule" and "Equipment Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Calcium Silicate:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Industrial Insulation Group (IIG); Thermo-12 Gold.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
 2. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
- G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pittsburgh Corning Corporation; Foamglas.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
 2. Block Insulation: ASTM C 552, Type I.
 3. Special-Shaped Insulation: ASTM C 552, Type III.

4. Board Insulation: ASTM C 552, Type IV.
 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 6. Preformed Pipe Insulation with Factory-Applied **[ASJ] [ASJ-SSL]**: Comply with ASTM C 552, Type II, Class 2.
 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Sheet and K-FLEX LS.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
- I. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.
 - f. **<Insert manufacturer's name; product name or designation>**.
 - g. or approved equal.
- J. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Industrial Insulation Group (IIG); MinWool-1200 Flexible Batt.
 - b. Johns Manville; HTB 26 Spin-Glas.
 - c. Roxul Inc.; Roxul RW.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
- K. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation **[without factory-applied jacket] [with factory-applied ASJ] [with factory-applied FSK jacket]**. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following :
 - a. CertainTeed Corp.; CertaPro Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.
 - g. **<Insert manufacturer's name; product name or designation>**.
 - h. or approved equal.

- L. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; FBX.
 - b. Industrial Insulation Group (IIG); MinWool-1200 Industrial Board.
 - c. Rock Wool; Delta Board.
 - d. Roxul Inc.; RHT and RockBoard.
 - e. Thermafiber, Inc.; Thermafiber Industrial Felt.
 - f. **<Insert manufacturer's name; product name or designation>**.
 - g. or approved equal.

- M. Mineral-Fiber, Preformed Pipe Insulation:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - f. **<Insert manufacturer's name; product name or designation>**.
 - g. or approved equal.

 2. Type I, **850 Deg F** (454 Deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, **[without factory-applied jacket] [with factory-applied ASJ] [with factory-applied ASJ-SSL]**. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

- N. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied **[ASJ] [FSK jacket]** complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is **2.5 lb/cu. ft.** (40 kg/cu. m) or more. Thermal conductivity (k-value) at **100 deg F** (55 deg C) is **0.29 Btu x in./h x sq. ft. x deg F** (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.
 - f. **<Insert manufacturer's name; product name or designation>**.
 - g. or approved equal.

- O. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armacell LLC; Tubolit.
 - b. Nomaco Insulation; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Ramco Insulation, Inc.; Super-Stik.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.

- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Ramco Insulation, Inc.; Thermokote V.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.

- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of **50 to 800 deg F** (10 to 427 deg C).
- Products: Subject to compliance with requirements, provide one of the following:
 - Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.
 - Eagle Bridges - Marathon Industries; 290.
 - Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.
 - Mon-Eco Industries, Inc.; 22-30.
 - Vimasco Corporation; 760.
 - <Insert manufacturer's name; product name or designation>**.
 - or approved equal.
 - For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of **minus 100 to plus 200 deg F** (minus 73 to plus 93 deg C).
- Products: Subject to compliance with requirements, provide one of the following:
 - Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
 - <Insert manufacturer's name; product name or designation>**.
 - or approved equal.
 - For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- Products: Subject to compliance with requirements, provide one of the following:

- a. Aeroflex USA, Inc.; Aeroseal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

G. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, **0.013 perm** (0.009 metric perm) at **43-mil** (1.09-mm) dry film thickness.
3. Service Temperature Range: **Minus 20 to plus 180 deg F** (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
 - b. Eagle Bridges - Marathon Industries; 501.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
 - d. Mon-Eco Industries, Inc.; 55-10.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
 3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
 4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
 - b. Eagle Bridges - Marathon Industries; 570.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
 3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 5. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.

- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 - f. **<Insert manufacturer's name; product name or designation>**.
 - g. or approved equal.
2. Water-Vapor Permeance: ASTM F 1249, **1.8 perms** (1.2 metric perms) at **0.0625-inch** (1.6-mm) dry film thickness.
 3. Service Temperature Range: **Minus 20 to plus 180 deg F** (Minus 29 to plus 82 deg C).
 4. Solids Content: 60 percent by volume and 66 percent by weight.
 5. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
1. For indoor applications, use lagging adhesives that have a VOC content of **<Insert value>** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - c. Vimasco Corporation; 713 and 714.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over insulation.
 4. Service Temperature Range: **0 to plus 180 deg F** (Minus 18 to plus 82 deg C).
 5. Color: White.

2.6 SEALANTS

- A. Joint Sealants:
1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.

- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - f. **<Insert manufacturer's name; product name or designation>**.
 - g. or approved equal.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Permanently flexible, elastomeric sealant.
 4. Service Temperature Range: **Minus 100 to plus 300 deg F** (Minus 73 to plus 149 deg C).
 5. Color: White or gray.
 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: **Minus 40 to plus 250 deg F** (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

- b. **<Insert manufacturer's name; product name or designation>.**
 - c. or approved equal.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: **Minus 40 to plus 250 deg F** (Minus 40 to plus 121 deg C).
 5. Color: White.
 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 4. PVDC Jacket for Indoor Applications: **4-mil-** (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at **0.02 perm** (0.013 metric perm) when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 - 2) **<Insert manufacturer's name; product name or designation>.**
 - 3) or approved equal.
 5. PVDC Jacket for Outdoor Applications: **6-mil-** (0.15-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at **0.01 perm** (0.007 metric perm) when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

- 2) **<Insert manufacturer's name; product name or designation>**.
 - 3) or approved equal.
6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 - 2) **<Insert manufacturer's name; product name or designation>**.
 - 3) or approved equal.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately **6 oz./sq. yd.** (203 g/sq. m) with a thread count of **5 strands by 5 strands/sq. in.** (2 strands by 2 strands/sq. mm) for covering equipment.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
- B. Woven Polyester Fabric: Approximately **1 oz./sq. yd.** (34 g/sq. m) with a thread count of **10 strands by 10 strands/sq. in.** (4 strands by 4 strands/sq. mm), in a Leno weave, for equipment.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.

2.9 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of **8 oz./sq. yd.** (271 g/sq. m).
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.
 - b. **<Insert manufacturer's name; product name or designation>**.

- c. or approved equal.

2.10 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: **[White] [Color-code jackets based on system. Color as selected by DEN Project Manager]**.
 4. Factory-fabricated tank heads and tank side panels.
- C. Metal Jacket:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
 2. Aluminum Jacket: Comply with **ASTM B 209** (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. **[Sheet and roll stock ready for shop or field sizing] [Factory cut and rolled to size]**.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: **[1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper] [3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper] [2.5-mil- (0.063-mm-) thick polysurlyn]**.
 - d. Moisture Barrier for Outdoor Applications: **[3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper] [2.5-mil- (0.063-mm-) thick polysurlyn]**.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. **[Sheet and roll stock ready for shop or field sizing] [Factory cut and rolled to size].**
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: **[1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper] [3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper] [2.5-mil- (0.063-mm-) thick polysurlyn].**
 - d. Moisture Barrier for Outdoor Applications: **[3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper] [2.5-mil- (0.063-mm-) thick polysurlyn].**

2.11 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - e. **<Insert manufacturer's name; product name or designation>.**
 - f. or approved equal.
 2. Width: **3 inches** (75 mm).
 3. Thickness: **11.5 mils** (0.29 mm).
 4. Adhesion: **90 ounces force/inch** (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: **40 lbf/inch** (7.2 N/mm) in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 - e. **<Insert manufacturer's name; product name or designation>.**
 - f. or approved equal.
 2. Width: **3 inches** (75 mm).
 3. Thickness: **6.5 mils** (0.16 mm).

4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
 2. Width: 2 inches (50 mm).
 3. Thickness: 6 mils (0.15 mm).
 4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
 2. Width: 2 inches (50 mm).
 3. Thickness: 3.7 mils (0.093 mm).
 4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.
- E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape and Saran 560 Vapor Retarder Tape.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
 2. Width: 3 inches (75 mm).
 3. Film Thickness: [4 mils (0.10 mm)] [6 mils (0.15 mm)].

4. Adhesive Thickness: 1.5 mils (0.04 mm).
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch (10.1 N/mm) in width.

2.12 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
 - c. <Insert manufacturer's name; product name or designation>.
 - d. or approved equal.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, [Type 304] [or] [Type 316]; 0.015 inch (0.38 mm) thick, [1/2 inch (13 mm)] [3/4 inch (19 mm)] wide with [wing seal] [or] [closed seal].
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, [1/2 inch (13 mm)] [3/4 inch (19 mm)] wide with [wing seal] [or] [closed seal].
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, [0.106-inch- (2.6-mm-)] [0.135-inch- (3.5-mm-)] diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
 - 5) <Insert manufacturer's name; product name or designation>.
 - 6) or approved equal.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, [0.106-inch- (2.6-mm-)] [0.135-inch- (3.5-mm-)] diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CHP-1.

- 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
 - 5) **<Insert manufacturer's name; product name or designation>**.
 - 6) or approved equal.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - 4) **<Insert manufacturer's name; product name or designation>**.
 - 5) or approved equal.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, **0.030 inch** (0.76 mm) thick by **2 inches** (50 mm) square.
 - c. Spindle: [**Copper- or zinc-coated, low-carbon steel**] [**Aluminum**] [**Stainless steel**], fully annealed, **0.106-inch-** (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - 3) **<Insert manufacturer's name; product name or designation>**.
 - 4) or approved equal.
 - b. Baseplate: Perforated, nylon sheet, **0.030 inch** (0.76 mm) thick by **1-1/2 inches** (38 mm) in diameter.
 - c. Spindle: Nylon, **0.106-inch-** (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to **2-1/2 inches** (63 mm).
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
 - 2) GEMCO; Peel & Press.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - 4) **<Insert manufacturer's name; product name or designation>**.
 - 5) or approved equal.
 - b. Baseplate: Galvanized carbon-steel sheet, **0.030 inch** (0.76 mm) thick by **2 inches** (50 mm) square.
 - c. Spindle: [**Copper- or zinc-coated, low-carbon steel**] [**Aluminum**] [**Stainless steel**], fully annealed, **0.106-inch-** (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from **0.016-inch-** (0.41-mm-) thick, [**galvanized-steel**] [**aluminum**] [**stainless-steel**] sheet, with beveled edge sized as required to hold insulation securely in place but not less than **1-1/2 inches** (38 mm) in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; RC 150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - 5) **<Insert manufacturer's name; product name or designation>**.
 - 6) or approved equal.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from **0.016-inch-** (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than **1-1/2 inches** (38 mm) in diameter.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
 - 3) **<Insert manufacturer's name>**.
 - 4) or approved equal.

- C. Staples: Outward-clinching insulation staples, nominal **3/4-inch-** (19-mm-) wide, stainless steel or Monel.
- D. Wire: **[0.080-inch (2.0-mm) nickel-copper alloy] [0.062-inch (1.6-mm) soft-annealed, stainless steel] [0.062-inch (1.6-mm) soft-annealed, galvanized steel]**.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.

2.13 CORNER ANGLES

- A. PVC Corner Angles: **30 mils** (0.8 mm) thick, minimum **1 by 1 inch** (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: **0.040 inch** (1.0 mm) thick, minimum **1 by 1 inch** (25 by 25 mm), aluminum according to **ASTM B 209** (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: **0.024 inch** (0.61 mm) thick, minimum **1 by 1 inch** (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, **[Type 304] [or] [Type 316]**.

PART 3 - EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesive and insulation.

3.2 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer **5 mils** (0.127 mm) thick and an epoxy finish **5 mils** (0.127 mm) thick if operating in a temperature range between **140 and 300 deg F** (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature between **32 and 300 deg F** (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.4 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes according to manufacturer's written instructions and requirements and N.I.C.A standards with smooth, straight, and even surfaces; free of voids throughout the length of equipment, including fittings, valves, and specialties.
- B. Do not insulate factory insulated equipment.
- C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item as specified in insulation system schedules.
- D. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- E. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- F. Install multiple layers of insulation with longitudinal and end seams staggered.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.

- J. On exposed equipment, locate insulation and cover seams in least visible locations.
- K. Apply insulation as close as possible to equipment by grooving, scoring, and beveling insulation. Secure insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- L. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- M. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
1. Install insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- N. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- O. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with **3 inch- (75-mm-)** wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced **4 inches (100 mm)** o.c.
 3. Overlap jacket longitudinal seams at least **1-1/2 inches (38 mm)**. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [**2 inches (50 mm)**] [**4 inches (100 mm)**] o.c.
 - a. For below ambient services, apply vapor-barrier mastics over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.
- P. Insulated dual temperature equipment or cold equipment containing fluids below ambient temperature:
1. Provide vapor barrier jackets, factory applied or field applied.
 2. Finish with glass cloth and vapor barrier adhesive.

3. Insulate entire system.
4. Where staples are used to secure insulation covering requiring vapor barrier, the staples shall be sealed with a vapor barrier mastic.

Q. For insulated equipment containing fluids above ambient temperature:

1. Provide standard jackets, with or without vapor barrier, factory applied or field applied.
2. Finish with glass cloth and adhesive.
3. For hot equipment containing fluids 140 degrees F or less, do not insulate flanges and unions, but bevel and seal ends of insulation.
4. For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.

R. Inserts and Shields:

1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between hangers and inserts.
3. Insert location: Between support shield and equipment and under the finish jacket.
4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert material: ASTM C640 cork, hydrous calcium silicate insulation, or other heavy density insulating material suitable for the planned temperature range.

S. Finish insulation at supports, protrusions, and interruptions.

T. For equipment in mechanical equipment rooms or in finished spaces, finish with PVC jacket and fitting covers.

U. For exterior applications, provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal equipment.

V. Cover glass fiber, cellular glass, or cellular foam insulation with metal mesh and finish with heavy coat of insulating cement.

W. Install insulation for equipment requiring access for maintenance, repair, or cleaning, in such a manner that it can be easily removed and replaced without damage.

X. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.

Y. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

Z. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

AA. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least **4 inches (100 mm)** beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

BB. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.5 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

A. Mineral-Fiber, Pipe, and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for **[100] [50] <Insert number>** percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is **3 inches (75 mm)** from insulation end joints, and **16 inches (400 mm)** o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately **6 inches (150 mm)** from each end. Install wire or cable between two circumferential girdles **12**

- inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches (75 mm).
 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply [100] [50] <Insert number> percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 2. Seal longitudinal seams and end joints.
- C. Insulation Installation on Pumps:
1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch (150-mm) centers, starting at corners. Install 3/8-inch- (10-mm-) diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
 2. Fabricate boxes from [galvanized steel] [aluminum] [stainless steel], at least [0.040 inch (1.0 mm)] [0.050 inch (1.3 mm)] [0.060 inch (1.6 mm)] thick.
 3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.
- ### 3.6 INSTALLATION OF CALCIUM SILICATE INSULATION
- A. Insulation Installation on Domestic Water Boiler Breechings:
1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation material.
 2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.
 3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch (25 mm). Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.
- E. Where PVDC jackets are indicated, install as follows:
1. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches (850 mm) or less. 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.

2. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.9 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: [**Two**] <Insert number> finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

- a. Finish Coat Material: Interior, flat, latex-emulsion size.

- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by DEN Project Manager. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.

- B. Perform tests and inspections.

- C. Tests and Inspections:

1. Inspect field-insulated equipment, randomly selected by DEN Project Manager, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to [**one**] <Insert number> location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 DOMESTIC WATER BOILER BREECHING INSULATION SCHEDULE

- A. Round, exposed breeching and connector insulation shall be [**one of**] the following:

1. Calcium Silicate: **4 inches** (100 mm) thick.

2. High-Temperature Mineral-Fiber Blanket: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
3. High-Temperature Mineral-Fiber Board: 3 inches (75 mm) thick and [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

B. Round, concealed breeching and connector insulation shall be[**one of**] the following:

1. Calcium Silicate: 4 inches (100 mm) thick.
2. High-Temperature Mineral-Fiber Blanket: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
3. High-Temperature Mineral-Fiber Board: 3 inches (75 mm) thick and [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

C. Rectangular, exposed breeching and connector insulation shall be[**one of**] the following:

1. Calcium Silicate: 4 inches (100 mm) thick.
2. High-Temperature Mineral-Fiber Blanket: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
3. High-Temperature Mineral-Fiber Board: 3 inches (75 mm) thick and [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

D. Rectangular, concealed breeching and connector insulation shall be[**one of**] the following:

1. Calcium Silicate: 4 inches (100 mm) thick.
2. High-Temperature Mineral-Fiber Blanket: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
3. High-Temperature Mineral-Fiber Board: 3 inches (75 mm) thick and [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

3.12 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment that is not factory insulated.

C. Heat-exchanger (water-to-water for domestic water heating service) insulation shall be[**one of**] the following:

1. Calcium Silicate: [3 inches (75 mm)] <Insert dimension> thick.
2. Cellular Glass: [3 inches (75 mm)] <Insert dimension> thick.
3. Mineral-Fiber Blanket: [2 inches (50 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
4. Mineral-Fiber Board: [2 inches (50 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

5. Mineral-Fiber Pipe and Tank: [2 inches (50 mm)] <Insert dimension> thick.
6. Mineral-Fiber Preformed Pipe Insulation, Type I: [2 inches (50 mm)] <Insert dimension> thick.

D. Steam-to-hot-water converter insulation shall be [one of] the following:

1. Calcium Silicate: [3 inches (75 mm)] <Insert dimension> thick.
2. Cellular Glass: [3 inches (75 mm)] <Insert dimension> thick.
3. Mineral-Fiber Blanket: [2 inches (50 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
4. Mineral-Fiber Board: [2 inches (50 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
5. Mineral-Fiber Pipe and Tank: [2 inches (50 mm)] <Insert dimension> thick.
6. Mineral-Fiber Preformed Pipe Insulation, Type I: [2 inches (50 mm)] <Insert dimension> thick.

E. Domestic water pump insulation shall be [one of] the following:

1. Cellular Glass: [2 inches (50 mm)] <Insert dimension> thick.
2. Mineral-Fiber Blanket: [1 inch (25 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
3. Mineral-Fiber Board: [1 inch (25 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

F. Domestic chilled-water (potable) pump insulation shall be [one of] the following:

1. Cellular Glass: [3 inches (75 mm)] <Insert dimension> thick.
2. Mineral-Fiber Blanket: [2 inches (50 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
3. Mineral-Fiber Board: [2 inches (50 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

G. Domestic hot-water pump insulation shall be [one of] the following:

1. Cellular Glass: [2 inches (50 mm)] <Insert dimension> thick.
2. Mineral-Fiber Blanket: [1 inch (25 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
3. Mineral-Fiber Board: [1 inch (25 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

H. Domestic water, domestic chilled-water (potable), and domestic hot-water hydropneumatic tank insulation shall be [one of] the following:

1. Cellular Glass: [1-1/2 inches (38 mm)] <Insert dimension> thick.
2. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.

3. Mineral-Fiber Blanket: [1 inch (25 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
 4. Mineral-Fiber Board: [1 inch (25 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
 5. Mineral-Fiber Pipe and Tank: [1 inch (25 mm)] <Insert dimension> thick.
 6. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.
- I. Domestic hot-water storage tank insulation shall be [one of] the following, of thickness to provide an R-value of [12.5] <Insert value>:
1. Cellular glass.
 2. Mineral-Fiber Blanket: [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
 3. Mineral-Fiber Board: [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
 4. Mineral-fiber pipe and tank.
- J. Domestic water storage tank insulation shall be [one of] the following:
1. Cellular Glass: [2 inches (50 mm)] <Insert dimension> thick.
 2. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
 3. Mineral-Fiber Blanket: [1 inch (25 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
 4. Mineral-Fiber Board: [1 inch (25 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
 5. Mineral-Fiber Pipe and Tank: [1 inch (25 mm)] <Insert dimension> thick.
 6. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.
- K. Domestic chilled-water (potable) storage tank insulation shall be [one of] the following:
1. Cellular Glass: [2 inches (50 mm)] <Insert dimension> thick.
 2. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
 3. Mineral-Fiber Blanket: [1 inch (25 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
 4. Mineral-Fiber Board: [1 inch (25 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
 5. Mineral-Fiber Pipe and Tank: [1 inch (25 mm)] <Insert dimension> thick.
 6. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.
- L. Domestic water filter-housing insulation shall be [one of] the following:
1. Cellular Glass: [3 inches (75 mm)] <Insert dimension> thick.
 2. Mineral-Fiber Blanket: [2 inches (50 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
 3. Mineral-Fiber Board: [2 inches (50 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
 4. Mineral-Fiber Pipe and Tank: [2 inches (50 mm)] <Insert dimension> thick.

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Concealed:
1. None.
 2. **[PVC] [PVC, Color-Coded by System]: [20 mils (0.5 mm)] [30 mils (0.8 mm)]** thick.
 3. Aluminum, **[Smooth] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)]** thick.
 4. Painted Aluminum, **[Smooth] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)]** thick.
 5. Stainless Steel, **[Type 304] [or] [Type 316], [Smooth 2B Finish] [Corrugated] [Stucco Embossed]: [0.010 inch (0.25 mm)] [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)]** thick.
 6. **<Insert jacket type>**.
- D. Equipment, Exposed, up to **48 Inches (1200 mm)** in Diameter or with Flat Surfaces up to **72 Inches (1800 mm)**:
1. None.
 2. **[PVC] [PVC, Color-Coded by System]: [20 mils (0.5 mm)] [30 mils (0.8 mm)]** thick.
 3. Aluminum, **[Smooth] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)]** thick.
 4. Painted Aluminum, **[Smooth] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)]** thick.
 5. Stainless Steel, **[Type 304] [or] [Type 316], [Smooth 2B Finish] [Corrugated] [Stucco Embossed]: [0.010 inch (0.25 mm)] [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)]** thick.
 6. **<Insert jacket type>**.
- E. Equipment, Exposed, Larger Than **48 Inches (1200 mm)** in Diameter or with Flat Surfaces Larger Than **72 Inches (1800 mm)**:
1. None.
 2. **[Painted]Aluminum, [Smooth] [Stucco Embossed] with [1-1/4-Inch- (32-mm-) Deep Corrugations] [2-1/2-Inch- (65-mm-) Deep Corrugations] [4-by-1-Inch (100-by-25-mm) Box Ribs]: [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)]** thick.
 3. Stainless Steel, **[Type 304] [or] [Type 316], [Smooth] [Stucco Embossed], with [1-1/4-Inch- (32-mm-) Deep Corrugations] [2-1/2-Inch- (65-mm-) Deep**

- Corrugations**] [4-by-1-Inch (100-by-25-mm) **Box Ribs**]: [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] thick.
4. <Insert jacket type>.

3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Concealed:
1. None.
 2. **[PVC]** [**PVC, Color-Coded by System**]: [20 mils (0.5 mm)] [30 mils (0.8 mm)] thick.
 3. Aluminum, [**Smooth**] [**Corrugated**] [**Stucco Embossed**]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
 4. Painted Aluminum, [**Smooth**] [**Corrugated**] [**Stucco Embossed**]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] thick.
 5. Stainless Steel, [**Type 304**] [or] [**Type 316**], [**Smooth 2B Finish**] [**Corrugated**] [**Stucco Embossed**]: [0.010 inch (0.25 mm)] [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] thick.
 6. <Insert jacket type>.
- D. Equipment, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):
1. [**Painted**] Aluminum, [**Smooth**] [**Corrugated**] [**Stucco Embossed**] [**with Z-Shaped Locking Seam**]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
 2. Stainless Steel, [**Type 304**] [or] [**Type 316**], [**Smooth 2B Finish**] [**Corrugated**] [**Stucco Embossed**] [**with Z-Shaped Locking Seam**]: [0.010 inch (0.25 mm)] [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] thick.
 3. <Insert jacket type>.
- E. Equipment, Exposed, Larger Than 48 Inches (1200 mm) in Diameter or with Flat Surfaces Larger Than 72 Inches (1800 mm):
1. [**Painted**] Aluminum, [**Smooth**] [**Stucco Embossed**] with [1-1/4-Inch- (32-mm-) **Deep Corrugations**] [2-1/2-Inch- (65-mm-) **Deep Corrugations**] [4-by-1-Inch (100-by-25-mm) **Box Ribs**]: [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
 2. Stainless Steel, [**Type 304**] [or] [**Type 316**], [**Smooth**] [**Stucco Embossed**], with [1-1/4-Inch- (32-mm-) **Deep Corrugations**] [2-1/2-Inch- (65-mm-) **Deep Corrugations**] [4-by-1-Inch (100-by-25-mm) **Box Ribs**]: [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] thick.
 3. <Insert jacket type>.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION **220716**

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Domestic recirculating hot-water piping.
 - 4. Domestic chilled-water piping for drinking fountains.
 - 5. Sanitary waste piping exposed to freezing conditions.
 - 6. Storm-water piping exposed to freezing conditions.
 - 7. Roof drains and rainwater leaders.
 - 8. Supplies and drains for handicap-accessible lavatories and sinks.
- B. Related Sections:
 - 1. Section 220400 "Basic Plumbing Requirements".
 - 2. Section 220529 "Hangers and Supports for Plumbing Piping and Equipment".
 - 3. Section 220533 "Heat Tracing for Plumbing Piping".
 - 4. Section 220553 "Identification for Plumbing Piping and Equipment".
 - 5. Section 220716 "Plumbing Equipment Insulation."

1.3 REFERENCES

- A. Materials and workmanship shall conform to the latest issue of all industry standards, publications, or regulations referenced in this section and with the following references as applicable. Refer to Section 014200 "References" for listing of issuing organizations or agencies.
 - 1. Applicable Standards:
 - a. American Society for Testing and Materials (ASTM):
 - b. A666 – Austenitic Stainless Steel, Strip, Plate, and Flat Bar.
 - c. B209/B209M – Aluminum and Aluminum-Alloy Sheet and Plate.
 - d. C195 – Mineral Fiber Thermal Insulating Cement.
 - e. C196 – Expanded or Exfoliated Vermiculite Thermal Insulating Cement.
 - f. C449/C449M – Mineral Fiber Hydraulic-Setting Thermal Insulating and

- Finish Cement.
- g. C533 – Calcium Silicate Block and Pipe Thermal Insulation.
 - h. C534 – Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - i. C547 – Mineral Fiber Preformed Pipe Insulation.
 - j. C552 – Cellular Glass Block and Pipe Thermal Insulation.
 - k. C553 – Mineral Fiber Blanket and Felt Insulation for Commercial and Industrial Applications.
 - l. C578 - Preformed, Block Type Cellular Polystyrene Thermal Insulation.
 - m. C610 - Expanded Perlite Block and Pipe Thermal Insulation.
 - n. C612 – Mineral Fiber Block and Board Thermal Insulation.
 - o. C921 – Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 - p. C1126 – Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
 - q. E84 – Test Method for Surface Burning Characteristics of Building Materials.

- 2. International Building Code (IBC) with the Denver Amendments.
- 3. International Fire Code (IFC) with the Denver Amendments.

- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.4 ACTION SUBMITTALS

- A. Submit product description, list of materials and thickness for each service, and locations.
- B. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).
 - 1. Include data substantiating that materials comply with requirements.
- C. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
 - 2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that product complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.

3. Detail insulation application at pipe expansion joints for each type of insulation.
 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 6. Detail application of field-applied jackets.
 7. Detail application at linkages of control devices.
- E. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
1. Preformed Pipe Insulation Materials: **12 inches** (300 mm) long by **NPS 2** (DN 50).
 2. Jacket Materials for Pipe: **12 inches** (300 mm) long by **NPS 2** (DN 50).
 3. Sheet Jacket Materials: **12 inches** (300 mm) square.
 4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.
- D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. "As Built" Plans shall be provided in the same format and manner as described above. Each set shall be equipped with a plan holder equal to "Stacor Plan Clamps" for the appropriate size drawings.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by DEN Project Manager. Use materials indicated for the completed Work.
1. Piping Mockups:
 - a. One 10-foot (3-m) section of NPS 2 (DN 50) straight pipe.
 - b. One each of a 90-degree threaded, welded, and flanged elbow.
 - c. One each of a threaded, welded, and flanged tee fitting.
 - d. One NPS 2 (DN 50) or smaller valve, and one NPS 2-1/2 (DN 65) or larger valve.
 - e. Four support hangers including hanger shield and insert.
 - f. One threaded strainer and one flanged strainer with removable portion of insulation.
 - g. One threaded reducer and one welded reducer.
 - h. One pressure temperature tap.
 - i. One mechanical coupling.
 2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
 3. Notify DEN Project Manager seven (7) days in advance of dates and times when mockups will be constructed.
 4. Obtain DEN Project Manager's approval of mockups before starting insulation application.
 5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless DEN Project Manager specifically approves such deviations in writing.
 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 7. Demolish and remove mockups when directed.
- D. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

- B. Deliver, store, protect, and handle products under provisions of Section 220400 "Basic Plumbing Requiements" and Division 01.
- C. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- D. Store insulation in original wrapping and protect from weather and construction traffic.
- E. Protect insulation against dirt, water, chemical, and mechanical damage.

1.9 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.10 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pittsburgh Corning Corporation; Foamglas.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
 2. Block Insulation: ASTM C 552, Type I.
 3. Special-Shaped Insulation: ASTM C 552, Type III.
 4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 5. Preformed Pipe Insulation with Factory-Applied **[ASJ]** **[ASJ-SSL]**: Comply with ASTM C 552, Type II, Class 2.
 6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
- H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.

- f. **<Insert manufacturer's name; product name or designation>.**
 - g. or approved equal.
- I. Mineral-Fiber, Preformed Pipe Insulation:
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - f. **<Insert manufacturer's name; product name or designation>.**
 - g. or approved equal.
 - 2. Type I, **850 Deg F** (454 Deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, **[without factory-applied jacket] [with factory-applied ASJ] [with factory-applied ASJ-SSL]**. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- J. Phenolic:
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Kingspan Tarec Industrial Insulation NV; Koolphen K.
 - b. Resolco International BV; Insul-phen.
 - c. **<Insert manufacturer's name; product name or designation>.**
 - d. or approved equal.
 - 2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
 - 3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
 - 4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
 - 5. Factory-Applied Jacket: **[None] [ASJ]**. Requirements are specified in "Factory-Applied Jackets" Article.
- K. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armacell LLC; Tubolit.
 - b. Nomaco Insulation; IMCOLOCK and NOMALOCK.
 - c. **<Insert manufacturer's name; product name or designation>.**
 - d. or approved equal.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Ramco Insulation, Inc.; Super-Stik.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Ramco Insulation, Inc.; Thermokote V.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of **minus 100 to plus 200 deg F** (minus 73 to plus 93 deg C).
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aero seal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of **minus 75 to plus 300 deg F** (minus 59 to plus 149 deg C).
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-96.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-33.
 - c. **<Insert manufacturer's name; product name or designation>**.

- d. or approved equal.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- G. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
- Products: Subject to compliance with requirements, provide one of the following:
 - Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - Vimasco Corporation; 749.
 - <Insert manufacturer's name; product name or designation>**.
 - or approved equal.
 - Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, **0.013 perm** (0.009 metric perm) at **43-mil** (1.09-mm) dry film thickness.
 - Service Temperature Range: **Minus 20 to plus 180 deg F** (Minus 29 to plus 82 deg C).
 - Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
- Products: Subject to compliance with requirements, provide one of the following:
 - Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
 - Eagle Bridges - Marathon Industries; 501.
 - Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
 - Mon-Eco Industries, Inc.; 55-10.
 - <Insert manufacturer's name; product name or designation>**.
 - or approved equal.
 - Water-Vapor Permeance: ASTM F 1249, **0.05 perm** (0.03 metric perm) at **35-mil** (0.9-mm) dry film thickness.
 - Service Temperature Range: **0 to 180 deg F** (Minus 18 to plus 82 deg C).
 - Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 - Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
- Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
 - b. Eagle Bridges - Marathon Industries; 570.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
2. Water-Vapor Permeance: ASTM F 1249, **0.05 perm** (0.033 metric perm) at **30-mil** (0.8-mm) dry film thickness.
 3. Service Temperature Range: **Minus 50 to plus 220 deg F** (Minus 46 to plus 104 deg C).
 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 5. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 - f. **<Insert manufacturer's name; product name or designation>**.
 - g. or approved equal.
 2. Water-Vapor Permeance: ASTM F 1249, **1.8 perms** (1.2 metric perms) at **0.0625-inch** (1.6-mm) dry film thickness.
 3. Service Temperature Range: **Minus 20 to plus 180 deg F** (Minus 29 to plus 82 deg C).
 4. Solids Content: 60 percent by volume and 66 percent by weight.
 5. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.

- b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - c. Vimasco Corporation; 713 and 714.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
 4. Service Temperature Range: **0 to plus 180 deg F** (Minus 18 to plus 82 deg C).
 5. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass and Phenolic Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - f. **<Insert manufacturer's name; product name or designation>**.
 - g. or approved equal.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: **Minus 100 to plus 300 deg F** (Minus 73 to plus 149 deg C).
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.

- d. Mon-Eco Industries, Inc.; 44-05.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: **Minus 40 to plus 250 deg F** (Minus 40 to plus 121 deg C).
 5. Color: Aluminum.
 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: **Minus 40 to plus 250 deg F** (Minus 40 to plus 121 deg C).
 5. Color: White.
 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately **2 oz./sq. yd.** (68 g/sq. m) with a thread count of **10 strands by 10 strands/sq. in.** (4 strands by 4 strands/sq. mm) for covering pipe and pipe fittings.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas Number 10.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.
- B. Woven Polyester Fabric: Approximately **1 oz./sq. yd.** (34 g/sq. m) with a thread count of **10 strands by 10 strands/sq. in.** (4 strands by 4 strands/sq. mm), in a Leno weave, for pipe.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.

2.9 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of **8 oz./sq. yd.** (271 g/sq. m).
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.
 - b. **<Insert manufacturer's name; product name or designation>**.
 - c. or approved equal.

2.10 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.

- b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: **[White] [Color-code jackets based on system. Color as selected by DEN Project Manager]**.
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- C. Metal Jacket:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
 2. Aluminum Jacket: Comply with **ASTM B 209 (ASTM B 209M)**, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. **[Sheet and roll stock ready for shop or field sizing] [Factory cut and rolled to size]**.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: **[1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper] [3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper] [2.5-mil- (0.063-mm-) thick polysurlyn]**.
 - d. Moisture Barrier for Outdoor Applications: **[3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper] [2.5-mil- (0.063-mm-) thick polysurlyn]**.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.

- 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. **[Sheet and roll stock ready for shop or field sizing] [Factory cut and rolled to size].**
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: **[1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper] [3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper] [2.5-mil- (0.063-mm-) thick polysurlyn].**
 - d. Moisture Barrier for Outdoor Applications: **[3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper] [2.5-mil- (0.063-mm-) thick polysurlyn].**
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
 - D. Underground Direct-Buried Jacket: **125-mil- (3.2-mm-) thick** vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pittsburgh Corning Corporation; Pittwrap.
 - b. Polyguard Products, Inc.; Insulrap No Torch 125.
 - c. **<Insert manufacturer's name; product name or designation>.**
 - d. or approved equal.
- ## 2.11 TAPES
- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.

- c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
 2. Width: **3 inches** (75 mm).
 3. Thickness: **11.5 mils** (0.29 mm).
 4. Adhesion: **90 ounces force/inch** (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: **40 lbf/inch** (7.2 N/mm) in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
 2. Width: **3 inches** (75 mm).
 3. Thickness: **6.5 mils** (0.16 mm).
 4. Adhesion: **90 ounces force/inch** (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: **40 lbf/inch** (7.2 N/mm) in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 - d. **<Insert manufacturer's name; product name or designation>**.
 - e. or approved equal.
 2. Width: **2 inches** (50 mm).
 3. Thickness: **6 mils** (0.15 mm).
 4. Adhesion: **64 ounces force/inch** (0.7 N/mm) in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: **18 lbf/inch** (3.3 N/mm) in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
 - e. **<Insert manufacturer's name; product name or designation>**.
 - f. or approved equal.
2. Width: **2 inches** (50 mm).
3. Thickness: **3.7 mils** (0.093 mm).
4. Adhesion: **100 ounces force/inch** (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: **34 lbf/inch** (6.2 N/mm) in width.

2.12 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping and Seals.
 - c. **<Insert manufacturer's name; product name or designation>**.
 - d. or approved equal.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, [**Type 304**] [**or**] [**Type 316**]; **0.015 inch** (0.38 mm) thick, [**1/2 inch** (13 mm)] [**3/4 inch** (19 mm)] wide with [**wing seal**] [**or**] [**closed seal**].
3. Aluminum: **ASTM B 209** (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, **0.020 inch** (0.51 mm) thick, [**1/2 inch** (13 mm)] [**3/4 inch** (19 mm)] wide with [**wing seal**] [**or**] [**closed seal**].

B. Staples: Outward-clinching insulation staples, nominal **3/4-inch-** (19-mm-) wide, stainless steel or Monel.

C. Wire: [**0.080-inch** (2.0-mm) **nickel-copper alloy**] [**0.062-inch** (1.6-mm) **soft-annealed, stainless steel**] [**0.062-inch** (1.6-mm) **soft-annealed, galvanized steel**].

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.

2.13 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers, **<Insert drawing designation>**:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Engineered Brass Company.
 - b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing.
 - d. Plumberex.
 - e. Truebro; a brand of IPS Corporation.
 - f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
 2. Description: Manufactured plastic wraps for covering plumbing fixture **[hot-water supply] [hot- and cold-water supplies]** and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures, **<Insert drawing designation>**:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Truebro; a brand of IPS Corporation.
 - b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.
 2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

3.2 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer **5 mils** (0.127 mm) thick and an epoxy finish **5 mils** (0.127 mm) thick if operating in a temperature range between **140 and 300 deg F** (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature between **32 and 300 deg F** (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.4 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes according to the manufacturer's written instructions and N.I.C.A standards, with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.

- J. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- K. Hangers and Anchors: Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
1. Install insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs at least 12 inches (300 mm) from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
 5. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- M. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Circumferential Joints: Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 3. Longitudinal Seams: Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [2 inches (50 mm)] [4 inches (100 mm)] o.c.
 - a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
 - b. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
 5. At penetrations in jackets for thermometers and pressure gauges, fill and seal voids with vapor-retarder mastic.
 6. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.

7. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- Q. For above-ambient services, do not install insulation to the following:
 1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Cleanouts.

3.5 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
 4. Seal jacket to wall flashing with flashing sealant.

- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.6 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.7 INSTALLATION OF CELLULAR-GLASS INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at **6 inches (150 mm)** o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least **1 inch (25 mm)**, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at **6 inches (150 mm)** o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least **1 inch (25 mm)**, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.10 INSTALLATION OF PHENOLIC INSULATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless-steel bands at **12-inch (300-mm)** intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least **3 inches (75 mm)**. Secure inner layer with **0.062-inch (1.6-mm)** wire spaced at **12-inch (300-mm)** intervals. Secure outer layer with stainless-steel bands at **12-inch (300-mm)** intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at **6 inches (150 mm)** o.c.
4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.11 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.12 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.
- E. Jacket Applications:
 1. Indoor, Concealed Applications: Insulated pipes conveying fluids above ambient temperature shall have standard jackets, with vapor barrier, factory-applied or field-applied. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass cloth and adhesive. PVC jackets may be used if in accordance with specified flame spread and smoke developed limitations.
 2. Indoor, Concealed Applications: Insulated dual-temperature pipes or pipes conveying fluids below ambient temperature shall have vapor barrier jackets, factory-applied or field-applied. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe, and finish with glass cloth and vapor barrier adhesive.

3. Indoor, Exposed Applications: For pipe exposed in mechanical equipment rooms or in finished spaces, insulate as for concealed applications. Finish with reinforced white kraft and aluminum foil laminates. **[Do not use PVC jackets.]**
4. Exterior Applications: Provide vapor barrier jackets. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement.
5. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

3.13 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 1. Flat Acrylic Finish: **[Two]** <Insert number> finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by DEN Project Manager. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.14 FIELD QUALITY CONTROL

- A. Testing Agency: **[Owner will engage]** **[Engage]** a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 1. Inspect pipe, fittings, strainers, and valves, randomly selected by DEN Project Manager, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to **[three]** <Insert number> locations of straight pipe, **[three]** <Insert number> locations of threaded fittings, **[three]** <Insert number> locations of welded fittings, **[two]** <Insert number> locations of threaded strainers, **[two]** <Insert number> locations of welded strainers, **[three]** <Insert number> locations of threaded

valves, and [three] <Insert number> locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.15 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Drainage piping located in crawl spaces.
 2. Underground piping.
 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.16 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. [NPS 1 (DN 25)] <Insert pipe size> and Smaller: Insulation shall be [one of] the following:
 - a. Cellular Glass: [1-1/2 inches (38 mm)] <Insert dimension> thick.
 - b. Flexible Elastomeric: [1/2 inch (13 mm)] [3/4 inch (19 mm)] [1 inch (25 mm)] <Insert dimension> thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: [1/2 inch (13 mm)] [1 inch (25 mm)] <Insert dimension> thick.
 - d. Phenolic: [1 inch (25 mm)] <Insert dimension> thick.
 - e. Polyolefin: [1/2 inch (13 mm)] [3/4 inch (19 mm)] [1 inch (25 mm)] <Insert dimension> thick.
2. [NPS 1-1/4 (DN 32)] <Insert pipe size> and Larger: Insulation shall be [one of] the following:
 - a. Cellular Glass: [1-1/2 inches (38 mm)] <Insert dimension> thick.
 - b. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: [1 inch (25 mm)] <Insert dimension> thick.
 - d. Phenolic: [1 inch (25 mm)] <Insert dimension> thick.
 - e. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.

B. Domestic Hot and Recirculated Hot Water:

1. [NPS 1-1/4 (DN 32)] <Insert pipe size> and Smaller: Insulation shall be [one of] the following:

- a. Cellular Glass: [1-1/2 inches (38 mm)] <Insert dimension> thick.
 - b. Flexible Elastomeric: [3/4 inch (19 mm)] [1 inch (25 mm)] <Insert dimension> thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: [1/2 inch (13 mm)] [1 inch (25 mm)] <Insert dimension> thick.
 - d. Phenolic: [1 inch (25 mm)] <Insert dimension> thick.
 - e. Polyolefin: [3/4 inch (19 mm)] [1 inch (25 mm)] <Insert dimension> thick.
2. [NPS 1-1/2 (DN 40)] <Insert pipe size> and Larger: Insulation shall be [one of] the following:
- a. Cellular Glass: [1-1/2 inches (38 mm)] <Insert dimension> thick.
 - b. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: [1 inch (25 mm)] <Insert dimension> thick.
 - d. Phenolic: [1 inch (25 mm)] <Insert dimension> thick.
 - e. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.
- C. Domestic Chilled Water (Potable):
1. All Pipe Sizes: Insulation shall be [one of] the following:
 - a. Cellular Glass: [1-1/2 inches (38 mm)] <Insert dimension> thick.
 - b. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: [1 inch (25 mm)] <Insert dimension> thick.
 - d. Phenolic: [1 inch (25 mm)] <Insert dimension> thick.
 - e. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.
- D. Stormwater and Overflow:
1. All Pipe Sizes: Insulation shall be [one of] the following:
 - a. Cellular Glass: [1-1/2 inches (38 mm)] <Insert dimension> thick.
 - b. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: [1 inch (25 mm)] <Insert dimension> thick.
 - d. Phenolic: [1 inch (25 mm)] <Insert dimension> thick.
 - e. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.
- E. Roof Drain and Overflow Drain Bodies:
1. All Pipe Sizes: Insulation shall be [one of] the following:
 - a. Cellular Glass: [1-1/2 inches (38 mm)] <Insert dimension> thick.
 - b. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: [1 inch (25 mm)] <Insert dimension> thick.
 - d. Phenolic: [1 inch (25 mm)] <Insert dimension> thick.
 - e. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.

- F. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
1. All Pipe Sizes: Insulation shall be[**one of**] the following:
 - a. Flexible Elastomeric: [1/2 inch (13 mm)] [3/4 inch (19 mm)] [1 inch (25 mm)] **<Insert dimension>** thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: [1/2 inch (13 mm)] [1 inch (25 mm)] **<Insert dimension>** thick.
 - c. Polyolefin: [1/2 inch (13 mm)] [3/4 inch (19 mm)] [1 inch (25 mm)] **<Insert dimension>** thick.
- G. Sanitary Waste Piping Where Heat Tracing Is Installed:
1. All Pipe Sizes: Insulation shall be[**one of**] the following:
 - a. Cellular Glass: [2 inches (50 mm)] **<Insert dimension>** thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: [1-1/2 inches (38 mm)] **<Insert dimension>** thick.
 - c. Phenolic: [1-1/2 inches (38 mm)] **<Insert dimension>** thick.
- H. Floor Drains, Traps, and Sanitary Drain Piping within [10 Feet (3 m)] **<Insert distance>** of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):
1. All Pipe Sizes: Insulation shall be[**one of**] the following:
 - a. Cellular Glass: [1-1/2 inches (38 mm)] **<Insert dimension>** thick.
 - b. Flexible Elastomeric: [3/4 inch (19 mm)] [1 inch (25 mm)] **<Insert dimension>** thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: [1/2 inch (13 mm)] [1 inch (25 mm)] **<Insert dimension>** thick.
 - d. Phenolic: [1 inch (25 mm)] **<Insert dimension>** thick.
 - e. Polyolefin: [3/4 inch (19 mm)] [1 inch (25 mm)] **<Insert dimension>** thick.
- I. Hot Service Drains:
1. All Pipe Sizes: Insulation shall be[**one of**] the following:
 - a. Cellular Glass: [1-1/2 inches (38 mm)] **<Insert dimension>** thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I or II: [1 inch (25 mm)] **<Insert dimension>** thick.
- J. Hot Service Vents:
1. All Pipe Sizes: Insulation shall be[**one of**] the following:
 - a. Cellular Glass: [1-1/2 inches (38 mm)] **<Insert dimension>** thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I or II: [1 inch (25 mm)] **<Insert dimension>** thick.

3.17 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping:

1. All Pipe Sizes: Insulation shall be[**one of**] the following:
 - a. Cellular Glass: [2 inches (50 mm)] <Insert dimension> thick.
 - b. Flexible Elastomeric: [2 inches (50 mm)] <Insert dimension> thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: [2 inches (50 mm)] <Insert dimension> thick.
 - d. Phenolic: [2 inches (50 mm)] <Insert dimension> thick.
 - e. Polyolefin: [2 inches (50 mm)] <Insert dimension> thick.

B. Domestic Hot and Recirculated Hot Water:

1. All Pipe Sizes: Insulation shall be[**one of**] the following:
 - a. Cellular Glass: [2 inches (50 mm)] <Insert dimension> thick.
 - b. Flexible Elastomeric: [2 inches (50 mm)] <Insert dimension> thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: [2 inches (50 mm)] <Insert dimension> thick.
 - d. Phenolic: [2 inches (50 mm)] <Insert dimension> thick.
 - e. Polyolefin: [2 inches (50 mm)] <Insert dimension> thick.

C. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation shall be[**one of**] the following:
 - a. Cellular Glass: [2 inches (50 mm)] <Insert dimension> thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: [2 inches (50 mm)] <Insert dimension> thick.
 - c. Phenolic: [2 inches (50 mm)] <Insert dimension> thick.

D. Hot Service Drains:

1. All Pipe Sizes: Insulation shall be[**one of**] the following:
 - a. Cellular Glass: [1-1/2 inches (38 mm)] <Insert dimension> thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: [1 inch (25 mm)] <Insert dimension> thick.

E. Hot Service Vents:

1. All Pipe Sizes: Insulation shall be[**one of**] the following:
 - a. Cellular Glass: [1-1/2 inches (38 mm)] <Insert dimension> thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type II: [1 inch (25 mm)] <Insert dimension> thick.

3.18 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

- A. Sanitary Waste Piping, All Sizes, Where Heat Tracing Is Installed: Cellular glass, [2 inches (50 mm)] <Insert dimension> thick.
- B. Chilled Water, All Sizes: Cellular glass, [2 inches (50 mm)] <Insert dimension> thick.

3.19 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 - 1. None.
 - 2. [PVC] [PVC, Color-Coded by System]: [20 mils (0.5 mm)] [30 mils (0.8 mm)] thick.
 - 3. Aluminum, [Smooth] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
 - 4. Painted Aluminum, [Smooth] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] thick.
 - 5. Stainless Steel, [Type 304] [or] [Type 316], [Smooth 2B Finish] [Corrugated] [Stucco Embossed]: [0.010 inch (0.25 mm)] [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] thick.
 - 6. <Insert jacket type>.
- D. Piping, Exposed:
 - 1. None.
 - 2. [PVC] [PVC, Color-Coded by System]: [20 mils (0.5 mm)] [30 mils (0.8 mm)] thick.
 - 3. Aluminum, [Smooth] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
 - 4. Painted Aluminum, [Smooth] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] thick.
 - 5. Stainless Steel, [Type 304] [or] [Type 316], [Smooth 2B Finish] [Corrugated] [Stucco Embossed]: [0.010 inch (0.25 mm)] [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] thick.
 - 6. <Insert jacket type>.

3.20 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
1. None.
 2. **[PVC]** **[PVC, Color-Coded by System]**: [20 mils (0.5 mm)] [30 mils (0.8 mm)] thick.
 3. Aluminum, **[Smooth]** **[Corrugated]** **[Stucco Embossed]**: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
 4. Painted Aluminum, **[Smooth]** **[Corrugated]** **[Stucco Embossed]**: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] thick.
 5. Stainless Steel, **[Type 304]** [or] **[Type 316]**, **[Smooth 2B Finish]** **[Corrugated]** **[Stucco Embossed]**: [0.010 inch (0.25 mm)] [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] thick.
 6. <Insert jacket type>.
- D. Piping, Exposed:
1. PVC: [20 mils (0.5 mm)] [30 mils (0.8 mm)] [40 mils (1.0 mm)] thick.
 2. **[Painted]** Aluminum, **[Smooth]** **[Corrugated]** **[Stucco Embossed]** **[with Z-Shaped Locking Seam]**: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
 3. Stainless Steel, **[Type 304]** [or] **[Type 316]**, **[Smooth 2B Finish]** **[Corrugated]** **[Stucco Embossed]** **[with Z-Shaped Locking Seam]**: [0.010 inch (0.25 mm)] [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] thick.
 4. <Insert jacket type>.

3.21 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION **220719**

SECTION 221016 - FACILITY HYDRAULIC PIPING AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Work Included: Furnish and install hydraulic piping and fittings as required for the Work. The installation shall be completed in accordance with these Specifications, and shall include installation [**and reconnection**] of system equipment [**furnished by <insert name>**], as indicated by the Drawings.
- B. Related Requirements:
 - 1. Section 221113 "Facility Water Distribution Piping" for water-service piping [**and water meters**] outside the building from source to the point where water-service piping enters the building.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: Submit product data on [**high pressure hose and**] hydraulic fluid.
 - 1. Include data substantiating that materials comply with requirements.
- B. "As Built" Plans shall be provided. Each set shall be equipped with a plan holder equal to "Stacor Plan Camps" for the appropriate size drawings.
- C. Contractor shall submit fully dimensioned spool drawings for all welded piping work. Drawings shall indicate all weld types, sizes, and materials to be used. The spool drawing size shall match the full size contract documents of either 24x36 or 34x44. Spool drawings shall be submitted in either the latest version of AutoCAD (dwg) or the latest version of Adobe Acrobat (pdf). Adobe Acrobat files shall not contain security. Other file formats will not be accepted.

1.4 INFORMATIONAL SUBMITTALS

- A. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Failed test results and corrective action taken to achieve requirements.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Record actual locations of valves.
- B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.6 EXTRA MATERIALS

- A. Provide, in a suitable container, [5] <insert number> gallons of hydraulic fluid as spare stock.
- B. Provide two repacking kits for each type and size valve.

1.7 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Unless specified otherwise, all materials and equipment shall be of domestic (USA) manufacture and shall be of the best quality used for the purpose in commercial practice.

1.8 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with City and County of Denver plumbing code.

1.9 REFERENCES

- A. Materials and workmanship shall conform to the latest issue of all industry standards, publications, or regulations referenced in this section and with the following references as applicable. Refer to Section 15010 for listing of issuing organizations or agencies.
 - 1. American Society of Mechanical Engineers (ASME):
 - a. ASME Sec 9 - Welding and Brazing Qualifications.

2. International Fire Code (IFC) with the Denver Amendments.
3. International Building Code (IBC) with the Denver Amendments.

1.10 FIELD CONDITIONS

- A. Interruption of Existing Hydraulic Fluid Service: Do not interrupt hydraulic fluid service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 1. Notify DEN Project Manager no fewer than **[two (2) <Insert number>** days in advance of proposed interruption of service.
 2. Do not interrupt water service without DEN Project Manager's written permission.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 HYDRAULIC FLUID RETURN PIPING

- A. Steel Pipe: 1-1/2 inch and smaller, Schedule 40, seamless steel, ASTM A 106, Grade B; 2 inch and larger, Schedule 40, seamless steel, ASTM A 53, Grade B.
- B. Fittings: Standard weight socket or seamless buttwelding, ASTM A 234, ASTM B 16.9.
- C. Unions: 1-1/2 inch and smaller, 300 lb. malleable iron screwed with brass seats, AAR Class 300; 2 inch and larger, use flanges.
- D. Flanges: 150 lb. RF welding neck or slip-on, ANSI B 16.5, ASTM A 105, Grade II; SAE 4-bolt flanges for hydraulic fluid piping.
- E. Joints: AWS D1.1, welded; screwed; and flanged as suitable.

2.2 HYDRAULIC FLUID SUPPLY PIPING

- A. Pipe: 1/2" through 1-1/2", Schedule 80, seamless steel, ASTM A 106, Grade C.
- B. Fittings: 1/2" through 1-1/2", 3000 lb forged steel, socket welding; ASTM A 234. 2" and larger: Standard weight, seamless steel, buttwelding, stainless steel seats. ASTM A 234.
- C. Unions: 1/2" through 1-1/2", 3000 lb forged steel, socket welding, stainless steel seats.

ASTM A 234. 2" and larger: Flange, with elastomeric or O-ring seals per SAE J-1231, J-1453, S-518.

- D. High-Pressure Hose: [14,000] <insert number> psi bursting pressure, double braided steel wire reinforcing, heat and oil resistant synthetic rubber tube, black oil-resistant synthetic rubber cover. Male NPT cadmium plated steel factory-quality connections each end with union on one end. Cut hose to length in field to suit conditions.

2.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products under provisions of Division 01.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

3.2 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

3.3 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly. See special requirements for hydraulic fluids piping.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Hydraulic fluid supply and return piping shall be thoroughly cleaned by degreasing and pickling until all internal oil, varnish, rust, and scale is removed. After flushing and

drying, internal surfaces shall be immediately oiled with hydraulic fluid and both ends of pipe securely capped until ready for installation. Protect exterior surfaces against rusting and apply primer paint coat.

3.4 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure.
- B. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 220516 "Expansion Fittings and Loops for Plumbing and Piping". Provide clearance for access to valves and fittings.
- C. Install piping to conserve building space and not interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Provide clearance for installation of insulation and access to valves and fittings.
- F. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Division 08 installer.
- G. Install valves with stems upright or horizontal, not inverted.
- H. Lever handle valves: Install valve handle so that the handle opens in the direction of fluid flow.

3.5 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Provide dielectric waterway fittings or insulating flanges at all connections between dissimilar materials.

3.6 CLEANING, FLUSHING, AND INSPECTING

- A. Before starting cleaning and flushing operations, bypass or remove equipment not to be flushed. Provide blind flanges or other closures where needed, and install bypass connections as required. Permanent system pumps shall not be utilized for cleaning and flushing.
- B. Clean and flush systems, using hydraulic fluid, of all dirt, metal chips, sand, and foreign matter. After flushing, remove, clean, and replace all strainer baskets or screens. Inspect each run of piping for completion of joints, supports, accessory items, and visible leaks. Contractor shall supply the hydraulic fluid needed for this procedure, and the fluid shall be Mobil Type DTE23 hydraulic oil, or equivalent.
- C. Provide pump, reservoir, and filter equipment as needed to produce flushing flows at not less than 15 feet per second velocity. Final system fill may utilize the hydraulic fluid

used for cleaning and flushing (supplemented by any additional fluid required to totally fill the piping system), provided that the fluid is restored to water-free and clean condition conforming to the requirements of SAE 749D, Class 4 standards. The criteria for acceptance shall be the following maximum particle counts in the flushing fluid, as determined by a properly calibrated Scientific Pacific HIAC particle counter:

Particle Size (microns):	Maximum Particles/100 ml:
5 to 10	32,000
10 to 25	10,700
25 to 50	1,510
50 to 100	225
Over 100	21

3.7 LEAK AND PRESSURE TESTING

- A. Perform all tests in the presence of the authorized City representative when required. Contractor shall provide inspector and DEN Project Manager 48-hour prior notice of test.
- B. No piping or joint shall be left untested. All leaks shall be repaired and the piping system shall be re-tested until satisfactory results are obtained.
- C. Provide temporary equipment for testing, including pump and gages. Test piping system before insulation is installed, wherever feasible, and remove control devices before testing. Subject entire piping systems to tests, either as a whole, or in sections; but leave no part untested.
- D. Pneumatic test are not allowed.
- E. Fill piping systems with hydraulic fluid, vent all air, and pressurize for 1 hour. Test fails if leakage is observed, or pressure drop exceeds 5% of test pressure. Hydraulic supply lines shall be tested at a pressure of [3750] <insert number> psig, and return lines shall be tested at a pressure of [75] <insert number> psig.
- F. Repair piping systems that fail required piping test, by disassembly and reinstallation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.
- G. After completion, ensure removal of any trapped air after reconnections to removed or bypassed equipment have been completed.
- H. Repair piping systems that fail required piping test, by disassembly and reinstallation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.
- I. Drain test fluid from piping systems after testing and repair work that has been completed.

- J. Prepare written report of testing procedures and result. Submit in accordance with Section 220400 "Basic Plumbing Requirements".
- K. In addition to the quantity of fluid required to completely fill the hydraulic system, the Contractor shall deliver [5] <insert number> gallons of hydraulic fluid for DEN Project Manager's use in system replenishment.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement will be made for work under this Section.

PART 5 - PAYMENT

5.1 PAYMENT

- A. No separate payment will be made for work under this section. The cost of the work described in this section shall be included in the Lump Sum Contract price.

END OF SECTION **221116**

SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for **[water service] [fire-service mains] [combined water service and fire-service mains] [above-ground water piping for applications other than water service piping]**.
- B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. Combined Water Service and Fire-Service Main: Exterior water piping for both domestic-water and fire-suppression piping.
- B. Fire-Service Main: Exterior fire-suppression-water piping.
- C. Fire-Suppression-Water Piping: Interior fire-suppression-water piping.
- D. Water-Distribution Piping: Interior domestic-water piping.
- E. Water Service: Exterior domestic-water piping.
- F. EPDM: Ethylene propylene diene terpolymer rubber.
- G. LLDPE: Linear, low-density polyethylene plastic.
- H. PA: Polyamide (nylon) plastic.
- I. PE: Polyethylene plastic.
- J. PEX: Crosslinked polyethylene plastic.

- K. PP: Polypropylene plastic.
- L. PVC: Polyvinyl chloride plastic.
- M. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
- N. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, including but not limited to the following:
 - 1. Piping specialties.
 - 2. Valves and accessories.
 - 3. Water meters and accessories.
 - 4. Backflow preventers and assemblies.
 - 5. Protective enclosures.
 - 6. Fire hydrants.
 - 7. Flushing hydrants.
 - 8. Fire department connections.
 - 9. Alarm devices.
 - 10. Post hydrants.
 - 11. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: Detail precast concrete vault assemblies, including frames and covers, ladders, and drains, and indicate dimensions, method of field assembly, and components.
 - 1. Wiring Diagrams: Power, signal, and control wiring for alarms.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Sections "[017720 "Contract Closeout] [017823 Operation and Maintenance Data]," include the following:
 - 1. Water meters.
 - 2. Valves.

3. Backflow preventers.
4. Protective enclosures.
5. Fire hydrants.
6. Flushing hydrants.
7. Post hydrants.

1.7 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of piping and specialties and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- B. Regulatory Requirements:
 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
 3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- C. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.
- F. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- G. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
- H. NSF Compliance:
 1. Comply with NSF 14 for plastic potable-water-service piping. [**Include marking "NSF-pw" on piping.**]
 2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
 1. Ensure that valves are dry and internally protected against rust and corrosion.

2. Protect valves against damage to threaded ends and flange faces.
 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.9 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
1. Notify DEN Project Manager no fewer than **[two] <Insert number>** days in advance of proposed interruption of service.
 2. Do not proceed with interruption of water-distribution service without DEN Project Manager's written permission.

1.10 COORDINATION

- A. Coordinate connection to water main with Denver Water Department. .

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to

satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: **[ASTM B 88, Type K (ASTM B 88M, Type A)] [and] [ASTM B 88, Type L (ASTM B 88M, Type B)]**, water tube, annealed temper.
1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
 2. Copper, Pressure-Seal Fittings:
 - a. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1) Viega; Plumbing & Heating Systems.
 - 2) **<Insert manufacturer's name.>**
 - 3) or approved equal.
 - b. **NPS 2 (DN 50) and Smaller:** Wrought-copper fitting with EPDM O-ring seal in each end.
 - c. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100):** Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
- B. Hard Copper Tube: **[ASTM B 88, Type K (ASTM B 88M, Type A)] [and] [ASTM B 88, Type L (ASTM B 88M, Type B)] [and] [ASTM B 88, Type M]**, water tube, drawn temper.
1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
 2. Copper, Pressure-Seal Fittings:
 - a. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1) Viega; Plumbing & Heating Systems.
 - 2) **<Insert manufacturer's name.>**
 - 3) or approved equal.
 - b. **NPS 2 (DN 50) and Smaller:** Wrought-copper fitting with EPDM O-ring seal in each end.
 - c. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100):** Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
- C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
- D. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.2 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Gaskets: AWWA C111, rubber.
- C. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.
1. Grooved-End, Ductile-Iron Pipe Appurtenances:
 - a. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1) Anvil International, Inc.
 - 2) Victaulic Company of America.
 - 3) **<Insert manufacturer's name.>**
 - 4) or approved equal.
 - b. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
 - c. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
- D. Flanges: ASME 16.1, Class 125, cast iron.

2.3 SPECIAL DUCTILE IRON PIPE FITTINGS

- A. Ductile-Iron Rigid Expansion Joints:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. EBAA Iron, Inc.
 - b. U.S. Pipe and Foundry Company.
 - c. **<Insert manufacturer's name.>**
 - d. or approved equal.
 2. Description: Three-piece, ductile-iron assembly consisting of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections

complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

- a. Pressure Rating: 250 psig (1725 kPa) minimum.
- b. Expansion Required: <Insert inches (mm).>

B. Ductile-Iron Flexible Expansion Joints:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. EBAA Iron, Inc.
- b. Hays Fluid Controls; a division of ROMAC Industries Inc.
- c. Star Pipe Products.
- d. <Insert manufacturer's name.>
- e. or approved equal.

2. Description: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections. Assemble components for offset and expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

- a. Pressure Rating: 250 psig (1725 kPa) minimum.
- b. Offset: <Insert inches (mm).>
- c. Expansion Required: <Insert inches (mm).>

C. Ductile-Iron Deflection Fittings:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. EBAA Iron, Inc.
- b. <Insert manufacturer's name.>
- c. or approved equal.

2. Description: Compound, ductile-iron coupling fitting with sleeve and 1 or 2 flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

- a. Pressure Rating: 250 psig (1725 kPa) minimum.

2.4 PE PIPE AND FITTINGS

A. PE, ASTM Pipe: ASTM D 2239, SIDR No. 5.3, 7, or 9; with PE compound number required to give pressure rating not less than [160 psig (1100 kPa)] [200 psig (1380 kPa)].

1. Insert Fittings for PE Pipe: ASTM D 2609, made of PA, PP, or PVC with serrated male insert ends matching inside of pipe. Include bands or crimp rings.
 2. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.
- B. PE, AWWA Pipe: AWWA C906, DR No. 7.3, 9, or 9.3; with PE compound number required to give pressure rating not less than **[160 psig (1100 kPa)] [200 psig (1380 kPa)]**.
1. PE, AWWA Fittings: AWWA C906, socket- or butt-fusion type, with DR number matching pipe and PE compound number required to give pressure rating not less than **[160 psig (1100 kPa)] [200 psig (1380 kPa)]**.
- C. PE, Fire-Service Pipe: ASTM F 714, AWWA C906, or equivalent for PE water pipe; FMG approved, with minimum thickness equivalent to FMG **[Class 150] [and] [Class 200]**.
1. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

2.5 PEX TUBE AND FITTINGS

- A. PEX Tube: ASTM F 876, SDR 9.
1. Brass Fittings for PEX Tube: Insert type with corrosion-resistant metal bands.

2.6 PVC PIPE AND FITTINGS

- A. PVC, Schedule 40 Pipe: ASTM D 1785.
1. PVC, Schedule 40 Socket Fittings: ASTM D 2466.
- B. PVC, Schedule 80 Pipe: ASTM D 1785.
1. PVC, Schedule 80 Socket Fittings: ASTM D 2467.
 2. PVC, Schedule 80 Threaded Fittings: ASTM D 2464.
- C. PVC, AWWA Pipe: AWWA C900, **[Class 150] [and] [Class 200]**, with bell end with gasket, and with spigot end.
1. Comply with UL 1285 for fire-service mains if indicated.
 2. PVC Fabricated Fittings: AWWA C900, **[Class 150] [and] [Class 200]**, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
 3. PVC Molded Fittings: AWWA C907, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
 4. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Gaskets: AWWA C111, rubber.

5. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.7 FIBERGLASS PIPE AND FITTINGS

- A. AWWA RTRP: AWWA C950, **[Class 150] [Class 200] [and] [Class 250]**, Type I **[or II]**, **[Grade 1, epoxy] [or] [Grade 2, polyester]**, with bell-and-spigot ends **[for bonded] [with gasket or seal for gasketed]** joints. Liner is optional, unless otherwise indicated. **[Include FMG approval if used for fire-service mains.]**
 1. RTRF: AWWA C950, similar to pipe in material, pressure class, and joining method.
- B. UL RTRP: UL 1713, **[Class 150] [Class 200] [and] [Class 250]**, with bell-and-spigot ends with gasket or seal for gasketed joints. Liner is optional, unless otherwise indicated.
 1. RTRF: Similar to pipe in material, pressure class, and joining method.

2.8 JOINING MATERIALS

- A. Refer to Section 330500 "Common Work Results for Utilities" for commonly used joining materials.
- B. Transition Couplings:
 1. Underground Piping, NPS 1-1/2 and Smaller: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
 2. Underground Piping, NPS 2 and Larger: AWWA C219, metal, sleeve-type coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
 3. Aboveground **[or Vault]** Piping: Pipe fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- C. Brazing Filler Metals: AWS A5.8, BCuP Series.
- D. Soldering Flux: ASTM B 813, water-flushable type.
- E. Solder Filler Metal: ASTM B 32, lead-free type with 0.20 percent maximum lead content.
- F. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.

- G. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.9 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

- B. Tubular-Sleeve Pipe Couplings:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Cascade Waterworks Manufacturing.
- b. Dresser, Inc.; Dresser Piping Specialties.
- c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
- d. Hays Fluid Controls; a division of ROMAC Industries Inc.
- e. JCM Industries.
- f. Smith-Blair, Inc.
- g. Viking Johnson.
- h. **<Insert manufacturer's name.>**
- i. or approved equal.

2. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.

- a. Standard: AWWA C219.
- b. Center-Sleeve Material: **[Manufacturer's standard] [Carbon steel] [Stainless steel] [Ductile iron] [Malleable iron]**.
- c. Gasket Material: Natural or synthetic rubber.
- d. Pressure Rating: **[150 psig (1035 kPa)] [200 psig (1380 kPa)] <Insert pressure>** minimum.
- e. Metal Component Finish: Corrosion-resistant coating or material.

- C. Split-Sleeve Pipe Couplings:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Victaulic Depend-O-Lok.
- b. **<Insert manufacturer's name.>**
- c. or approved equal.

2. Description: Metal, bolted, split-sleeve-type, reducing or transition coupling with sealing pad and closure plates, O-ring gaskets, and bolt fasteners.

- a. Standard: AWWA C219.
- b. Sleeve Material: **[Manufacturer's standard] [Carbon steel] [Stainless steel]**.

- c. Sleeve Dimensions: Of thickness and width required to provide pressure rating.
- d. Gasket Material: O-rings made of EPDM rubber, unless otherwise indicated.
- e. Pressure Rating: **[150 psig (1035 kPa)] [200 psig (1380 kPa)] <Insert pressure>** minimum.
- f. Metal Component Finish: Corrosion-resistant coating or material.

D. Flexible Connectors:

1. Nonferrous-Metal Piping: Bronze hose covered with bronze wire braid; with copper-tube, pressure-type, solder-joint ends or bronze flanged ends brazed to hose.
2. Ferrous-Metal Piping: Stainless-steel hose covered with stainless-steel wire braid; with ASME B1.20.1, threaded steel pipe nipples or ASME B16.5, steel pipe flanges welded to hose.

E. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:
 - a. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: **[125 psig (860 kPa) minimum at 180 deg F (82 deg C)] [150 psig (1035 kPa)] [250 psig (1725 kPa)]**.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
3. Dielectric Flanges:
 - a. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: **[150 psig (1035 kPa)] [175 psig (1200 kPa)] [300 psig (2070 kPa)]**.
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
4. Dielectric-Flange Insulating Kits:
 - a. Description:
 - 1) Nonconducting materials for field assembly of companion flanges.
 - 2) Pressure Rating: **[150 psig (1035 kPa)] <Insert pressure>**.
 - 3) Gasket: Neoprene or phenolic.
 - 4) Bolt Sleeves: Phenolic or polyethylene.

- 5) Washers: Phenolic with steel backing washers.
5. Dielectric Couplings: Galvanized-steel couplings with inert and noncorrosive thermo-plastic lining, with threaded ends and 300-psig minimum working pressure at 225 deg F.
6. Dielectric Nipples:
 - a. Description:
 - 1) Standard: IAPMO PS 66
 - 2) Electroplated steel nipple. complying with ASTM F 1545.
 - 3) Pressure Rating: **300 psig (2070 kPa) at 225 deg F (107 deg C)** <Insert pressure and temperature>.
 - 4) End Connections: Male threaded or grooved.
 - 5) Lining: Inert and noncorrosive, propylene.

2.10 CORROSION-PROTECTION PIPING ENCASUREMENT

A. Encasement for Underground Metal Piping:

1. Standards: ASTM A 674 or AWWA C105.
2. Form: **[Sheet] [Sheet or tube] [Tube]**.
3. Material: LLDPE film of **0.008-inch (0.20-mm)** minimum thickness.
4. Material: LLDPE film of **0.008-inch (0.20-mm)** minimum thickness, or high-density, crosslaminated PE film of **0.008-inch (0.10-mm)** minimum thickness.
5. Material: High-density, crosslaminated PE film of **0.008-inch (0.10-mm)** minimum thickness.
6. Color: **[Black] [Natural] <Insert color>**.

2.11 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. American AVK Co.; Valves & Fittings Div.
 - b. American Cast Iron Pipe Co.; American Flow Control Div.
 - c. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. East Jordan Iron Works, Inc.
 - f. Grinnell Corporation; Mueller Co.; Water Products Div.
 - g. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - h. McWane, Inc.; Kennedy Valve Div.
 - i. McWane, Inc.; M & H Valve Company Div.
 - j. McWane, Inc.; Tyler Pipe Div.; Utilities Div.
 - k. Mueller Co.; Water Products Div.
 - l. NIBCO INC.
 - m. U.S. Pipe and Foundry Company.

- n. **<Insert manufacturer's name.>**
 - o. or approved equal.
2. Nonrising-Stem, Metal-Seated Gate Valves:
- a. Description: Gray- or ductile-iron body and bonnet; with cast-iron or bronze double-disc gate, bronze gate rings, bronze stem, and stem nut.
 - 1) Standard: AWWA C500.
 - 2) Minimum Pressure Rating: **200 psig** (1380 kPa).
 - 3) End Connections: Mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.
3. Nonrising-Stem, Resilient-Seated Gate Valves:
- a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: **200 psig** (1380 kPa).
 - 3) End Connections: Mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.
4. Nonrising-Stem, High-Pressure, Resilient-Seated Gate Valves:
- a. Description: Ductile-iron body and bonnet; with bronze or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: **250 psig** (1725 kPa).
 - 3) End Connections: Push on or mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.
5. OS&Y, Rising-Stem, Metal-Seated Gate Valves:
- a. Description: Cast- or ductile-iron body and bonnet, with cast-iron double disc, bronze disc and seat rings, and bronze stem.
 - 1) Standard: AWWA C500.
 - 2) Minimum Pressure Rating: **200 psig** (1380 kPa).
 - 3) End Connections: Flanged.
6. OS&Y, Rising-Stem, Resilient-Seated Gate Valves:
- a. Description: Cast- or ductile-iron body and bonnet, with bronze or gray- or ductile-iron gate, resilient seats, and bronze stem.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: **200 psig** (1380 kPa).
 - 3) End Connections: Flanged.

B. UL/FMG, Cast-Iron Gate Valves:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. American Cast Iron Pipe Co.; American Flow Control Div.
- b. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
- c. Central Sprinkler Company.
- d. Crane Co.; Crane Valve Group; Stockham Div.
- e. Grinnell Corporation; Mueller Co.; Water Products Div.
- f. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
- g. McWane, Inc.; Kennedy Valve Div.
- h. McWane, Inc.; M & H Valve Company Div.
- i. Mueller Co.; Water Products Div.
- j. NIBCO INC.
- k. U.S. Pipe and Foundry Company.
- l. **<Insert manufacturer's name.>**
- m. or approved equal.

2. UL/FMG, Nonrising-Stem Gate Valves:

- a. Description: Iron body and bonnet with flange for indicator post, bronze seating material, and inside screw.
 - 1) Standards: UL 262 and FMG approved.
 - 2) Minimum Pressure Rating: **175 psig** (1207 kPa).
 - 3) End Connections: Flanged.

3. OS&Y, Rising-Stem Gate Valves:

- a. Description: Iron body and bonnet and bronze seating material.
 - 1) Standards: UL 262 and FMG approved.
 - 2) Minimum Pressure Rating: **175 psig** (1207 kPa).
 - 3) End Connections: Flanged.

C. Bronze Gate Valves:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Div.
- d. Grinnell Corporation.
- e. Hammond Valve.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Red-White Valve Corporation.
- i. **<Insert manufacturer's name.>**
- j. or approved equal.

2. OS&Y, Rising-Stem Gate Valves:
 - a. Description: Bronze body and bonnet and bronze stem.
 - 1) Standards: UL 262 and FMG approved.
 - 2) Minimum Pressure Rating: 175 psig (1207 kPa).
 - 3) End Connections: Threaded.
3. Nonrising-Stem Gate Valves:
 - a. Description: Class 125, Type 1, bronze with solid wedge, threaded ends, and malleable-iron handwheel.
 - 1) Standard: MSS SP-80.

2.12 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
- b. East Jordan Iron Works, Inc.
- c. Flowserve.
- d. Grinnell Corporation; Mueller Co.; Water Products Div.
- e. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
- f. McWane, Inc.; Kennedy Valve Div.
- g. McWane, Inc.; M & H Valve Company Div.
- h. Mueller Co.; Water Products Div.
- i. U.S. Pipe and Foundry Company.
- j. **<Insert manufacturer's name.>**
- k. or approved equal.

2. Description: Sleeve and valve compatible with drilling machine.

- a. Standard: MSS SP-60.
- b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
- c. Valve: AWWA, cast-iron, nonrising-stem, **[metal] [resilient]**-seated gate valve with one raised face flange mating tapping-sleeve flange.

- ### B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches (125 mm) in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

- C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.
- D. Indicator Posts: UL 789, FM-approved, horizontal, wall-type, cast-iron body with operating wrench, extension rod, and cast-iron barrel.
- E. CHECK VALVES
- F. AWWA Check Valves:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. AFAC, Inc.; Badger Fire Protection.
 - b. American AVK Co.; Valves & Fittings Div.
 - c. American Cast Iron Pipe Co.; American Flow Control Div.
 - d. APCO Williamette; Valve and Primer Corporation.
 - e. Central Sprinkler Company.
 - f. Crane Co.; Crane Valve Group; Crane Valves.
 - g. Crane Co.; Crane Valve Group; Stockham Div.
 - h. Firematic Sprinkler Devices, Inc.
 - i. Grinnell Corporation.
 - j. Grinnell Corporation; Mueller Co.; Water Products Div.
 - k. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - l. McWane, Inc.; Kennedy Valve Div.
 - m. McWane, Inc.; M & H Valve Company Div.
 - n. Mueller Co.; Water Products Div.
 - o. NIBCO INC.
 - p. Star Sprinkler, Inc.
 - q. Valve and Primer Corp.
 - r. Venus Fire Protection, Ltd.
 - s. Watts Water Technologies, Inc.
 - t. **<Insert manufacturer's name.>**
 - u. or approved equal.
 2. Description: Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.
 - a. Standard: AWWA C508.
 - b. Pressure Rating: **[175 psig (1207 kPa)] [and] [250 psig (1724 kPa)].**
- G. UL/FMG, Check Valves:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
 - b. Crane Co.; Crane Valve Group; Stockham Div.
 - c. Globe Fire Sprinkler Corporation.
 - d. Kidde Fire Fighting.
 - e. MATCO-NORCA, Inc.

- f. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - g. McWane, Inc.; Kennedy Valve Div.
 - h. Mueller Co.; Water Products Div.
 - i. NIBCO INC.
 - j. Reliable Automatic Sprinkler Co., Inc.
 - k. Tyco Fire & Building Products.
 - l. United Brass Works, Inc.
 - m. Victaulic Company of America.
 - n. Viking Corporation.
 - o. Watts Water Technologies, Inc.
 - p. **<Insert manufacturer's name.>**
 - q. or approved equal.
2. Description: Swing-check type with pressure rating; rubber-face checks, unless otherwise indicated; and ends matching piping.
- a. Standards: UL 312 and FMG approved.
 - b. Pressure Rating: [**175 psig (1207 kPa)**] [**250 psig (1725 kPa)**].

2.13 DETECTOR CHECK VALVES

A. Detector Check Valves:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Ames Fire & Waterworks; a division of Watts Regulator Co.
 - b. Badger Meter, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Firematic Sprinkler Devices, Inc.
 - e. Globe Fire Sprinkler Corporation.
 - f. Grinnell Corporation; Mueller Co.; Hersey Meters.
 - g. McWane, Inc.; Kennedy Valve Div.
 - h. Mueller Co.; Hersey Meters.
 - i. Smith-Blair, Inc.
 - j. Victaulic Company of America.
 - k. Viking Corporation.
 - l. Watts Water Technologies, Inc.
 - m. **<Insert manufacturer's name.>**
 - n. or approved equal.
2. Description: Galvanized cast-iron body, bolted cover with air-bleed device for access to internal parts, and flanged ends. Include one-piece bronze disc with bronze bushings, pivot, and replaceable seat. Include threaded bypass taps in inlet and outlet for bypass meter connection. Set valve to allow minimal water flow through bypass meter when major water flow is required.
 - a. Standards: UL 312 and FMG approved.
 - b. Pressure Rating: **175 psig (1207 kPa)**.

- c. Water Meter: AWWA C700, disc type, at least one-fourth size of detector check valve. Include meter, bypass piping, gate valves, check valve, and connections to detector check valve.
3. Description: Iron body, corrosion-resistant clapper ring and seat ring material, flanged ends, with connections for bypass and installation of water meter.
 - a. Standards: UL 312 and FMG approved.
 - b. Pressure Rating: 175 psig (1207 kPa).

2.14 BUTTERFLY VALVES

A. AWWA Butterfly Valves:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. DeZURIK/Copes-Vulcan; a unit of SPX Corporation.
 - b. Milliken Valve Company.
 - c. Mosser Valve; a division of Olson Technologies, Inc.
 - d. Mueller Co.; Water Products Div.
 - e. Pratt, Henry Company.
 - f. Val-Matic Valve & Manufacturing Corp.
 - g. **<Insert manufacturer's name.>**
 - h. or approved equal.
2. Description: Rubber seated.
 - a. Standard: AWWA C504.
 - b. Body: Cast or ductile iron.
 - c. Body Type: **[Wafer] [Wafer or flanged] [Flanged]**.
 - d. Pressure Rating: 150 psig (1035 kPa).

B. UL Butterfly Valves:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. McWane, Inc.; Kennedy Valve Div.
 - b. Milwaukee Valve Company.
 - c. Mueller Co.; Water Products Div.
 - d. NIBCO INC.
 - e. Pratt, Henry Company.
 - f. **<Insert manufacturer's name.>**
 - g. or approved equal.
2. Description: Metal on resilient material seating.
 - a. Standards: UL 1091 and FMG approved.
 - b. Body: Cast or ductile iron.
 - c. Body Type: **[Wafer] [Wafer or flanged] [Flanged]**.

- d. Pressure Rating: 175 psig (1207 kPa).

2.15 PLUG VALVES

A. Plug Valves:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. DeZURIK/Copes-Vulcan; a unit of SPX Corporation.
- b. Homestead Valve; a division of Olson Technologies, Inc.
- c. Milliken Valve Company.
- d. McWane, Inc.; M & H Valve Company Div.
- e. Pratt, Henry Company.
- f. Val-Matic Valve & Manufacturing Corp.
- g. **<Insert manufacturer's name.>**
- h. or approved equal.

2. Description: Resilient-seated eccentric.

- a. Standard: MSS SP-108.
- b. Body: Cast iron.
- c. Pressure Rating: 175-psig (1207-kPa) minimum CWP.
- d. Seat Material: Suitable for potable-water service.

2.16 [CORPORATION VALVES] [AND] [CURB VALVES]

A. Manufacturers:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Amcast Industrial Corporation; Lee Brass Co.
- b. Ford Meter Box Company, Inc. (The); Pipe Products Div.
- c. Grinnell Corporation; Mueller Co.; Water Products Div.
- d. Jones, James Company.
- e. Master Meter, Inc.
- f. McDonald, A. Y. Mfg. Co.
- g. Mueller Co.; Water Products Div.
- h. Red Hed Manufacturing & Supply.
- i. **<Insert manufacturer's name.>**
- j. or approved equal.

- ### B. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.

1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.

3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.
- C. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.
- D. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches (75 mm) in diameter.
1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

2.17 WATER METERS

- A. Water meters will be furnished by utility company.
- B. Manufacturers:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB Water Meters, Inc.
 - b. AMCO Water Metering Systems.
 - c. Badger Meter, Inc.
 - d. Carlon Meter.
 - e. Grinnell Corporation; Mueller Co.; Hersey Meters.
 - f. Hays Fluid Controls; a division of ROMAC Industries Inc.
 - g. McCrometer.
 - h. Mueller Co.; Hersey Meters.
 - i. Neptune Technology Group Inc.
 - j. ROMAC Industries, Inc.; Hays Fluid Control Div.
 - k. Schlumberger Limited; Water Div.
 - l. Sensus Metering Systems.
 - m. Water Specialties Corp.
 - n. <Insert manufacturer's name.>
 - o. or approved equal.
- C. Displacement-Type Water Meters:
 1. Description: With bronze main case.
 - a. Standard: AWWA C700.
 - b. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].
- D. Turbine-Type Water Meters:
 1. Description:
 - a. Standard: AWWA C701.

- b. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].
- E. Compound-Type Water Meters:
 - 1. Description:
 - a. Standard: AWWA C702.
 - b. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].
- F. Remote Registration System:
 - 1. Description: Utility company standard; direct-reading type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
 - a. Standard: AWWA C706.
 - b. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].
- G. Remote Registration System:
 - 1. Description: Utility company standard; encoder type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
 - a. Standard: AWWA C707.
 - b. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].
 - c. Data-Acquisition Units: Comply with utility company requirements for type and quantity.
 - d. Visible Display Units: Comply with utility company requirements for type and quantity.

2.18 DETECTOR-TYPE WATER METERS

- A. Detector-Type Water Meters:
 - 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Badger Meter, Inc.
 - b. Grinnell Corporation.
 - c. Grinnell Corporation; Mueller Co.; Hersey Meters.
 - d. Mueller Co.; Hersey Meters.
 - e. Neptune Technology Group Inc.
 - f. Sensus Metering Systems.
 - g. **<Insert manufacturer's name.>**
 - h. or approved equal.
- B. Description: Main line, proportional meter with second meter on bypass. Register flow in [gallons (liters)] [cubic feet (cubic meters)].
 - 1. Standards: AWWA C703, UL listed, and FMG approved.

2. Pressure Rating: 150 psig (1035 kPa).
 3. Bypass Meter: [AWWA C701, turbine] [AWWA C702, compound]-type, bronze case.
 - a. Size: At least one-half nominal size of main-line meter.
- C. Description: Main-line turbine meter with strainer and second meter on bypass. Register flow in [gallons (liters)] [cubic feet (cubic meters)].
1. Standards: AWWA C703, UL listed, and FMG approved.
 2. Pressure Rating: 175 psig (1207 kPa).
 3. Bypass Meter: AWWA C701, turbine-type, bronze case.
 - a. Size: At least NPS 2 (DN 50).
- D. Remote Registration System:
1. Description: Utility company standard; direct-reading type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
 - a. Standard: AWWA C706.
 - b. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].
- E. Remote Registration System:
1. Description: Utility company standard; encoder type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
 - a. Standard: AWWA C707.
 - b. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].
 - c. Data-Acquisition Units: Comply with utility company requirements for type and quantity.
 - d. Visible Display Units: Comply with utility company requirements for type and quantity.

2.19 PRESSURE-REDUCING VALVES

- A. Water Regulators:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Cash Acme; a division of The Reliance Worldwide Corporation.
 - b. Conbraco Industries, Inc.
 - c. Honeywell Water Controls.
 - d. Watts Water Technologies, Inc.
 - e. Wilkins; a Zurn company.
 - f. <Insert manufacturer's name.>
 - g. or approved equal.

2. Standard: ASSE 1003.
3. Pressure Rating: Initial pressure of **150 psig** (1035 kPa).
4. Size: **<Insert NPS (DN).>**
5. Design Flow Rate: **<Insert gpm (L/s).>**
6. Design Inlet Pressure: **<Insert psig (kPa).>**
7. Design Outlet Pressure Setting: **<Insert psig (kPa).>**
8. Body: Bronze[**with chrome-plated finish**] for **NPS 2** (DN 50) and smaller; cast iron[**with interior lining complying with AWWA C550 or that is FDA approved**] for **NPS 2-1/2** and **NPS 3** (DN 65 and DN 80).
9. Valves for Booster Heater Water Supply: Include integral bypass.
10. End Connections: Threaded for **NPS 2** (DN 50) and smaller; flanged for **NPS 2-1/2** and **NPS 3** (DN 65 and DN 80).

B. Water Control Valves:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. **Ames Co., Inc.**
 - b. **BERMAD.**
 - c. CLA-VAL Automatic Control Valves.
 - d. Flomatic Corporation.
 - e. GA Industries, Inc.
 - f. IMI Cash Valve, Inc.
 - g. OCV Control Valves.
 - h. Watts Regulator Co.; Ames Fluid Control Systems.
 - i. Watts Regulator Co.; Watts ACV Division.
 - j. Wilkins; a Zurn company.
 - k. **<Insert manufacturer's name.>**
 - l. or approved equal.
2. Description: Pilot-operation, diaphragm-type, single-seated main water control valve with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot control valve, restrictor device, specialty fittings, and sensor piping.
 - a. Pressure Rating: Initial pressure of **150 psig** (1035 kPa) minimum.
 - b. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
 - 1) Size: **<Insert NPS (DN).>**
 - 2) Pattern: [**Angle**] [**Globe**]-valve design.
 - 3) Trim: Stainless steel.
 - c. Design Flow Rate: **<Insert gpm (L/s).>**
 - d. Design Inlet Pressure: **<Insert psig (kPa).>**
 - e. Design Outlet Pressure Setting: **<Insert psig (kPa).>**
 - f. End Connections: Threaded for **NPS 2** (DN 50) and smaller; [**flanged**] **<Insert type>** for **NPS 2-1/2** (DN 65) and larger.

2.20 RELIEF VALVES

A. Air-Release Valves:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. **BERMAD.**
- b. Crispin-Multiplex Manufacturing Co.
- c. GA Industries, Inc.
- d. MULTIPLEX Manufacturing Co.
- e. OCECO, Inc.
- f. Val-Matic Valve & Manufacturing Corp.
- g. **<Insert manufacturer's name.>**
- h. or approved equal.

2. Description: Hydromechanical device to automatically release accumulated air.

- a. Standard: AWWA C512.
- b. Pressure Rating: **[300 psig (2070 kPa)] <Insert pressure>**.
- c. Body Material: **[Cast iron] <Insert material>**.
- d. Trim Material: Stainless steel[, **brass, or bronze**].
- e. Water Inlet Size: **<Insert NPS (DN).>**
- f. Air Outlet Size: **<Insert NPS (DN).>**
- g. Orifice Size: **<Insert inch (mm).>**
- h. Design Air-Release Capacity: **<Insert cfm (L/s)>** at **<Insert psig (kPa)>** pipeline pressure.

B. Air/Vacuum Valves:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. **BERMAD.**
- b. Crispin-Multiplex Manufacturing Co.
- c. GA Industries, Inc.
- d. MULTIPLEX Manufacturing Co.
- e. OCECO, Inc.
- f. Val-Matic Valve & Manufacturing Corp.
- g. **<Insert manufacturer's name.>**
- h. or approved equal.

2. Description: Direct-acting, float-operated, hydromechanical device with large orifice to automatically release accumulated air or to admit air during filling of piping.

- a. Standard: AWWA C512.
- b. Pressure Rating: **[300 psig (2070 kPa)] <Insert pressure>**.
- c. Body Material: **[Cast iron] <Insert material>**.
- d. Trim Material: Stainless steel[, **brass, or bronze**].
- e. Inlet and Outlet Size: **<Insert NPS (DN).>**
- f. Orifice Size: **<Insert inch (mm).>**

6. Design Flow Rate: <Insert gpm (L/s).>
7. Selected Unit Flow Range Limits: <Insert gpm (L/s).>
8. Pressure Loss at Design Flow Rate: <Insert psig (kPa).>
9. Accessories: Ball valves on inlet and outlet.

2.22 HOSE-CONNECTION, BACKFLOW-PREVENTION DEVICES

- A. General: ASSE standard, nonremovable-type, backflow-prevention devices with ASME B1.20.7, garden-hose threads on outlet.
- B. Hose-Connection Vacuum Breakers: ASSE 1011, nickel plated, with manual drain feature. Units attached to rough-bronze-finish hose connections may be rough bronze.
- C. Hose-Connection Backflow Preventers: ASSE 1052, suitable for at least 3-gpm flow and applications with up to 10-foot head of water back pressure. Include two check valves and intermediate atmospheric vent.

2.23 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Ames Fire & Waterworks; a division of Watts Regulator Co.
 - b. Cla-Val Co.
 - c. CMB Industries, Inc.; Febco Div.
 - d. Conbraco Industries, Inc.
 - e. FEBCO; SPX Valves & Controls.
 - f. Flomatic Corporation.
 - g. Grinnell Corporation; Mueller Co.; Hersey Meters.
 - h. Watts Water Technologies, Inc.
 - i. Wilkins; a Zurn company.
 - j. Zurn Industries, Inc.; Wilkins Div.
 - k. <Insert manufacturer's name.>
 - l. or approved equal.
 2. Standard: **[ASSE 1013] [or] [AWWA C511]**.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: **[12 psig (83 kPa)] <Insert pressure>** maximum, through middle 1/3 of flow range.
 5. Size: <Insert NPS (DN).>
 6. Design Flow Rate: <Insert gpm (L/s).>
 7. Selected Unit Flow Range Limits: <Insert gpm (L/s).>
 8. Pressure Loss at Design Flow Rate: <Insert psig (kPa)> for **NPS 2 (DN 50)** and smaller; <Insert psig (kPa)> for **NPS 2-1/2 (DN 65)** and larger.
 9. Body: Bronze for **NPS 2 (DN 50)** and smaller; **[cast iron with interior lining complying with AWWA C550 or that is FDA approved] [steel with interior**

- lining complying with AWWA C550 or that is FDA approved] [stainless steel]** for **NPS 2-1/2 (DN 65)** and larger.
10. End Connections: Threaded for **NPS 2 (DN 50)** and smaller; **[flanged]** **<Insert type>** for **NPS 2-1/2 (DN 65)** and larger.
 11. Configuration: Designed for **[horizontal, straight through]** **[vertical inlet, horizontal center section, and vertical outlet]** **[vertical]** **<Insert configuration>** flow.
 12. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of **NPS 2 (DN 50)** and smaller; OS&Y gate type with flanged ends on inlet and outlet of **NPS 2-1/2 (DN 65)** and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.
- B. Double-Check, Backflow-Prevention Assemblies:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Ames Fire & Waterworks; a division of Watts Regulator Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Water Technologies, Inc.
 - f. Wilkins; a Zurn company.
 - g. **<Insert manufacturer's name.>**
 - h. or approved equal.
 2. Standard: **[ASSE 1015]** **[or]** **[AWWA C510]**.
 3. Operation: Continuous-pressure applications, unless otherwise indicated.
 4. Pressure Loss: **[5 psig (35 kPa)]** **<Insert pressure>** maximum, through middle 1/3 of flow range.
 5. Size: **<Insert NPS (DN).>**
 6. Design Flow Rate: **<Insert gpm (L/s).>**
 7. Selected Unit Flow Range Limits: **<Insert gpm (L/s).>**
 8. Pressure Loss at Design Flow Rate: **<Insert psig (kPa)>** for **NPS 2 (DN 50)** and smaller; **<Insert psig (kPa)>** for **NPS 2-1/2 (DN 65)** and larger.
 9. Body: Bronze for **NPS 2 (DN 50)** and smaller; **[cast iron with interior lining complying with AWWA C550 or that is FDA approved]** **[steel with interior lining complying with AWWA C550 or that is FDA approved]** **[stainless steel]** for **NPS 2-1/2 (DN 65)** and larger.
 10. End Connections: Threaded for **NPS 2 (DN 50)** and smaller; **[flanged]** **<Insert type>** for **NPS 2-1/2 (DN 65)** and larger.
 11. Configuration: Designed for **[horizontal, straight through]** **<Insert configuration>** flow.
 12. Accessories: Ball valves with threaded ends on inlet and outlet of **NPS 2 (DN 50)** and smaller; OS&Y gate valves with flanged ends on inlet and outlet of **NPS 2-1/2 (DN 65)** and larger.
- C. Reduced-Pressure-Detector, Fire-Protection Backflow Preventer Assemblies:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Ames Fire & Waterworks; a division of Watts Regulator Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Watts Water Technologies, Inc.
 - e. Wilkins; a Zurn company.
 - f. **<Insert manufacturer's name.>**
 - g. or approved equal.
 2. Standards: ASSE 1047 and UL listed or FMG approved.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: **[12 psig (83 kPa)] <Insert pressure>** maximum, through middle 1/3 of flow range.
 5. Size: **<Insert NPS (DN).>**
 6. Design Flow Rate: **<Insert gpm (L/s).>**
 7. Selected Unit Flow Range Limits: **<Insert gpm (L/s).>**
 8. Pressure Loss at Design Flow Rate: **<Insert psig (kPa).>**
 9. Body: **[Cast iron with interior lining complying with AWWA C550 or that is FDA approved] [Steel with interior lining complying with AWWA C550 or that is FDA approved] [Stainless steel].**
 10. End Connections: Flanged.
 11. Configuration: Designed for **[horizontal, straight through] [vertical inlet, horizontal center section, and vertical outlet] [vertical] <Insert configuration>** flow.
 12. Accessories:
 - a. Valves: UL 262, FMG-approved, OS&Y gate type with flanged ends on inlet and outlet.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.
 - c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.
- D. Double-Check, Detector-Assembly Backflow Preventers:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Ames Fire & Waterworks; a division of Watts Regulator Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Watts Water Technologies, Inc.
 - e. Wilkins; a Zurn company.
 - f. **<Insert manufacturer's name.>**
 - g. or approved equal.
 2. Standards: ASSE 1048 and UL listed or FMG approved.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: **[5 psig (35 kPa)] <Insert pressure>** maximum, through middle 1/3 of flow range.

5. Size: <Insert NPS (DN).>
 6. Design Flow Rate: <Insert gpm (L/s).>
 7. Selected Unit Flow Range Limits: <Insert gpm (L/s).>
 8. Pressure Loss at Design Flow Rate: <Insert psig (kPa).>
 9. Body: [**Cast iron with interior lining complying with AWWA C550 or that is FDA approved**] [**Steel with interior lining complying with AWWA C550 or that is FDA approved**] [**Stainless steel**].
 10. End Connections: Flanged.
 11. Configuration: Designed for [**horizontal, straight through**] [**vertical inlet, horizontal center section, and vertical outlet**] [**vertical**] <Insert configuration> flow.
 12. Accessories:
 - a. Valves: UL 262, FMG-approved, OS&Y gate type with flanged ends on inlet and outlet.
 - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.
- E. Pipe-Applied, Atmospheric-Type Vacuum Breakers: ASSE 1001, with floating disc and at-mospheric vent.
- F. Backflow Preventer Test Kits:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Flomatic Corporation.
 - d. Watts Water Technologies, Inc.
 - e. Wilkins; a Zurn company.
 - f. <Insert manufacturer's name.>
 - g. or approved equal.
 2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.24 WATER METER BOXES

- A. Description: Cast-iron body and cover for disc-type water meter, with lettering "WATER METER" in cover; and with slotted, open-bottom base section of length to fit over service piping.
1. Option: Base section may be cast-iron, PVC, clay, or other pipe.
- B. Description: Cast-iron body and double cover for disc-type water meter, with lettering "WATER METER" in top cover; and with separate inner cover; air space between covers; and slotted, open-bottom base section of length to fit over service piping.

- C. Description: Polymer-concrete body and cover for disc-type water meter, with lettering "WATER" in cover; and with slotted, open-bottom base section of length to fit over service piping. Include vertical and lateral design loadings of **15,000 lb minimum over 10 by 10 inches** (6800 kg minimum over 254 by 254 mm) square.

2.25 CONCRETE VAULTS

- A. Description: Precast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C 857 and made according to ASTM C 858.
1. Ladder: ASTM A 36/A 36M, steel or polyethylene-encased steel steps.
 2. Manhole: ASTM A 48/A 48M Class No. 35A minimum tensile strength, gray-iron traffic frame and cover.
 - a. Dimension: **24-inch** (610-mm) minimum diameter, unless otherwise indicated.
 3. Manhole: ASTM A 536, Grade 60-40-18, ductile-iron traffic frame and cover.
 - a. Dimension: **24-inch-** (610-mm-) minimum diameter, unless otherwise indicated.
 4. Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

2.26 PROTECTIVE ENCLOSURES

- A. Freeze-Protection Enclosures:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Aqua Shield.
 - b. BF Products, Inc.
 - c. DekoRRa Products.
 - d. Dunco Manufacturing, Inc.
 - e. G&C Enclosures.
 - f. Hot Box, Inc.
 - g. HydroCowl, Inc.
 - h. Watts Water Technologies, Inc.
 - i. **<Insert manufacturer's name.>**
 - j. or approved equal.
 2. Description: Insulated enclosure designed to protect aboveground water piping, equipment, or specialties from freezing and damage, with heat source to maintain minimum internal temperature of **40 deg F** (4 deg C) when external temperatures reach as low as **minus 34 deg F** (minus 36 deg C).
 - a. Standard: ASSE 1060.

- b. Class I: For equipment or devices other than pressure or atmospheric vacuum breakers.
 - c. Class I-V: For pressure or atmospheric vacuum breaker equipment or devices. Include drain opening in housing.
 - 1) Housing: Reinforced[-aluminum] [or] [-fiberglass] <Insert housing> construction.
 - a) Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
 - b) Drain opening for units with drain connection.
 - c) Access doors with locking devices.
 - d) Insulation inside housing.
 - e) Anchoring devices for attaching housing to concrete base.
 - 2) Electric heating cable or heater with self-limiting temperature control.
- B. Weather-Resistant Enclosures:
- 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Aqua Shield.
 - b. BF Products, Inc.
 - c. DekoRRa Products.
 - d. Dunco Manufacturing, Inc.
 - e. G&C Enclosures.
 - f. Hot Box, Inc.
 - g. HydroCowl, Inc.
 - h. Watts Water Technologies, Inc.
 - i. <Insert manufacturer's name.>
 - j. or approved equal.
 - 2. Description: Uninsulated enclosure designed to protect aboveground water piping, equipment, or specialties from weather and damage.
 - a. Standard: ASSE 1060.
 - b. Class III: For equipment or devices other than pressure or atmospheric vacuum breakers.
 - c. Class III-V: For pressure or atmospheric vacuum breaker equipment or devices. Include drain opening in housing.
 - 1) Housing: Reinforced[-aluminum] [or] [-fiberglass] <Insert housing> construction.
 - a) Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
 - b) Drain opening for units with drain connection.
 - c) Access doors with locking devices.
 - d) Anchoring devices for attaching housing to concrete base.

C. Expanded-Metal Enclosures:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Backflow Prevention Device InnClosures, Inc.
- b. BF Products, Inc.
- c. Cross Brothers, Inc.
- d. Le Meur Welding & Manufacturing Co.
- e. **<Insert manufacturer's name.>**
- f. or approved equal.

2. Description: Enclosure designed to protect aboveground water piping, equipment, or specialties from damage.

- a. Material: ASTM F 1267, expanded metal side and top panels, of weight and with reinforcement of same metal at edges as required for rigidity.
- b. Type: Type[**I, expanded**] [**II, expanded and flattened**].
- c. Class: Class[**1, uncoated carbon steel**] [**2, hot-dip, zinc-coated carbon steel**] [**3, corrosion-resisting steel**].
- d. Finish: Manufacturer's enamel paint.
- e. Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
- f. Locking device.
- g. Lugs or devices for securing enclosure to base.

D. Enclosure Bases:

1. Description: [**4-inch- (100-mm-)**] [**6-inch- (150-mm-)**] minimum thickness precast concrete, of dimensions required to extend at least **6 inches (150 mm)** beyond edges of enclosure housings. Include openings for piping.

2.27 FIRE HYDRANTS

A. Dry-Barrel Fire Hydrants:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. American AVK Co.; Valves & Fittings Div.
- b. American Cast Iron Pipe Co.; American Flow Control Div.
- c. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
- d. American Foundry Group, Inc.
- e. East Jordan Iron Works, Inc.
- f. Grinnell Corporation; Mueller Co.; Water Products Div.
- g. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
- h. McWane, Inc.; Kennedy Valve Div.
- i. McWane, Inc.; M & H Valve Company Div.
- j. Mueller Co.; Water Products Div.
- k. Troy Valve; a division of Penn-Troy Manufacturing, Inc.
- l. U.S. Pipe and Foundry Company.

- m. **<Insert manufacturer's name.>**
 - n. or approved equal.
 - 2. Description: Freestanding, with one **NPS 4-1/2 (DN 115)** and two **NPS 2-1/2 (DN 65)** outlets, **5-1/4-inch (133-mm)** main valve, drain valve, and **NPS 6 (DN 150)** mechanical-joint inlet. Include interior coating according to AWWA C550. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.
 - a. Standard: AWWA C502.
 - b. Pressure Rating: [**150 psig (1035 kPa) minimum**] [**250 psig (1725 kPa)**].
 - 3. Description: Freestanding, with one **NPS 4-1/2 (DN 115)** and two **NPS 2-1/2 (DN 65)** outlets, **5-1/4-inch (133-mm)** main valve, drain valve, and **NPS 6 (DN 150)** mechanical-joint inlet. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.
 - a. Standards: UL 246, FMG approved.
 - b. Pressure Rating: [**150 psig (1035 kPa) minimum**] [**250 psig (1725 kPa)**].
 - c. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
 - d. Operating and Cap Nuts: Pentagon, **1-1/2 inches (38 mm)** point to flat.
 - e. Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise.
 - f. Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.
- B. Wet-Barrel Fire Hydrants:
- 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. American AVK Co.; Valves & Fittings Div.
 - b. Grinnell Corporation; Mueller Co.; Water Products Div.
 - c. Jones, James Company.
 - d. McWane, Inc.; Clow Valve Co. Div. (Corona).
 - e. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - f. Mueller Co.; Water Products Div.
 - g. **<Insert manufacturer's name.>**
 - h. or approved equal.
 - 2. Description: Freestanding, with one **NPS 4-1/2 (DN 115)** and two **NPS 2-1/2 (DN 65)** outlets, **NPS 6 (DN 150)** threaded or flanged inlet, and base section with **NPS 6 (DN 150)** mechanical-joint inlet. Include interior coating according to AWWA C550.
 - a. Standard: AWWA C503.
 - b. Pressure Rating: **150 psig (1035 kPa) minimum**.
 - 3. Description: Freestanding, with one **NPS 4-1/2 (DN 115)** and two **NPS 2-1/2 (DN 65)** outlets, **NPS 6 (DN 150)** threaded or flanged inlet, and base section with **NPS 6 (DN 150)** mechanical-joint inlet.

- a. Standards: UL 246 and FMG approved.
- b. Pressure Rating: 150 psig (1035 kPa) minimum.
- c. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
- d. Operating and Cap Nuts: Pentagon, 1-1/2 inches (38 mm) point to flat.
- e. Direction of Opening: Open hydrant valves by turning operating nut to left or counterclockwise.
- f. Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.

2.28 WALL FIRE HYDRANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Elkhart Brass Mfg. Co., Inc.
2. Fire End & Croker Corporation.
3. Guardian Fire Equipment, Inc.
4. Smith Industries, Inc.; Potter-Roemer Div.
5. <Insert manufacturer's name.>
6. or approved equal.

B. Description: Flush-type, two-way wall hydrant with the following:

1. Body: Bronze or cast iron.
2. Inlet: [NPS 4] [NPS 6].
3. Outlets: Two NPS 2-1/2, with thread according to NFPA 1963 and matching local fire department hose thread. Include lugged caps, gaskets, and chains.
4. Hydrant Escutcheon Plate: Rectangular, with marking "HYDRANT."
5. Hydrant Valve Control: Wall-mounting assembly with extension rod for manual control of valve inside building.
6. Hydrant Valve Escutcheon Plate: Square, with marking "HYDRANT VALVE CONTROL."

C. Finish: [Polished chrome plated] [Rough chrome plated] [Polished bronze].

2.29 FLUSHING HYDRANTS

A. Post-Type Flushing Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. GIL Industries, Inc.
- b. Grinnel Corporation; Mueller Co.; Water Products Div.
- c. Kupferle Foundry Co. (The).
- d. Mueller Co.; Water Products Div.
- e. <Insert manufacturer's name.>
- f. or approved equal.

2. Description: Nonfreeze and drainable, of length required for shutoff valve installation below frost line.
 - a. Pressure Rating: 150 psig (1035 kPa) minimum.
 - b. Outlet: One, with horizontal discharge.
 - c. Hose Thread: NPS 2-1/2 (DN 65), with NFPA 1963 external hose thread for use by local fire department, and with cast-iron cap with brass chain.
 - d. Barrel: Cast-iron or steel pipe with breakaway feature.
 - e. Valve: Bronze body with bronze-ball or plunger closure, and automatic draining.
 - f. Security: Locking device for padlock.
 - g. Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.
 - h. Inlet: NPS 2 (DN 50) minimum.
 - i. Operating Wrench: One for each unit.

- B. Ground-Type Flushing Hydrants:
 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Kupferle Foundry Co. (The).
 - b. Mueller Co.; Water Products Div.
 - c. **<Insert manufacturer's name.>**
 - d. or approved equal.

 2. Description: Nonfreeze and drainable, of length required for shutoff valve installation below frost line.
 - a. Pressure Rating: 150 psig (1035 kPa) minimum.
 - b. Outlet: One, with [vertical] [angle] discharge.
 - c. Hose Thread: NPS 2-1/2 (DN 65), with NFPA 1963 external hose thread for use by local fire department, and with cast-iron cap with brass chain.
 - d. Barrel: Cast-iron or steel pipe.
 - e. Valve: Bronze body with bronze-ball or plunger closure, and automatic draining.
 - f. Inlet: NPS 2 (DN 50) minimum.
 - g. Hydrant Box: Cast iron with cover, for ground mounting.
 - h. Operating Wrench: One for each unit.

- C. Post-Type Sampling Station:
 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. GIL Industries, Inc.
 - b. Kupferle Foundry Co. (The).
 - c. **<Insert manufacturer's name.>**
 - d. or approved equal.

 2. Description: Nonfreeze and drainable, of length required for shutoff valve installation below frost line.

- a. Pressure Rating: 100 psig (690 kPa) minimum.
- b. Sampling Outlet: One unthreaded nozzle with handle.
- c. Valve: Bronze body with bronze-ball or plunger closure. Include operating handle.
- d. Drain: Tubing with separate manual vacuum pump.
- e. Inlet: NPS 3/4 (DN 20) minimum.
- f. Housing: Weatherproof material with locking device. Include anchor device.
- g. Operating Wrench: One for each unit.

2.30 FIRE DEPARTMENT CONNECTIONS

A. Fire Department Connections:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. **AFAC, Inc.; Badger Fire Protection.**
- b. Elkhart Brass Mfg. Co., Inc.
- c. Fire End & Croker Corporation.
- d. Firematic Sprinkler Devices, Inc.
- e. Grinnell Corporation.
- f. Guardian Fire Equipment, Inc.
- g. Kidde Fire Fighting.
- h. Potter Roemer.
- i. Reliable Automatic Sprinkler Co., Inc.
- j. **<Insert manufacturer's name.>**
- k. or approved equal.

2. Description: Freestanding, with cast-bronze body, thread inlets according to NFPA 1963 and matching local fire department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch- (460-mm-) high brass sleeve; and round escutcheon plate.

- a. Standard: UL 405.
- b. Connections: Two NPS 2-1/2 (DN 65) inlets and one [NPS 4 (DN 100)] [NPS 6 (DN 150)] outlet.
- c. Connections: [Three] [Four] NPS 2-1/2 (DN 65) inlets and one NPS 6 (DN 150) outlet.
- d. Connections: Six NPS 2-1/2 (DN 65) inlets and one [NPS 6 (DN 150)] [NPS 8 (DN 200)] outlet.
- e. Inlet Alignment: [Inline, horizontal] [Square].
- f. Finish Including Sleeve: [Polished chrome-plated] [Rough chrome-plated] [Polished bronze].
- g. Escutcheon Plate Marking: "[AUTO SPKR] [&] [STANDPIPE]."

2.31 ALARM DEVICES

- A. Alarm Devices, General: UL 753 and FMG approved, of types and sizes to mate and match piping and equipment.
- B. Water-Flow Indicators: Vane-type water-flow detector, rated for **250-psig** (1725-kPa) working pressure; designed for horizontal or vertical installation; with 2 single-pole, double-throw circuit switches to provide isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal when cover is removed.
- C. Supervisory Switches: Single pole, double throw; designed to signal valve in other than fully open position.
- D. Pressure Switches: Single pole, double throw; designed to signal increase in pressure.

2.32 POST HYDRANTS

- A. General: All-metal lever operation with nondraining water-storage reservoir, designed without drain and to be freezeproof with components of at least length required for burial of valve and water storage reservoir below frost line.
- B. Closed-Reservoir, Nondraining, Nonfreeze Post Hydrants: With lever-piston operating mechanism, NPS 1 threaded inlet, **[NPS 1 outlet and coupling plug for 1-inch hose] [NPS 1 by NPS 3/4 adapter with nonremovable, drainable, hose-connection vacuum breaker com-plying with ASSE 1011 and garden-hose threads complying with ASME B1.20.7 on outlet] [or] [NPS 1 by NPS 3/4 adapter with nonremovable, drainable, hose-connection backflow preventer complying with ASSE 1052 and garden-hose threads complying with ASME B1.20.7 on outlet]**.
 - 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Murdock, Inc.
 - b. **<Insert manufacturer's name.>**
 - c. or approved equal.
- C. Vented-Reservoir, Nondraining, Nonfreeze Post Hydrants: With reservoir venturi and vent devices; NPS 3/4 minimum threaded inlet; nonremovable, drainable, hose-connection **[vacuum breaker complying with ASSE 1011] [or] [backflow preventer complying with ASSE 1052]**; and garden-hose threads complying with ASME B1.20.7 on outlet.
 - 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Hoeptner Products.
 - b. Simmons Manufacturing Co.
 - c. Woodford Manufacturing Co.
 - d. **<Insert manufacturer's name.>**

- e. or approved equal.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground water-service piping [**NPS 3/4 to NPS 3 (DN 20 to DN 80)**] <Insert pipe size range> shall be[**any of**] the following:
1. Soft copper tube, [**ASTM B 88, Type K (ASTM B 88M, Type A)**] [**ASTM B 88, Type L (ASTM B 88M, Type B)**]; [**wrought-copper, solder-joint fittings; and brazed**] [**copper, pressure-seal fittings; and pressure-sealed**] joints.
 2. PE, ASTM pipe; [**insert fittings for PE pipe; and clamped**] [**molded PE fittings; and heat-fusion**] joints.
 3. PVC, Schedule [**40 pipe; PVC, Schedule 40**] [**80 pipe; PVC, Schedule 80**] socket fittings; and solvent-cemented joints.
 4. **NPS 1 to NPS 3 (DN 25 to DN 80)** fiberglass, AWWA RTRP, Class [**150**] [**200**] [**250**]; RTRF; and bonded joints.
 5. Fiberglass, AWWA RTRP, Class [**150**] [**200**] [**250**]; RTRF; and bonded joints.
- F. Underground water-service piping [**NPS 4 to NPS 8 (DN 100 to DN 200)**] <Insert pipe size range> shall be[**any of**] the following:
1. Soft copper tube, [**ASTM B 88, Type K (ASTM B 88M, Type A)**] [**ASTM B 88, Type L (ASTM B 88M, Type B)**]; wrought-copper, solder-joint fittings; and brazed joints.
 2. Ductile-iron, [**push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed**] [**mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical**] [**grooved-end pipe; ductile-iron-pipe appurtenances; and grooved**] joints.
 3. PE, AWWA pipe; PE, AWWA fittings; and heat-fusion joints.
 4. PVC, Schedule [**40 pipe; PVC, Schedule 40**] [**80 pipe; PVC, Schedule 80**] socket fittings; and solvent-cemented joints.

5. **NPS 4 and NPS 6** (DN 100 and DN 150): **NPS 6** (DN 150) PVC, AWWA Class 150 pipe; PVC, AWWA Class 150 **[fabricated] [or] [molded]** fittings; and gasketed joints.
 6. **NPS 8** (DN 200): PVC, AWWA Class 200 pipe; **[PVC, AWWA Class 200 fabricated] [push-on-joint, ductile-iron] [mechanical-joint, ductile-iron]** fittings; and gasketed joints.
 7. Fiberglass, AWWA RTRP, Class **[150] [200] [250]**; RTRF; and bonded joints.
- G. Water Meter Box Water-Service Piping [**NPS 3/4 to NPS 2** (DN 20 to DN 50)] **<Insert pipe size range>** shall be same as underground water-service piping.
- H. Aboveground[**and Vault**] Water-Service Piping [**NPS 3/4 to NPS 3** (DN 20 to DN 80)] **<Insert pipe size range>** shall be[**any of**] the following:
1. Hard copper tube, [**ASTM B 88, Type K** (ASTM B 88M, Type A)] [**ASTM B 88, Type L** (ASTM B 88M, Type B)]; **[wrought-copper, solder-joint fittings; and brazed] [copper, pressure-seal fittings; and pressure-sealed]** joints.
 2. PVC, Schedule 80 pipe; PVC, Schedule 80 **[socket fittings; and solvent-cemented] [threaded fittings; and threaded]** joints.
 3. **NPS 1 to NPS 2** (DN 25 to DN 50) fiberglass, AWWA RTRP, Class **[150] [200] [250]**; RTRF; and bonded joints.
- I. Aboveground [**and vault**] water-service piping [**NPS 4 to NPS 8** (DN 100 to DN 200)] **<Insert pipe size range>** shall be[**any of**] the following:
1. Hard copper tube, [**ASTM B 88, Type K** (ASTM B 88M, Type A)] [**ASTM B 88, Type L** (ASTM B 88M, Type B)]; wrought-copper, solder-joint fittings; and brazed joints.
 2. Ductile-iron, grooved-end pipe; ductile-iron, grooved-end appurtenances; and grooved joints.
 3. PVC, Schedule 80 pipe; PVC, Schedule 80 **[socket fittings; and solvent-cemented] [threaded fittings; and threaded]** joints.
 4. Fiberglass, AWWA RTRP, Class **[150] [200] [250]**; RTRF; and bonded joints.
- J. Underground Fire-Service-Main Piping [**NPS 4 to NPS 12** (DN 100 to DN 300)] **<Insert pipe size range>** shall be[**any of**] the following:
1. Ductile-iron, **[push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed] [mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical] [grooved-end pipe; ductile-iron-pipe appurtenances; and grooved]** joints.
 2. PE, Class **[150] [200]**, fire-service pipe; molded PE fittings; and heat-fusion joints.
 3. PVC, AWWA Class 150 pipe listed for fire-protection service; PVC Class 150 fabricated or molded fittings; and gasketed joints.
 4. PVC, AWWA Class 200 pipe listed for fire-protection service; PVC Class 200 fabricated fittings; and gasketed joints.
 5. Fiberglass, AWWA, FMG-approved RTRP, Class **[150] [200]**; RTRF; and gasketed joints.
 6. Fiberglass, UL RTRP, Class **[150] [200] [250]**; RTRF; and gasketed joints.

- K. Aboveground[**and Vault**] Fire-Service-Main Piping [**NPS 4 to NPS 12 (DN 100 to DN 300)**] **<Insert pipe size range>** shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.
- L. Underground Combined Water-Service and Fire-Service-Main Piping [**NPS 6 to NPS 12 (DN 150 to DN 300)**] **<Insert pipe size range>** shall be[**any of**] the following:
1. Ductile-iron, [**push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed**] [**mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical**] [**grooved-end pipe; ductile-iron-pipe appurtenances; and grooved**] joints.
 2. PVC, AWWA Class [**150**] [**200**] pipe listed for fire-protection service; PVC fabricated or molded fittings of same class as pipe; and gasketed joints.
 3. Fiberglass, AWWA, FMG-approved RTRP, Class [**150**] [**200**]; RTRF; and gasketed joints.
- M. Aboveground[**and Vault**] Combined Water Service and Fire-Service-Main Piping [**NPS 6 to NPS 12 (DN 150 to DN 300)**] **<Insert pipe size range>** shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.

3.3 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for **NPS 3 (DN 80)** and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for **NPS 2 (DN 50)** and smaller installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Underground Valves, **NPS 3 (DN 80)** and Larger: AWWA, cast-iron, nonrising-stem, [**metal**] [**resilient**] [**high-pressure, resilient**]-seated gate valves with valve box.
 2. Underground Valves, **NPS 4 (DN 100)** and Larger, for Indicator Posts: UL/FMG, cast-iron, nonrising-stem gate valves with indicator post.
 3. Use the following for valves in vaults and aboveground:
 - a. Gate Valves, **NPS 2 (DN 50)** and Smaller: Bronze, [**nonrising**] [**rising**] stem.
 - b. Gate Valves, **NPS 3 (DN 80)** and Larger: [**AWWA, cast iron, OS&Y rising stem, metal seated**] [**AWWA, cast iron, OS&Y rising stem, resilient seated**] [**UL/FMG, cast iron, OS&Y rising stem**].
 - c. Check Valves: [**AWWA C508**] [**UL/FMG**], swing type.
 4. Pressure-Reducing Valves: Use for water-service piping in vaults and aboveground to control water pressure.
 5. Relief Valves: Use for water-service piping in vaults and aboveground.

- a. Air-Release Valves: To release accumulated air.
 - b. Air/Vacuum Valves: To release or admit large volume of air during filling of piping.
 - c. Combination Air Valves: To release or admit air.
6. Detector Check Valves: Use for water-service piping in vaults and aboveground to detect unauthorized use of water.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. See Section 330500 "Common Work Results for Utilities" for piping-system common requirements.

3.5 PIPING INSTALLATION

- A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.
- B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
- C. Make connections larger than **NPS 2 (DN 50)** with tapping machine according to the following:
1. Install tapping sleeve and tapping valve according to MSS SP-60.
 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- D. Make connections **NPS 2 (DN 50)** and smaller with drilling machine according to the following:
1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
 2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
 3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
 4. Install corporation valves into service-saddle assemblies.
 5. Install manifold for multiple taps in water main.
 6. Install curb valve in water-service piping with head pointing up and with service box.
- E. Comply with NFPA 24 for fire-service-main piping materials and installation.

1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
 2. Install copper tube and fittings according to CDA's "Copper Tube Handbook."
- F. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
- G. Install PE pipe according to ASTM D 2774 and ASTM F 645.
- H. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.
- I. Install fiberglass AWWA pipe according to AWWA M45.
- J. Bury piping with depth of cover over top at least **[30 inches (750 mm)]** <Insert dimension>, with top at least **[12 inches (300 mm)]** <Insert dimension> below level of maximum frost penetration, and according to the following:
1. Under Driveways: With at least **[36 inches (910 mm)]** <Insert dimension> cover over top.
 2. Under Railroad Tracks: With at least **[48 inches (1220 mm)]** <Insert dimension> cover over top.
 3. In Loose Gravelly Soil and Rock: With at least **[12 inches (300 mm)]** <Insert dimension> additional cover.
- K. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- L. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- M. Sleeves are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- N. Mechanical sleeve seals are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- O. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
- P. See Section 211200 "Fire-Suppression Standpipes," Section 211313 "Wet-Pipe Sprinkler Systems," and Section 211316 "Dry-Pipe Sprinkler Systems" for fire-suppression-water piping inside the building.

- Q. See Section 221116 "Domestic Water Piping" for potable-water piping inside the building.

3.6 JOINT CONSTRUCTION

- A. See Section 330500 "Common Work Results for Utilities" for basic piping joint construction.
- B. Make pipe joints according to the following:
1. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.
 2. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
 3. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
 4. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
 5. PE Piping Insert-Fitting Joints: Use plastic insert fittings and fasteners according to fitting manufacturer's written instructions.
 6. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
 7. Fiberglass Piping Bonded Joints: Use adhesive and procedure recommended by piping manufacturer.
 8. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 - a. Dielectric Fittings for [NPS 2 (DN 50)] <Insert pipe size> and Smaller: Use dielectric [nipples] [unions].
 - b. Dielectric Fittings for [NPS 2-1/2 to NPS 4 (DN 65 to DN 100)] <Insert pipe size range>: Use dielectric [flanges] [flange kits] [nipples].
 - c. Dielectric Fittings for [NPS 5 (DN 125)] <Insert pipe size> and Larger: Use dielectric flange kits.

3.7 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
1. Concrete thrust blocks.
 2. Locking mechanical joints.
 3. Set-screw mechanical retainer glands.
 4. Bolted flanged joints.
 5. Heat-fused joints.
 6. Pipe clamps and tie rods.
 7. <Insert devices.>

- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 - 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
 - 2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
 - 3. Bonded-Joint Fiberglass, Water-Service Piping: According to AWWA M45.
 - 4. Fire-Service-Main Piping: According to NFPA 24.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.8 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
- C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
- D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.
- E. MSS Valves: Install as component of connected piping system.
- F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.
- G. Pressure-Reducing Valves: Install in vault or aboveground between shutoff valves. [**Install full-size valved bypass.**]
- H. Relief Valves: Comply with AWWA C512. Install aboveground with shutoff valve on inlet.

3.9 DETECTOR-CHECK VALVE INSTALLATION

- A. Install in vault or aboveground.
- B. Install for proper direction of flow. Install bypass with water meter, gate valves on each side of meter, and check valve downstream from meter.
- C. Support detector check valves, meters, shutoff valves, and piping on brick or concrete piers.

3.10 WATER METER INSTALLATION

- A. Install water meters, piping, and specialties according to utility company's written instructions.

- B. Water Meters: Install **[displacement] [turbine]**-type water meters, **NPS 2 (DN 50)** and smaller, in meter boxes with shutoff valves on water meter inlets. Include valves on water meter outlets and valved bypass around meters unless prohibited by authorities having jurisdiction.
- C. Water Meters: Install **[compound] [turbine]**-type water meters, **NPS 3 (DN 80)** and larger, in meter vaults. Include shutoff valves on water meter inlets and outlets and valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.
- D. Water Meters: Install detector-type water meters in meter vault according to AWWA M6. Include shutoff valves on water meter inlets and outlets and full-size valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.

3.11 ROUGHING-IN FOR WATER METERS

- A. Rough-in piping and specialties for water meter installation according to utility company's written instructions.

3.12 VACUUM BREAKER ASSEMBLY INSTALLATION

- A. Install pressure vacuum breaker assemblies of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install pressure vacuum breaker assemblies in vault or other space subject to flooding.

3.13 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.
- D. Support **NPS 2-1/2 (DN 65)** and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.14 WATER METER BOX INSTALLATION

- A. Install water meter boxes in paved areas flush with surface.

- B. Install water meter boxes in grass or earth areas with top [2 inches (50 mm)] <Insert dimension> above surface.

3.15 CONCRETE VAULT INSTALLATION

- A. Install precast concrete vaults according to ASTM C 891.

3.16 PROTECTIVE ENCLOSURE INSTALLATION

- A. Install concrete base level and with top approximately [2 inches (50 mm)] <Insert measurement> above grade.
- B. Install protective enclosure over valves and equipment.
- C. Anchor protective enclosure to concrete base.

3.17 FIRE HYDRANT INSTALLATION

- A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.
- B. Wet-Barrel Fire Hydrants: Install with valve below frost line. Provide for drainage.
- C. AWWA Fire Hydrants: Comply with AWWA M17.
- D. UL/FMG Fire Hydrants: Comply with NFPA 24.

3.18 FLUSHING HYDRANT INSTALLATION

- A. Install post-type flushing hydrants with valve below frost line and provide for drainage. Support in upright position. Include separate gate valve or curb valve and restrained joints in supply piping.
- B. Install ground-type flushing hydrants with valve below frost line and provide for drainage. Install hydrant box flush with grade. Include separate gate valve or curb valve and restrained joints in supply piping.
- C. Install sampling stations with valve below frost line and provide for drainage. Attach weather-resistant housing and support in upright position. Include separate curb valve in supply piping.

3.19 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Install ball drip valves at each check valve for fire department connection to mains.

- B. Install protective pipe bollards [**on two sides of**] [**on three sides of**] <**Describe arrangement**> each fire department connection. Pipe bollards are specified in Section 055000 "Metal Fabrications."

3.20 ALARM DEVICE INSTALLATION

- A. General: Comply with NFPA 24 for devices and methods of valve supervision. Underground valves with valve box do not require supervision.
- B. Supervisory Switches: Supervise valves in open position.
 - 1. Valves: Grind away portion of exposed valve stem. Bolt switch, with plunger in stem depression, to OS&Y gate-valve yoke.
 - 2. Indicator Posts: Drill and thread hole in upper-barrel section at target plate. Install switch, with toggle against target plate, on barrel of indicator post.
- C. Locking and Sealing: Secure unsupervised valves as follows:
 - 1. Valves: Install chain and padlock on open OS&Y gate valve.
 - 2. Post Indicators: Install padlock on wrench on indicator post.
- D. Pressure Switches: Drill and thread hole in exposed barrel of fire hydrant. Install switch.
- E. Water-Flow Indicators: Install in water-service piping in vault. Select indicator with saddle and vane matching pipe size. Drill hole in pipe, insert vane, and bolt saddle to pipe.
- F. Connect alarm devices to building fire alarm system. Wiring and fire-alarm devices are specified in Section 283111 "Digital, Addressable Fire-Alarm System" and Section 283112 "Zoned (DC Loop) Fire-Alarm System."

3.21 CONNECTIONS

- A. See Section 330500 "Common Work Results for Utilities" for piping connections to valves and equipment.
- B. Connect water-distribution piping to [**utility water main**] [**existing water main**] <**Insert piping system**>. Use [**tapping sleeve and tapping valve**] [**service clamp and corporation valve**] <**Insert method**>.
- C. Connect water-distribution piping to interior [**domestic water**] [**and**] [**fire-suppression**] piping.
- D. Connect waste piping from concrete vault drains to [**sanitary sewerage system. See Section 221313 "Facility Sanitary Sewers" for connection to sanitary-sewer**] [**storm-drainage system. See Section 334100 "Storm Utility Drainage Piping" for connection to storm-sewer**] piping.

- E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.22 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
 - 1. Increase pressure in **50-psig (350-kPa)** increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to **0 psig (0 kPa)**. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is **2 quarts (1.89 L)** per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- C. Prepare reports of testing activities.

3.23 IDENTIFICATION

- A. Install continuous underground[**detectable**] warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."
- B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Section 330500 "Common Work Results for Utilities" for identifying devices.

3.24 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 - 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

- a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 221113

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
 - 2. Encasement for piping.

- B. Related Requirements:

- 1. Section 221113 "Facility Water Distribution Piping" for water-service piping[**and water meters**] outside the building from source to the point where water-service piping enters the building.

1.3 ACTION SUBMITTALS

- A. Product Data: For transition fittings, dielectric fittings, and accessories.

- 1. Include data substantiating that materials comply with requirements.

- B. Welders Certificate: Include welders' certification of compliance with [**ASME SEC 9**] [**AWS D1.1.**] [_____] and section 059990 "Welding".

- C. Contractor shall submit fully dimensioned spool drawings for all welded piping work. Drawings shall indicate all weld types, sizes, and materials to be used. The spool drawing size shall match the full size contract documents of either 24x36 or 34x44. Spool drawings shall be submitted in either the latest version of AutoCAD (dwg) or the latest version of Adobe Acrobat (pdf). Adobe Acrobat files shall not contain security. Other file formats will not be accepted.

- D. LEED Submittals:

- 1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard

Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.4 INFORMATIONAL SUBMITTALS

- A. Pneumatic Leak Test for water systems:
 - 1. Contractor shall submit drawings and procedures of the pneumatic leak test to the DEN Mechanical Engineer no later than two (2) weeks prior to testing. Contractor may not proceed with tests unless approved in writing by the DEN Mechanical Engineer or DEN Mechanical Inspector.
- B. Disinfection and other Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
- C. Test procedures used.
- D. Test results that comply with requirements.
- E. Failed test results and corrective action taken to achieve requirements

1.5 CLOSEOUT SUBMITTALS

- A. "As Built" Plans shall be provided in the same format and manner as described above. Each set shall be equipped with a plan holder equal to "Stacor Plan Clamps" for the appropriate size drawings.
- B. Record actual locations of valves.
- C. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.6 EXTRA MATERIALS

- A. Provide two (2) repacking kits for each type and size valve.

1.7 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- C. Welders Certification: In accordance with ASME Sec 9.
- D. Unless specified otherwise, all materials and equipment shall be of domestic (USA) manufacture and shall be of the best quality used for the purpose in commercial

practice.

1.8 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with City and County of Denver plumbing code.
- B. Conform to code for installation of backflow prevention devices.

1.9 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify DEN Project Manager no fewer than **[two]** <Insert number> days in advance of proposed interruption of water service.
 - 2. Do not interrupt water service without DEN Project Manager's written permission.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: **[ASTM B 88, Type L (ASTM B 88M, Type B)] [and] [ASTM B 88, Type M (ASTM B 88M, Type C)]** water tube, drawn temper.
- B. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

D. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

2.3 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe:

1. ASTM A 53/A 53M, [**Type E**] [S] [E or S] <Insert type>, [Grade A] [**Grade B**] [Grade A or B] <Insert grade>, Standard Weight.
2. Include ends matching joining method.

B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless steel pipe with threaded ends.

C. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

D. Malleable-Iron Unions:

1. ASME B16.39, Class 150.
2. Hexagonal-stock body.
3. Ball-and-socket, metal-to-metal, bronze seating surface.
4. Threaded ends.

E. Flanges: ASME B16.1, Class 125, cast iron.

F. Appurtenances for Grooved-End, Galvanized-Steel Pipe:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Anvil International.
- b. Grinnell Mechanical Products; Tyco Fire Products LP.
- c. Shurjoint Piping Products.
- d. Victaulic Company.
- e. <Insert manufacturer's name>.
- f. or approved equal.

2. Fittings for Grooved-End, Galvanized-Steel Pipe: Galvanized, ASTM A 47/A 47M, malleable-iron casting; ASTM A 106/A 106M, steel pipe; or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.

3. Fittings for Grooved-End, Galvanized-Steel Pipe:

- a. AWWA C606 for steel-pipe dimensions.
- b. Ferrous housing sections.
- c. EPDM-rubber gaskets suitable for hot and cold water.
- d. Bolts and nuts.

e. Minimum Pressure Rating:

- 1) NPS 8 (DN 200) and Smaller: [600 psig (4137 kPa)] <Insert value>.
 - 2) NPS 10 and NPS 12 (DN 250 to DN 300): [400 psig (2758 kPa)] <Insert value>.
 - 3) NPS 14 to NPS 24 (DN 350 to DN 600): [250 psig (1725 kPa)] <Insert value>.
4. Steel-Piping, Expansion Joints: Compound, galvanized steel fitting with telescoping body and slip-pipe section. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.
 5. Steel-Piping, Double Expansion Joints: Compound, galvanized steel fitting with telescoping body and two slip-pipe sections. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.

2.4 CPVC PIPING

- A. CPVC Pipe: ASTM F 441/F 441M, [Schedule 40] [and] [Schedule 80], plenum-rated.
 1. CPVC Socket Fittings: [ASTM F 438 for Schedule 40] [and] [ASTM F 439 for Schedule 80], plenum-rated.
 2. CPVC Threaded Fittings: ASTM F 437, Schedule 80, plenum rated.
- B. CPVC Piping System: ASTM D 2846/D 2846M, SDR 11, pipe and socket fittings, plenum-rated.
- C. CPVC Tubing System: ASTM D 2846/D 2846M, SDR 11, tube and socket fittings, plenum-rated.

2.5 PEX TUBE AND FITTINGS

- A. PEX Distribution System: ASTM F 877, SDR 9 tubing, plenum-rated.
- B. Fittings for PEX Tube: ASTM F 1807, metal-insert type with copper or stainless-steel crimp rings and matching PEX tube dimensions, plenum-rated.
- C. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 877; with plastic or corrosion-resistant-metal valve for each outlet.

2.6 PEX-AL-PEX TUBE AND FITTINGS

- A. PEX-AL-PEX Distribution System: ASTM F 1281 tubing, plenum-rated.
- B. Fittings for PEX-AL-PEX Tube: ASTM F 1281, metal-insert type with copper or stainless-steel crimp rings and matching PEX-AL-PEX tube dimensions, plenum-rated.

2.7 PEX-AL-HDPE TUBE AND FITTINGS

- A. PEX-AL-HPDE Distribution System: ASTM F 1986 tubing, plenum-rated.
- B. Fittings for PEX-AL-HDPE Tube: ASTM F 1986, metal-insert type with copper or stainless-steel crimp ring and matching PEX-AL-HDPE tube dimensions, plenum-rated.

2.8 PVC PIPE AND FITTINGS

- A. PVC Pipe: ASTM D 1785, [**Schedule 40**] [**and**] [**Schedule 80**], plenum-rated.
- B. PVC Socket Fittings: [**ASTM D 2466 for Schedule 40**] [**and**] [**ASTM D 2467 for Schedule 80**], plenum-rated.
- C. PVC Schedule 80 Threaded Fittings: ASTM D 2464, plenum-rated.

2.9 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
 - 1. AWWA C110/A21.10, rubber, flat face, **1/8 inch (3.2 mm)** thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
 - 1. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- G. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

H. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.10 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105/A21.5.
- B. Form: **[Sheet]** **[or]** **[tube]**.
- C. Color: **[Black]** **[or]** **[natural]** **<Insert color>**.

2.11 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Cascade Waterworks Manufacturing.
- b. Dresser, Inc.; Piping Specialties Products.
- c. Ford Meter Box Company, Inc. (The).
- d. JCM Industries.
- e. Romac Industries, Inc.
- f. Smith-Blair, Inc.; a Sensus company.
- g. Viking Johnson.
- h. **<Insert manufacturer's name>**.
- i. or approved equal.

D. Plastic-to-Metal Transition Fittings:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Charlotte Pipe and Foundry Company.
- b. Harvel Plastics, Inc.
- c. Spears Manufacturing Company.
- d. **<Insert manufacturer's name>**.
- e. or approved equal.

2. Description:

- a. **[CPVC] [or] [PVC]** one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
- b. One end with threaded brass insert and one solvent-cement-socket[**or threaded**] end.

E. Plastic-to-Metal Transition Unions:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Colonial Engineering, Inc.
- b. NIBCO Inc.
- c. Spears Manufacturing Company.
- d. **<Insert manufacturer's name>**.
- e. or approved equal.

2. Description:

- a. **[CPVC] [or] [PVC]** four-part union.
- b. Brass[**or stainless-steel**] threaded end.
- c. Solvent-cement-joint[**or threaded**] plastic end.
- d. Rubber O-ring.
- e. Union nut.

2.12 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
- b. Central Plastics Company.
- c. Elster-Perfection Corporation.
- d. Hart Industries International, Inc.

- e. Jomar International.
 - f. Matco-Norca.
 - g. McDonald, A. Y. Mfg. Co.
 - h. Watts; a division of Watts Water Technologies, Inc.
 - i. Wilkins; a Zurn company.
 - j. **<Insert manufacturer's name>**.
 - k. or approved equal.
2. Standard: ASSE 1079.
 3. Pressure Rating: [125 psig (860 kPa) **minimum at 180 deg F (82 deg C)**] [150 psig (1035 kPa)] [250 psig (1725 kPa)] **<Insert value>**.
 4. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
 - b. Central Plastics Company.
 - c. Elster-Perfection Corporation.
 - d. Matco-Norca.
 - e. Watts; a division of Watts Water Technologies, Inc.
 - f. Wilkins; a Zurn company.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
 2. Standard: ASSE 1079.
 3. Factory-fabricated, bolted, companion-flange assembly.
 4. Pressure Rating: [125 psig (860 kPa) **minimum at 180 deg F (82 deg C)**] [150 psig (1035 kPa)] [175 psig (1200 kPa)] [300 psig (2070 kPa)] **<Insert value>**.
 5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
1. Except as otherwise specifically indicated, insulating joint assemblies shall be provided at all riser locations where buried metallic piping (other than copper piping 2 inches or smaller in size) transitions to aboveground extensions. Assemblies shall consist of dielectric fittings or insulating flange assemblies as appropriate for the application. Insulating flange assemblies shall conform to the following requirements:
 - a. Flanged joints shall include full face insulating gaskets, insulating bolt sleeves and double quantity of insulating washers and stainless steel washers.
 - b. Insulating materials shall be as follows:
 - 1) Gasket: NEMA Grade G10 retainer conforming to ASTM D 229 with Teflon ring seal on each side of the retainer. Minimum dielectric

- strength shall be 500 volts per mil (VPM). Compressive strength shall be 50,000 psi. Water absorption shall be 0.05 percent (max.)
- 2) Sleeves: Shall be 1/32-inch wall thickness, length to suit two class 150 lb. weld neck flanges, insulating gaskets and valve body thickness. Sleeve shall provide "full" insulation of studs; minimum dielectric strength shall be 500 VPM. Material shall be NEMA Grade G10.
 - 3) Insulating washers: NEMA Grade G10, 1/8-inch thick (minimum).
2. Install insulating joints at the locations indicated on the drawings. Where not shown on the drawings, they shall be installed within 24 inches of the location at which underground piping transitions to aboveground or within-structure extension.
 3. Insulating assemblies shall provide a minimum resistance of 500,000 ohms when tested.
 4. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Elster-Perfection Corporation.
 - e. Pipeline Seal and Insulator, Inc.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
 5. Nonconducting materials for field assembly of companion flanges.
 6. Pressure Rating: [150 psig (1035 kPa)] **<Insert value>**.
 7. Gasket: Neoprene or phenolic.
 8. Bolt Sleeves: Phenolic or polyethylene.
 9. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Elster Perfection Corporation.
 - b. Grinnell Mechanical Products; Tyco Fire Products LP.
 - c. Matco-Norca.
 - d. Precision Plumbing Products, Inc.
 - e. Victaulic Company.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
 2. Standard: IAPMO PS 66.
 3. Electroplated steel nipple complying with ASTM F 1545.

4. Pressure Rating and Temperature: [300 psig (2070 kPa) at 225 deg F (107 deg C)] <Insert values>.
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.3 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.4 EXCAVATION

- A. Excavate and backfill in accordance with Division 31 requirements for work of this Section.
- B. All piping installed below concrete slabs, aprons or roadways shall be encased in flowable backfill. Refer to Section 033350 "Flowable Backfill Low-Strength Concrete".

3.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products under provisions of Section 220400 "Basic Plumbing Requirements" and Division 01.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

3.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

3.7 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install underground [**copper tube**] [**and**] [**ductile-iron pipe**] in PE encasement according to ASTM A 674 or AWWA C105/A21.5.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- H. Install domestic water piping level [**with 0.25 percent slope downward toward drain**] [**without pitch**] and plumb.
- I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

- L. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- N. Install piping to permit valve servicing.
- O. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- P. Install piping free of sags and bends.
- Q. Install fittings for changes in direction and branch connections.
- R. Install PEX piping with loop at each change of direction of more than 90 degrees.
- S. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- T. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."
- U. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."
- V. Install thermometers on[**inlet and**] outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."
- Z. Provide dielectric fittings wherever jointing dissimilar metals.
- AA. Route piping in orderly manner and maintain gradient.
- BB. Install piping to conserve building space and not interfere with use of space. Refer to Section 220400 "Basic Plumbing Requirements" for coordination requirements.

- CC. Group piping whenever practical at common elevations.
- DD. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- EE. Provide clearance for installation of insulation and access to valves and fittings.
- FF. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Division 08 installer.
- GG. Slope water piping and arrange to drain at low points.
- HH. Establish elevations of buried water piping outside the building at depth of not less than 12 inches below average local frost depth or as required under applicable codes. Consult with water supply utility company and provide [**meter pits,**] [**curb stops,**] [**vaults,**] meter bypass, and equipment as required.
- II. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- JJ. Provide support for utility meters in accordance with requirements of utility companies.
- KK. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting. Refer to Division 09 Sections.
- LL. Install valves with stems upright or horizontal, not inverted.
- MM. Provide one plug cock wrench for every ten plug cocks sized 2 inches and smaller, minimum of one. Provide each plug cock sized 2-1/2 inches or larger with a wrench with set screw.
- NN. Vents less than six inches above the flood level rim of the fixture shall be installed with approved drainage fittings and materials, and grade to drain.
- OO. Lever handle valves: Install valve handle so that the handle opens in the direction of fluid flow.
- PP. Install a cleanout in the vertical riser (vent to drain transition) above the connection to each urinal to allow for individual cleaning of each fixture drain.
- QQ. Install ABS soil and waste drainage and vent piping according to ASTM D2661.
- RR. Install PVC soil and waste drainage and vent piping according to ASTM D2665.
- SS. Install underground [**ABS**] [**and**] [**PVC**] soil and waste drainage piping according to ASTM D2321.

3.8 APPLICATION

- A. Provide and install unions downstream of valves and at equipment or apparatus

connections.

- B. Provide and install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
- C. Provide and install ball or butterfly valves for shut-off and to isolate all equipment, isolate connections to existing piping mains, part of systems as indicated, and/or vertical risers.
- D. Provide and install **[globe]** **[ball]** **[butterfly]** valves for throttling, bypass, or manual flow control services.
- E. Provide and install spring loaded check valves on discharge of water pumps.
- F. Provide and install flow controls in water recirculating systems where indicated.

3.9 ERECTION TOLERANCES

- A. Establish invert elevations, slopes for drainage to **[1/4]** [_____] inch per foot (**[2]** **[one]** [_____] percent) minimum. Maintain gradients.
- B. Slope water piping and arrange to drain at low points.

3.10 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

- G. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- H. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. **[Square cut] [Roll]** groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- I. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- J. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Piping: Join according to ASTM D 2855.
- K. Joints for PEX Piping: Join according to ASTM F 1807.
- L. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.11 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for **NPS 1-1/2 (DN 40)** and Smaller: Fitting-type coupling.
 - 2. Fittings for **NPS 2 (DN 50)** and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping **NPS 2 (DN 50)** and Smaller: Plastic-to-metal transition **[fittings] [or] [unions]**.

3.12 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for **[NPS 2 (DN 50)] <Insert pipe size>** and Smaller: Use dielectric **[couplings] [couplings or nipples] [nipples] [unions]**.
- C. Dielectric Fittings for **[NPS 2-1/2 to NPS 4 (DN 65 to DN 100)] <Insert pipe size range>**: Use dielectric **[flanges] [flange kits] [nipples]**.

- D. Dielectric Fittings for [NPS 5 (DN 125)] <Insert pipe size> and Larger: Use dielectric flange kits.

3.13 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
1. Vertical Piping: MSS Type 8 or 42, clamps.
 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
 3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
 5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
 6. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
 7. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
- F. Install supports for vertical copper tubing every 10 feet (3 m).
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.

5. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
 8. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
- H. Install supports for vertical steel piping every 15 feet (4.5 m).
- I. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 5. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
 8. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
- J. Install supports for vertical stainless-steel piping every 15 feet (4.5 m).
- K. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
 2. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 3. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 4. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 5. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 6. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
- L. Install supports for vertical CPVC piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
- M. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1 (DN 25) and Smaller: 32 inches (815 mm) with 3/8-inch (10-mm) rod.
- N. Install hangers for vertical PEX piping every 48 inches (1200 mm).
- O. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 2 (DN 50) and Smaller: 48 inches (1200 mm) with 3/8-inch (10-mm) rod.

2. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 4. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 5. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
- P. Install supports for vertical PVC piping every 48 inches (1200 mm).
- Q. Install vinyl-coated hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
 2. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 3. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 4. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 5. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 6. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
- R. Install supports for vertical PP piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
- S. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.
- 3.14 SERVICE CONNECTIONS
- A. Provide new services to the extent indicated on the drawings. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
 - B. Provide new water service complete with [**reduced pressure backflow preventer and**] water meter with by-pass valves [**and sand strainer**]. [**Provide sleeve in wall for service main and support at wall with reinforced concrete bridge**. Caulk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.]
 - C. Provide 18 gage galvanized sheet metal sleeve around service main to 6 inch above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.
- 3.15 CONNECTIONS
- A. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

3.16 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

3.17 FIELD QUALITY CONTROL

- A. Perform the following inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Perform the Following Piping Tests:

1. Perform all tests in the presence of the authorized City representative when required. Contractor shall provide inspector 48-hour prior notice of test; also notify DEN Project Manager.
2. Test soil, waste, and vent and roof drainage and drain systems with a minimum of 10-foot hydrostatic head or in accordance with local and state codes governing plumbing and drainage work.
3. Hydrostatic Leak Test:
 - a. Perform hydrostatic leak test on all piping systems prior to making final connections to fixtures and equipment.
 - b. Hydrostatic Leak Test Procedure:
 - 1) Leak test procedures shall comply with ASME B31.9.
 - 2) Fill piping systems with clear water, vent all air, and pressurize at 150% of operating pressure, (but not less than 100 psi or more than the pipe rating pressure) for 15 minutes. Test fails if leakage is observed, or pressure drop exceeds 5% of test pressure.
4. No piping or joint shall be left untested. All leaks shall be repaired and the piping system shall be re-tested until satisfactory results are obtained.
5. Pneumatic Leak Test:
 - a. General: Pneumatic leak tests shall only be used on piping with restricted access, piping exposed to freezing conditions, or where water leakage would damage critical DEN operational equipment.
 - 1) Contractor shall submit a written request for test in accordance with the SUBMITTALS Article of this specification Section.
 - b. Pneumatic Test Procedure:
 - 1) Contractor shall submit safety plan for pneumatic testing prior to test.
 - 2) General: Compressed gas poses the risk of sudden release of stored energy. For that reason, pneumatic testing shall be used only within the following limitations:
 - a) The piping system does not contain cast iron pipe or plastic pipe subject to brittle failure.
 - b) The system does not contain soldered or solvent cement joints over NPS 2.
 - c) The test pressure does not exceed 150 psig.
 - 3) Test Medium: The gas shall be nonflammable and nontoxic.
 - 4) Preliminary Test: Prior to application of full pneumatic test pressure, a preliminary test of not more than 10 psig shall be applied to reveal possible major leaks. Pneumatic test pressure is as follows:

- a) Except as limited in Subparagraph b below, the test pressure shall not exceed 1.25 times the design pressure. Pressure shall be applied in several stages, allowing time for the system to reach equilibrium at each stage.
 - b) The test pressure shall not exceed the maximum allowable pneumatic test pressure for any vessel, pump, valve, or other component in the system under test.
- 5) Examination for Leakage: After the preliminary test, pressure shall be raised in stages of not more than 25% up to full pneumatic test pressure, allowing time for equalization of strains and detection of major leaks at each stage. Following the application of test pressure for at least 10 minutes, the pressure may be reduced to design pressure and examination shall be made for leakage of the piping. Leaks may be detected by soap bubble, halogen gas, scented gas, test gage monitoring, ultrasonic, or other suitable means. If leaks are found, pressure shall be vented, appropriate repair or replacement shall be made, and the pneumatic test repeated until no leakage is found.
- 6) Contractor shall measure the surface temperature of the pipe for the duration of testing. The pneumatic test will be deemed successful only when the test pressure can be held at a constant pipe surface temperature for a period of no less than 10 continuous minutes. Record of the pipe temperatures and pressures during the duration of the test shall be submitted to the DEN Project Manager following completion of the test.
6. Testing shall be witnessed by DEN Mechanical Inspector and DEN Project Manager or Designated Representative.
 7. Repair piping systems which fail required piping test, by disassembly and reinstallation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.
 8. Drain test water from piping systems after testing and repair work that has been completed.
 9. Prepare written report of testing procedures and result. Submit in accordance with Section 220400 "Basic Plumbing Requirements".

3.18 ADJUSTING

- A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
 2. Open shutoff valves to fully open position.
 3. Open throttling valves to proper setting.
 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

- a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.19 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed, and clean.
- B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- C. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form, throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- E. Maintain disinfectant in system for 24 hours.
- F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from **[10] [5] [2]** percent of outlets and from water entry, and analyze in accordance with AWWA C651-99.

3.20 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Under-building-slab, domestic water, building-service piping, within five (5) feet of building **[NPS 3 (DN 80) and smaller]** <Insert pipe size range>, shall be **[one of]** the following:
 1. CPVC PIPING:

- a. CPVC Schedule **[40] [80]** Pipe: ASTM F441/F441M.
 - 1) CPVC Schedule 40 Fittings: ASTM F438, socket type.
 - 2) CPVC Schedule 80 Fittings: **[ASTM F439, socket] [ASTM F437, threaded] [ASTM F439, socket type or ASTM F437, threaded]** type.
 - b. CPVC Piping System: ASTM D2846/D2846M, SDR 11, pipe and socket fittings.
 - c. CPVC Tubing System: ASTM D2846/D2846M, SDR 11, tube and socket fittings.
2. PEX PIPE AND FITTINGS:
- a. PEX Distribution System: ASTM F877, SDR 9 tubing.
 - 1) Fittings for PEX Tube: ASTM F1807, metal-insert type with copper crimp rings and matching PEX tube dimensions.
 - b. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F877 and with plastic or corrosion-resistant-metal valve for each outlet.
3. PVC PIPE AND FITTINGS:
- a. PVC Schedule **[40] [80]** Pipe: ASTM D1785.
 - 1) PVC Schedule 40 Fittings: ASTM D2466, socket type.
 - 2) PVC Schedule 80 Fittings: **[ASTM D2467, socket] [ASTM D2464, threaded] [ASTM D2467, socket type or ASTM D2464, threaded]** type.
- D. Under-building-slab, domestic water, building-service piping, within five (5) feet of building **[NPS 4 to NPS 8 (DN 100 to DN 200) and larger]** **<Insert pipe size range>**, shall be **[one of]** the following:
1. CPVC PIPING:
 - a. CPVC Schedule **[40] [80]** Pipe: ASTM F441/F441M.
 - 1) CPVC Schedule 40 Fittings: ASTM F438, socket type.
 - 2) CPVC Schedule 80 Fittings: **[ASTM F439, socket] [ASTM F437, threaded] [ASTM F439, socket type or ASTM F437, threaded]** type.
 - b. CPVC Piping System: ASTM D2846/D2846M, SDR 11, pipe and socket fittings.
 - c. CPVC Tubing System: ASTM D2846/D2846M, SDR 11, tube and socket fittings.
 2. PEX PIPE AND FITTINGS:

- a. PEX Distribution System: ASTM F877, SDR 9 tubing.
 - 1) Fittings for PEX Tube: ASTM F1807, metal-insert type with copper crimp rings and matching PEX tube dimensions.
 - b. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F877 and with plastic or corrosion-resistant-metal valve for each outlet.
3. PVC PIPE AND FITTINGS:
- a. PVC Schedule **[40] [80]** Pipe: ASTM D1785.
 - 1) PVC Schedule 40 Fittings: ASTM D2466, socket type.
 - 2) PVC Schedule 80 Fittings: **[ASTM D2467, socket] [ASTM D2464, threaded] [ASTM D2467, socket type or ASTM D2464, threaded]** type.
- E. Under-building-slab, domestic water piping, **[NPS 2 (DN 50) and smaller]** <Insert pipe size range>, shall be **[one of]** the following:
1. CPVC PIPING:
 - a. CPVC Schedule **[40] [80]** Pipe: ASTM F441/F441M.
 - 1) CPVC Schedule 40 Fittings: ASTM F438, socket type.
 - 2) CPVC Schedule 80 Fittings: **[ASTM F439, socket] [ASTM F437, threaded] [ASTM F439, socket type or ASTM F437, threaded]** type.
 - b. CPVC Piping System: ASTM D2846/D2846M, SDR 11, pipe and socket fittings.
 - c. CPVC Tubing System: ASTM D2846/D2846M, SDR 11, tube and socket fittings.
 2. PEX PIPE AND FITTINGS:
 - a. PEX Distribution System: ASTM F877, SDR 9 tubing.
 - 1) Fittings for PEX Tube: ASTM F1807, metal-insert type with copper crimp rings and matching PEX tube dimensions.
 - b. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F877 and with plastic or corrosion-resistant-metal valve for each outlet.
 3. PVC PIPE AND FITTINGS:
 - a. PVC Schedule **[40] [80]** Pipe: ASTM D1785.
 - 1) PVC Schedule 40 Fittings: ASTM D2466, socket type.

- 2) PVC Schedule 80 Fittings: **[ASTM D2467, socket] [ASTM D2464, threaded] [ASTM D2467, socket type or ASTM D2464, threaded]** type.
- F. Aboveground domestic water piping, **[NPS 2 (DN 50) and smaller] <Insert pipe size range>**, shall be **[one of]** the following:
1. Copper Tubing: ASTM B 88, Type L, hard drawn.
 - a. Fittings: ASME B 16.22, wrought copper and bronze.
 - b. Joints: ASTM B 32, solder, Grade 95TA.
 2. NPS 4 to NPS 12 Steel Pipe: ASTM A53/A53M, Type **[E] [S] [E or S]**, Grade **[A] [B] [A or B] <Insert grade>**, Schedule **[40]**, galvanized. Include ends matching joining method.
 - a. Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M or ASTM A106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
 - b. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body, with ball-and-socket, metal-to-metal, bronze seating surface and female threaded ends.
 - c. Malleable-Iron, Threaded Fittings: ASME B16.3, Class 150, galvanized, standard pattern.
 - d. Cast-Iron Flanges: ASME B16.1, Class 125.
 - e. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.
 - f. Steel-Piping, Grooved-End Fittings: ASTM A47/A47M, **[galvanized,**]malleable-iron casting; ASTM A106, galvanized steel pipe; or ASTM A536, **[galvanized,**]ductile-iron casting; with dimensions matching steel pipe.
 - 1) Grooved-End-Pipe Couplings: AWWA C606, for steel-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
 - g. Steel-Piping, Expansion Joints: Compound, galvanized steel fitting with telescoping body and slip-pipe section. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.
 - h. Steel-Piping, Double Expansion Joints: Compound, galvanized steel fitting with telescoping body and two slip-pipe sections. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.
 3. CPVC PIPING:
 - a. CPVC Schedule **[40] [80]** Pipe: ASTM F441/F441M, plenum-rated.
 - 1) CPVC Schedule 40 Fittings: ASTM F438, socket type, plenum-rated.
 - 2) CPVC Schedule 80 Fittings: **[ASTM F439, socket] [ASTM F437, threaded] [ASTM F439, socket type or ASTM F437, threaded]** type, plenum-rated.

- b. CPVC Piping System: ASTM D2846/D2846M, SDR 11, pipe and socket fittings, plenum-rated.
 - c. CPVC Tubing System: ASTM D2846/D2846M, SDR 11, tube and socket fittings, plenum-rated.
4. PEX PIPE AND FITTINGS:
- a. PEX Distribution System: ASTM F877, SDR 9 tubing, plenum-rated.
 - 1) Fittings for PEX Tube: ASTM F1807, metal-insert type with copper crimp rings and matching PEX tube dimensions, plenum-rated.
 - 2) Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F877 and with plastic or corrosion-resistant-metal valve for each outlet.
5. PVC PIPE AND FITTINGS:
- a. PVC Schedule **[40] [80]** Pipe: ASTM D1785, plenum-rated.
 - 1) PVC Schedule 40 Fittings: ASTM D2466, socket type, plenum-rated.
 - 2) PVC Schedule 80 Fittings: **[ASTM D2467, socket] [ASTM D2464, threaded] [ASTM D2467, socket type or ASTM D2464, threaded]** type, plenum-rated.
6. Retain "one of" option in first paragraph below to allow Contractor to select piping materials from those retained.
- G. Aboveground domestic water piping, **[NPS 2-1/2 to NPS 4 (DN 65 to DN 100)]** **<Insert pipe size range>**, shall be **[one of]** the following:
- 1. Copper Tubing: ASTM B 88, Type L, hard drawn.
 - a. Fittings: ASME B 16.22, wrought copper and bronze.
 - b. Joints: ASTM B 32, solder, Grade 95TA.
 - 2. NPS 4 to NPS 12 Steel Pipe: ASTM A53/A53M, Type **[E] [S] [E or S]**, Grade **[A] [B] [A or B]** **<Insert grade>**, Schedule **[40]**, galvanized. Include ends matching joining method.
 - a. Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M or ASTM A106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
 - b. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body, with ball-and-socket, metal-to-metal, bronze seating surface and female threaded ends.
 - c. Malleable-Iron, Threaded Fittings: ASME B16.3, Class 150, galvanized, standard pattern.
 - d. Cast-Iron Flanges: ASME B16.1, Class 125.
 - e. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.
 - f. Steel-Piping, Grooved-End Fittings: ASTM A47/A47M, **[galvanized]**,

]malleable-iron casting; ASTM A106, galvanized steel pipe; or ASTM A536, **[galvanized,**]ductile-iron casting; with dimensions matching steel pipe.

- 1) Grooved-End-Pipe Couplings: AWWA C606, for steel-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
 - g. Steel-Piping, Expansion Joints: Compound, galvanized steel fitting with telescoping body and slip-pipe section. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.
 - h. Steel-Piping, Double Expansion Joints: Compound, galvanized steel fitting with telescoping body and two slip-pipe sections. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.
3. CPVC PIPING:
- a. CPVC Schedule **[40] [80]** Pipe: ASTM F441/F441M, plenum-rated.
 - 1) CPVC Schedule 40 Fittings: ASTM F438, socket type, plenum-rated.
 - 2) CPVC Schedule 80 Fittings: **[ASTM F439, socket] [ASTM F437, threaded] [ASTM F439, socket type or ASTM F437, threaded]** type, plenum-rated.
 - b. CPVC Piping System: ASTM D2846/D2846M, SDR 11, pipe and socket fittings, plenum-rated.
 - c. CPVC Tubing System: ASTM D2846/D2846M, SDR 11, tube and socket fittings, plenum-rated.
4. PEX PIPE AND FITTINGS:
- a. PEX Distribution System: ASTM F877, SDR 9 tubing, plenum-rated.
 - 1) Fittings for PEX Tube: ASTM F1807, metal-insert type with copper crimp rings and matching PEX tube dimensions, plenum-rated.
 - 2) Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F877 and with plastic or corrosion-resistant-metal valve for each outlet.
5. PVC PIPE AND FITTINGS:
- a. PVC Schedule **[40] [80]** Pipe: ASTM D1785, plenum-rated.
 - 1) PVC Schedule 40 Fittings: ASTM D2466, socket type, plenum-rated.
 - 2) PVC Schedule 80 Fittings: **[ASTM D2467, socket] [ASTM D2464, threaded] [ASTM D2467, socket type or ASTM D2464, threaded]** type, plenum-rated.

H. Aboveground domestic water piping, **[NPS 5 to NPS 8 (DN 125 to DN 200)]** **<Insert pipe size range>**, shall be **[one of]** the following:

1. Copper Tubing: ASTM B 88, Type L, hard drawn.
 - a. Fittings: ASME B 16.22, wrought copper and bronze.
 - b. Joints: ASTM B 32, solder, Grade 95TA.

2. NPS 4 to NPS 12 Steel Pipe: ASTM A53/A53M, Type **[E] [S] [E or S]**, Grade **[A] [B] [A or B] <Insert grade>**, Schedule **[40]**, galvanized. Include ends matching joining method.
 - a. Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M or ASTM A106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
 - b. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body, with ball-and-socket, metal-to-metal, bronze seating surface and female threaded ends.
 - c. Malleable-Iron, Threaded Fittings: ASME B16.3, Class 150, galvanized, standard pattern.
 - d. Cast-Iron Flanges: ASME B16.1, Class 125.
 - e. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.
 - f. Steel-Piping, Grooved-End Fittings: ASTM A47/A47M, **[galvanized,]malleable-iron casting; ASTM A106, galvanized steel pipe; or ASTM A536, [galvanized,]ductile-iron casting; with dimensions matching steel pipe.**
 - 1) Grooved-End-Pipe Couplings: AWWA C606, for steel-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
 - g. Steel-Piping, Expansion Joints: Compound, galvanized steel fitting with telescoping body and slip-pipe section. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.
 - h. Steel-Piping, Double Expansion Joints: Compound, galvanized steel fitting with telescoping body and two slip-pipe sections. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.

3. CPVC PIPING:
 - a. CPVC Schedule **[40] [80]** Pipe: ASTM F441/F441M, plenum-rated.
 - 1) CPVC Schedule 40 Fittings: ASTM F438, socket type, plenum-rated.
 - 2) CPVC Schedule 80 Fittings: **[ASTM F439, socket] [ASTM F437, threaded] [ASTM F439, socket type or ASTM F437, threaded]** type, plenum-rated.
 - b. CPVC Piping System: ASTM D2846/D2846M, SDR 11, pipe and socket fittings, plenum-rated.
 - c. CPVC Tubing System: ASTM D2846/D2846M, SDR 11, tube and socket fittings, plenum-rated.

4. PEX PIPE AND FITTINGS:

- a. PEX Distribution System: ASTM F877, SDR 9 tubing, plenum-rated.
 - 1) Fittings for PEX Tube: ASTM F1807, metal-insert type with copper crimp rings and matching PEX tube dimensions, plenum-rated.
 - 2) Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F877 and with plastic or corrosion-resistant-metal valve for each outlet.
5. PVC PIPE AND FITTINGS:
 - a. PVC Schedule **[40] [80]** Pipe: ASTM D1785, plenum-rated.
 - 1) PVC Schedule 40 Fittings: ASTM D2466, socket type, plenum-rated.
 - 2) PVC Schedule 80 Fittings: **[ASTM D2467, socket] [ASTM D2464, threaded] [ASTM D2467, socket type or ASTM D2464, threaded]** type, plenum-rated.

3.21 VALVE SCHEDULE

- A. Reference other Division 22 Sections on valves for more information on specific valve types and applications.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Shutoff Duty: Use ball or gate valves for piping **NPS 2 (DN 50)** and smaller. Use butterfly, ball, or gate valves with flanged ends for piping **NPS 2-1/2 (DN 65)** and larger.
 2. Throttling Duty: Use ball or globe valves for piping **NPS 2 (DN 50)** and smaller. Use butterfly or ball valves with flanged ends for piping **NPS 2-1/2 (DN 65)** and larger.
 3. Hot-Water Circulation Piping, Balancing Duty: **[Calibrated] [Memory-stop]** balancing valves.
 4. Drain Duty: Hose-end drain valves.
- C. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- D. Iron grooved-end valves may be used with grooved-end piping.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers.
7. Outlet boxes.
8. Hose stations.
9. Hose bibbs.
10. Wall hydrants.
11. Ground hydrants.
12. Post hydrants.
13. Drain valves.
14. Water-hammer arresters.
15. Air vents.
16. Trap-seal primer valves.
17. Trap-seal primer systems.
18. Specialty valves.
19. Flexible connectors.
20. Water meters.

- B. Related Requirements:

1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 221116 "Domestic Water Piping" for water meters.
3. Section 223200 "Domestic Water Filtration Equipment" for water filters in domestic water piping.
4. Section 224300 "Medical Plumbing Fixtures" for thermostatic mixing valves for sitz baths, thermostatic mixing-valve assemblies for hydrotherapy equipment, and outlet boxes for dialysis equipment.
5. Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.

6. Section 224713 "Drinking Fountains" for water filters for water coolers.
7. Section 224716 "Pressure Water Coolers" for water filters for water coolers.
8. Section 224723 "Remote Water Coolers" for water filters for water coolers.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Provide component sizes, rough-in requirements, service sizes, and finishes.
2. Include data substantiating that materials comply with requirements.

- B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.
2. For fabricated items, indicate dimensions, weights, and placement of openings and holes.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1. Indicate frequency of treatment required for interceptors.
2. Include installation instructions, spare parts lists, exploded assembly views.

- B. Project Record Documents:

1. Record actual locations of equipment, cleanouts, backflow preventers.

- C. "As Built" Plans shall be provided in the same format and manner as described above. Each set shall be equipped with a plan holder equal to "Stacor Plan Clamps" for the appropriate size drawings.

- D. Extra Materials:

1. Provide two (2) each of [**loose keys**] [**hose end vacuum breakers**].
2. Water Filter Cartridges: Provide two (2) or 10% of amount installed, whichever is greater, for each type and size indicated.
3. Operating Key Handles: Provide two (2) or 10% of amount installed, whichever is greater, for each key-operated hose bibb and hydrant installed.

- E. DELIVERY, STORAGE, AND HANDLING

1. Deliver, store, protect, and handle products under provisions of Section 220400 "Basic Plumbing Requirements" and Division 01.
2. Accept specialties on site in original factory packaging. Inspect for damage.
3. Remove and perfect installation instructions for inspection.

1.6 QUALITY ASSURANCE

- A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

1.7 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61[**and NSF 14**].[**Mark "NSF-pw" on plastic piping components.**]

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: [125 psig (860 kPa)] **<Insert value>** unless otherwise indicated.

2.3 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers **<Insert drawing designation if any>**:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
- b. Cash Acme; a division of Reliance Worldwide Corporation.
- c. Conbraco Industries, Inc.
- d. FEBCO; a division of Watts Water Technologies, Inc.
- e. Rain Bird Corporation.
- f. Toro Company (The); Irrigation Div.
- g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

- h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
 - 2. Standard: ASSE 1001.
 - 3. Size: **NPS 1/4 to NPS 3 (DN 8 to DN 80)**, as required to match connected piping.
 - 4. Body: Bronze.
 - 5. Inlet and Outlet Connections: Threaded.
 - 6. Finish: **[Rough bronze] [Chrome plated]**.
- B. Hose-Connection Vacuum Breakers **<Insert drawing designation if any>**:
 - 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Arrowhead Brass Products.
 - b. Cash Acme; a division of Reliance Worldwide Corporation.
 - c. Conbraco Industries, Inc.
 - d. Legend Valve.
 - e. MIFAB, Inc.
 - f. Prier Products, Inc.
 - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - h. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - i. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
 - j. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - k. **<Insert manufacturer's name>**.
 - l. or approved equal.
 - 2. Standard: ASSE 1011.
 - 3. Body: Bronze, nonremovable, with manual drain.
 - 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 - 5. Finish: **[Chrome or nickel plated] [Rough bronze]**.
- C. Pressure Vacuum Breakers **<Insert drawing designation if any>**:
 - 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Flomatic Corporation.
 - e. Toro Company (The); Irrigation Div.
 - f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

4. Size: [NPS 1/4 (DN 8)] [NPS 3/8 (DN 10)] [NPS 1/2 (DN 15)] [NPS 3/4 (DN 20)] [NPS 1 (DN 25)].
5. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers <Insert drawing designation if any>:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Cash Acme; a division of Reliance Worldwide Corporation.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Honeywell International Inc.
 - e. Legend Valve.
 - f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - g. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - h. <Insert manufacturer's name>.
 - i. or approved equal.
2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Size: [NPS 1/2 (DN 15)] [NPS 3/4 (DN 20)].
5. Body: Bronze.
6. End Connections: [Union, solder] [Solder] joint.
7. Finish: [Chrome plated] [Rough bronze].

B. Reduced-Pressure-Principle Backflow Preventers <Insert drawing designation if any>:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Flomatic Corporation.
 - e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - f. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - g. <Insert manufacturer's name>.
 - h. or approved equal.

2. Standard: ASSE 1013.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: [12 psig (83 kPa)] <Insert value> maximum, through middle third of flow range.
 5. Size: <Insert NPS (DN)>.
 6. Design Flow Rate: <Insert gpm (L/s)>.
 7. Selected Unit Flow Range Limits: <Insert gpm (L/s)>.
 8. Pressure Loss at Design Flow Rate: <Insert psig (kPa)> for sizes NPS 2 (DN 50) and smaller; <Insert psig (kPa)> for NPS 2-1/2 (DN 65) and larger.
 9. Body: Bronze for NPS 2 (DN 50) and smaller; [cast iron with interior lining that complies with AWWA C550 or that is FDA approved] [steel with interior lining that complies with AWWA C550 or that is FDA approved] [stainless steel] for NPS 2-1/2 (DN 65) and larger.
 10. End Connections: Threaded for NPS 2 (DN 50) and smaller; [flanged] <Insert type> for NPS 2-1/2 (DN 65) and larger.
 11. Configuration: Designed for [horizontal, straight-through] [vertical-inlet, horizontal-center-section, and vertical-outlet] [vertical] <Insert configuration> flow.
 12. Accessories:
 - a. Valves NPS 2 (DN 50) and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 (DN 65) and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
- C. Double-Check, Backflow-Prevention Assemblies <Insert drawing designation if any>:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Flomatic Corporation.
 - e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - f. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - g. <Insert manufacturer's name>.
 - h. or approved equal.
 2. Standard: ASSE 1015.
 3. Operation: Continuous-pressure applications unless otherwise indicated.
 4. Pressure Loss: [5 psig (35 kPa)] <Insert value> maximum, through middle third of flow range.
 5. Size: <Insert NPS (DN)>.
 6. Design Flow Rate: <Insert gpm (L/s)>.
 7. Selected Unit Flow Range Limits: <Insert gpm (L/s)>.

8. Pressure Loss at Design Flow Rate: <Insert psig (kPa)> for sizes NPS 2 (DN 50) and smaller; <Insert psig (kPa)> for NPS 2-1/2 (DN 65) and larger.
 9. Body: Bronze for NPS 2 (DN 50) and smaller; **[cast iron with interior lining that complies with AWWA C550 or that is FDA approved] [steel with interior lining that complies with AWWA C550 or that is FDA approved] [stainless steel]** for NPS 2-1/2 (DN 65) and larger.
 10. End Connections: Threaded for NPS 2 (DN 50) and smaller; **[flanged]** <Insert type> for NPS 2-1/2 (DN 65) and larger.
 11. Configuration: Designed for **[horizontal, straight-through]** <Insert configuration> flow.
 12. Accessories:
 - a. Valves NPS 2 (DN 50) and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 (DN 65) and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
- D. Beverage-Dispensing-Equipment Backflow Preventers <Insert drawing designation if any>:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Conbraco Industries, Inc.
 - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - d. <Insert manufacturer's name>.
 - e. or approved equal.
 2. Standard: ASSE 1022.
 3. Operation: Continuous-pressure applications.
 4. Size: NPS 1/4 or NPS 3/8 (DN 8 or DN 10).
 5. Body: Stainless steel.
 6. End Connections: Threaded.
- E. Dual-Check-Valve Backflow Preventers <Insert drawing designation if any>:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Cash Acme; a division of Reliance Worldwide Corporation.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Flomatic Corporation.
 - e. Ford Meter Box Company, Inc. (The).
 - f. Honeywell International Inc.
 - g. Legend Valve.
 - h. McDonald, A. Y. Mfg. Co.

- i. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
 - j. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - k. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - l. **<Insert manufacturer's name>**.
 - m. or approved equal.
2. Standard: ASSE 1024.
 3. Operation: Continuous-pressure applications.
 4. Size: [NPS 1/2 (DN 15)] [NPS 3/4 (DN 20)] [NPS 1 (DN 25)] [NPS 1-1/4 (DN 32)].
 5. Body: Bronze with union inlet.
- F. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers **<Insert drawing designation if any>**:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Cash Acme; a division of Reliance Worldwide Corporation.
 - b. Lancer Corporation.
 - c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
 2. Standard: ASSE 1032.
 3. Operation: Continuous-pressure applications.
 4. Size: NPS 1/4 or NPS 3/8 (DN 8 or DN 10).
 5. Body: Stainless steel.
 6. End Connections: Threaded.
- G. Reduced-Pressure-Detector, Fire-Protection, Backflow-Preventer Assemblies **<Insert drawing designation if any>**:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
 2. Standard: ASSE 1047 and is FM Global approved or UL listed.
 3. Operation: Continuous-pressure applications.

4. Pressure Loss: [12 psig (83 kPa)] <Insert value> maximum, through middle third of flow range.
 5. Size: <Insert NPS (DN)>.
 6. Design Flow Rate: <Insert gpm (L/s)>.
 7. Selected Unit Flow Range Limits: <Insert gpm (L/s)>.
 8. Pressure Loss at Design Flow Rate: <Insert psig (kPa)>.
 9. Body: [Cast iron with interior lining that complies with AWWA C550 or that is FDA approved] [Steel with interior lining that complies with AWWA C550 or that is FDA approved] [Stainless steel].
 10. End Connections: Flanged.
 11. Configuration: Designed for [horizontal, straight-through] [vertical-inlet, horizontal-center-section, and vertical-outlet] [vertical] <Insert configuration> flow.
 12. Accessories:
 - a. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
 - c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.
- H. Double-Check, Detector-Assembly Backflow Preventers <Insert drawing designation if any>:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - f. <Insert manufacturer's name>.
 - g. or approved equal.
 2. Standard: ASSE 1048 and is FM Global approved or UL listed.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: [5 psig (35 kPa)] <Insert value> maximum, through middle third of flow range.
 5. Size: <Insert NPS (DN)>.
 6. Design Flow Rate: <Insert gpm (L/s)>.
 7. Selected Unit Flow Range Limits: <Insert gpm (L/s)>.
 8. Pressure Loss at Design Flow Rate: <Insert psig (kPa)>.
 9. Body: [Cast iron with interior lining that complies with AWWA C550 or that is FDA approved] [Steel with interior lining that complies with AWWA C550 or that is FDA approved] [Stainless steel].
 10. End Connections: Flanged.

11. Configuration: Designed for [**horizontal, straight-through**] [**vertical-inlet, horizontal-center-section, and vertical-outlet**] [**vertical**] <Insert **configuration**> flow.
12. Accessories:
 - a. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

I. Hose-Connection Backflow Preventers <Insert drawing designation if any>:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Conbraco Industries, Inc.
 - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - c. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - d. <Insert manufacturer's name>.
 - e. or approved equal.
2. Standard: ASSE 1052.
3. Operation: Up to **10-foot head of water** (30-kPa) back pressure.
4. Inlet Size: **NPS 1/2 or NPS 3/4** (DN 15 or DN 20).
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least **3-gpm** (0.19-L/s) flow.

J. Backflow-Preventer Test Kits <Insert drawing designation if any>:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Conbraco Industries, Inc.
 - b. FEBCO; a division of Watts Water Technologies, Inc.
 - c. Flomatic Corporation.
 - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - f. <Insert manufacturer's name>.
 - g. or approved equal.
2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators <Insert drawing designation if any>:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Cash Acme; a division of Reliance Worldwide Corporation.
 - b. Conbraco Industries, Inc.
 - c. Honeywell International Inc.
 - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of **150 psig** (1035 kPa).
4. Size: **<Insert NPS (DN)>**.
5. Design Flow Rate: **<Insert gpm (L/s)>**.
6. Design Inlet Pressure: **<Insert psig (kPa)>**.
7. Design Outlet Pressure Setting: **<Insert psig (kPa)>**.
8. Body: Bronze[**with chrome-plated finish**] for **NPS 2 (DN 50)** and smaller; cast iron[**with interior lining that complies with AWWA C550 or that is FDA approved**] for **NPS 2-1/2 and NPS 3 (DN 65 and DN 80)**.
9. Valves for Booster Heater Water Supply: Include integral bypass.
10. End Connections: Threaded for **NPS 2 (DN 50)** and smaller; flanged for **NPS 2-1/2 and NPS 3 (DN 65 and DN 80)**.

B. Water-Control Valves **<Insert drawing designation if any>**:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. CLA-VAL.
 - b. Flomatic Corporation.
 - c. OCV Control Valves.
 - d. Watts; a division of Watts Water Technologies, Inc.; Control Valves (Watts ACV).
 - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
2. Description: Pilot-operated, diaphragm-type, single-seated, main water-control valve.
3. Pressure Rating: Initial working pressure of **150 psig** (1035 kPa) minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
 - a. Size: **<Insert NPS (DN)>**.

- b. Pattern: [**Angle**] [**Globe**]-valve design.
 - c. Trim: Stainless steel.
- 5. Design Flow: <Insert gpm (L/s)>.
 - 6. Design Inlet Pressure: <Insert psig (kPa)>.
 - 7. Design Outlet Pressure Setting: <Insert psig (kPa)>.
 - 8. End Connections: Threaded for NPS 2 (DN 50) and smaller; [**flanged**] <Insert type> for NPS 2-1/2 (DN 65) and larger.

2.6 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves <Insert drawing designation if any>:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Armstrong International, Inc.
 - b. Flo Fab Inc.
 - c. ITT Corporation; Bell & Gossett Div.
 - d. NIBCO Inc.
 - e. TAC.
 - f. TACO Incorporated.
 - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - h. <Insert manufacturer's name>.
 - i. or approved equal.
- 2. Type: [**Ball**] [or] [**Y-pattern globe**] valve with two readout ports and memory-setting indicator.
 - 3. Body: [**Brass**] [or] [**bronze**].
 - 4. Size: Same as connected piping, but not larger than NPS 2 (DN 50).
 - 5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing Valves <Insert drawing designation if any>:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Armstrong International, Inc.
- b. Flo Fab Inc.
- c. ITT Corporation; Bell & Gossett Div.
- d. NIBCO Inc.
- e. TAC.
- f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
- g. <Insert manufacturer's name>.
- h. or approved equal.

2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
 3. Size: Same as connected piping, but not smaller than **NPS 2-1/2 (DN 65)**.
- C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- D. Memory-Stop Balancing Valves **<Insert drawing designation if any>**:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO Inc.
 - h. Red-White Valve Corp.
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
 2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
 3. Pressure Rating: **400-psig (2760-kPa)** minimum CWP.
 4. Size: **NPS 2 (DN 50)** or smaller.
 5. Body: Copper alloy.
 6. Port: Standard or full port.
 7. Ball: Chrome-plated brass.
 8. Seats and Seals: Replaceable.
 9. End Connections: Solder joint or threaded.
 10. Handle: Vinyl-covered steel with memory-setting device.

2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

- A. Water-Temperature Limiting Devices **<Insert drawing designation if any>**:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Armstrong International, Inc.
 - b. Cash Acme; a division of Reliance Worldwide Corporation.
 - c. Conbraco Industries, Inc.
 - d. Honeywell International Inc.
 - e. Lawler Manufacturing Company, Inc.
 - f. Legend Valve.
 - g. Leonard Valve Company.
 - h. Mark Controls Corp.; Powers Process Controls.
 - i. Powers; a division of Watts Water Technologies, Inc.

- j. Symmons Industries, Inc.
 - k. TACO Incorporated.
 - l. T & S Brass and Bronze Works, Inc.
 - m. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - n. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - o. **<Insert manufacturer's name>**.
 - p. or approved equal.
2. Standard: ASSE 1017.
 3. Pressure Rating: **125 psig** (860 kPa).
 4. Type: Thermostatically controlled, water mixing valve.
 5. Material: Bronze body with corrosion-resistant interior components.
 6. Connections: Threaded[**union**] inlets and outlet.
 7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 8. Tempered-Water Setting: **<Insert deg F (deg C)>**.
 9. Tempered-Water Design Flow Rate: **<Insert gpm (L/s)>**.
 10. Valve Finish: [**Chrome plated**] [**Rough bronze**].

B. Primary, Thermostatic, Water Mixing Valves **<Insert drawing designation if any>**:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Armstrong International, Inc.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. Powers; a division of Watts Water Technologies, Inc.
 - e. Symmons Industries, Inc.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
2. Standard: ASSE 1017.
3. Pressure Rating: **125 psig** (860 kPa) minimum unless otherwise indicated.
4. Type: [**Exposed-mounted**] [**Cabinet-type**], thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded[**union**] inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: **<Insert deg F (deg C)>**.
9. Tempered-Water Design Flow Rate: **<Insert gpm (L/s)>**.
10. Selected Valve Flow Rate at **45-psig** (310-kPa) Pressure Drop: **<Insert gpm (L/s)>**.
11. Pressure Drop at Design Flow Rate: **<Insert psig (kPa)>**.
12. Valve Finish: [**Chrome plated**] [**Polished, chrome plated**] [**Rough bronze**].
13. Piping Finish: [**Chrome plated**] [**Copper**].
14. Cabinet: Factory fabricated, for [**recessed**] [**surface**] mounting:

- a. Cabinet: **[Recessed]** **[Surface]**-mounting 16 gage steel box with steel hinged door, white enameled finish, and thermometer in front, labeled "Mixing Valve".
 - b. Cabinet: **[Recessed]** **[Surface]**-mounting 16 gage stainless-steel box with stainless-steel hinged door and thermometer in front, labeled "Mixing Valve".
- C. Manifold, Thermostatic, Water Mixing-Valve Assemblies <Insert drawing designation if any>:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Leonard Valve Company.
 - b. Powers; a division of Watts Water Technologies, Inc.
 - c. Symmons Industries, Inc.
 - d. <Insert manufacturer's name>.
 - e. or approved equal.
 2. Description: Factory-fabricated, **[cabinet-type]** **[exposed-mounted]**, thermostatically controlled, water mixing-valve assembly in **[two]** **[three]**-valve parallel arrangement.
 3. Large-Flow Parallel: Thermostatic, water mixing valve and downstream-pressure regulator with pressure gages on inlet and outlet.
 4. Intermediate-Flow Parallel: Thermostatic, water mixing valve and downstream-pressure regulator with pressure gages on inlet and outlet.
 5. Small-Flow Parallel: Thermostatic, water mixing valve.
 6. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.
 7. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
 8. Pressure Rating: **125 psig (860 kPa)** minimum unless otherwise indicated.
 9. Cabinet: Factory fabricated, for **[recessed]** **[surface]** mounting:
 - a. Retain one of two subparagraphs below or delete both and Subparagraph above if cabinet is not required. Edit as necessary. Cabinet: **[Recessed]** **[Surface]**-mounting 16 gage steel box with steel hinged door, white enameled finish, and thermometer in front, labeled "Mixing Valve".
 - b. Cabinet: **[Recessed]** **[Surface]**-mounting 16 gage stainless-steel box with stainless-steel hinged door and thermometer in front, labeled "Mixing Valve".
 10. Selected Large-Flow, Tempered-Water Valve Size: <Insert size>.
 11. Tempered-Water Setting: <Insert deg F (deg C)>.
 12. Unit Tempered-Water Design Flow Rate: <Insert gpm (L/s)>.
 13. Unit Minimum Tempered-Water Design Flow Rate: <Insert gpm (L/s)>.
 14. Selected Unit Flow Rate at **45-psig (310-kPa)** Pressure Drop: <Insert gpm (L/s)>.
 15. Unit Pressure Drop at Design Flow Rate: <Insert psig (kPa)>.
 16. Unit Tempered-Water Outlet Size: <Insert NPS (DN)> end connection.
 17. Unit Hot- and Cold-Water Inlet Size: <Insert NPS (DN)> end connections.

18. Thermostatic Mixing Valve and Water Regulator Finish: [**Chrome plated**] [**Polished, chrome plated**] [**Rough bronze**].
19. Piping Finish: [**Chrome plated**] [**Copper**].

D. Photographic-Process, Thermostatic, Water Mixing-Valve Assemblies <Insert drawing designation if any>:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Lawler Manufacturing Company, Inc.
 - b. Leonard Valve Company.
 - c. Powers; a division of Watts Water Technologies, Inc.
 - d. Symmons Industries, Inc.
 - e. <Insert manufacturer's name>.
 - f. or approved equal.
2. Standard: ASSE 1017, thermostatically controlled, water mixing valve made for precise, process-water temperature control.
 3. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
 4. Body: Bronze with corrosion-resistant interior components.
 5. Connections: Threaded inlets and outlet.
 6. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, thermometer, shutoff valve, and adjustable, temperature-control handle.
 7. Cabinet: Factory fabricated, for surface mounting; with controls and thermometer mounted on front.
 - a. Panel: [**Steel box with white enameled finish**] [**Stainless-steel box**].
 - b. Panel Mounting: [**Recessed**] [**Surface**].
 8. Tempered-Water Setting: <Insert deg F (deg C)>.
 9. Tempered-Water Design Flow Rate: <Insert gpm (L/s)>.
 10. Tempered-Water Outlet Size: <Insert NPS (DN)> end connection.
 11. Hot- and Cold-Water Inlet Size: <Insert NPS (DN)> end connections.

E. Individual-Fixture, Water Tempering Valves <Insert drawing designation if any>:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Cash Acme; a division of Reliance Worldwide Corporation.
- b. Conbraco Industries, Inc.
- c. Honeywell International Inc.
- d. Lawler Manufacturing Company, Inc.
- e. Leonard Valve Company.
- f. Powers; a division of Watts Water Technologies, Inc.
- g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
- h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

- i. **<Insert manufacturer's name>**.
 - j. or approved equal.
2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
 3. Pressure Rating: **125 psig** (860 kPa) minimum unless otherwise indicated.
 4. Body: Bronze body with corrosion-resistant interior components.
 5. Temperature Control: Adjustable.
 6. Inlets and Outlet: Threaded.
 7. Finish: Rough or chrome-plated bronze.
 8. Tempered-Water Setting: **<Insert deg F (deg C)>**.
 9. Tempered-Water Design Flow Rate: **<Insert gpm (L/s)>**.
- F. Primary Water Tempering Valves **<Insert drawing designation if any>**:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Heat-Timer Corporation.
 - b. Holby Valve Co., Inc.
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.
 2. Standard: ASSE 1017, thermostatically controlled, water tempering valve, listed as tempering valve.
 3. Pressure Rating: **125 psig** (860 kPa) minimum unless otherwise indicated.
 4. Body: Bronze.
 5. Temperature Control: Manual.
 6. Inlets and Outlet: Threaded.
 7. Selected Primary Water Tempering Valve Size: **<Insert size>**.
 8. Tempered-Water Setting: **<Insert deg F (deg C)>**.
 9. Tempered-Water Design Flow Rate: **<Insert gpm (L/s)>**.
 10. Pressure Drop at Design Flow Rate: **<Insert psig (kPa)>**.
 11. Tempered-Water Outlet Size: **<Insert NPS (DN)>** end connection.
 12. Cold-Water Inlet Size: **<Insert NPS (DN)>** end connection.
 13. Hot-Water Inlet Size: **<Insert NPS (DN)>** end connection.
 14. Valve Finish: **[Rough bronze] <Insert finish>**.

2.8 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers **<Insert drawing designation if any>**:

1. Pressure Rating: **125 psig** (860 kPa) minimum unless otherwise indicated.
2. Body: Bronze for **NPS 2 (DN 50)** and smaller; cast iron[**with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and**] for **NPS 2-1/2 (DN 65)** and larger.
3. End Connections: Threaded for **NPS 2 (DN 50)** and smaller; flanged for **NPS 2-1/2 (DN 65)** and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:

- a. Strainers **NPS 2 (DN 50) and Smaller**: [0.020 inch (0.51 mm)] [0.033 inch (0.84 mm)] [0.062 inch (1.57 mm)] **<Insert dimension>**.
 - b. Strainers **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: [0.045 inch (1.14 mm)] [0.062 inch (1.57 mm)] [0.125 inch (3.18 mm)] **<Insert dimension>**.
 - c. Strainers **NPS 5 (DN 125) and Larger**: [0.10 inch (2.54 mm)] [0.125 inch (3.18 mm)] [0.25 inch (6.35 mm)] **<Insert dimension>**.
6. Drain: [**Pipe plug**] [**Factory-installed, hose-end drain valve**].

2.9 OUTLET BOXES

A. Clothes Washer Outlet Boxes **<Insert drawing designation if any>**:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Acorn Engineering Company.
 - b. Guy Gray Manufacturing Co., Inc.
 - c. IPS Corporation.
 - d. LSP Products Group, Inc.
 - e. Oatey.
 - f. Plastic Oddities.
 - g. Symmons Industries, Inc.
 - h. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - i. Whitehall Manufacturing; a div. of Acorn Engineering Company.
 - j. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
 - k. **<Insert manufacturer's name>**.
 - l. or approved equal.
2. Mounting: Recessed.
3. Material and Finish: [**Enameled-steel or epoxy-painted-steel**] [**Enameled-steel, epoxy-painted-steel, or plastic**] [**Plastic**] [**Stainless-steel**] box and faceplate.
4. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
5. Supply Shutoff Fittings: **NPS 1/2 (DN 15)** gate, globe, or ball valves and **NPS 1/2 (DN 15)** copper, water tubing.
6. Drain: [**NPS 1-1/2 (DN 40)**] [**NPS 2 (DN 50)**] standpipe and P-trap for direct waste connection to drainage piping.
7. Inlet Hoses: Two **60-inch- (1500-mm-)** long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
8. Drain Hose: One **48-inch- (1200-mm-)** long, rubber household clothes washer drain hose with hooked end.

B. Icemaker Outlet Boxes **<Insert drawing designation if any>**:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Acorn Engineering Company.
 - b. IPS Corporation.
 - c. LSP Products Group, Inc.
 - d. Oatey.
 - e. Plastic Oddities.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
2. Mounting: Recessed.
3. Material and Finish: **[Enameled-steel or epoxy-painted-steel]** **[Enameled-steel, epoxy-painted-steel, or plastic]** **[Plastic]** **[Stainless-steel]** box and faceplate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include **NPS 1/2 (DN 15)** or smaller copper tube outlet.
5. Supply Shutoff Fitting: **NPS 1/2 (DN 15)** gate, globe, or ball valve and **NPS 1/2 (DN 15)** copper, water tubing.

2.10 HOSE STATIONS

A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

1. ARCHON Industries, Inc.
2. Armstrong International, Inc.
3. Cooney Brothers, Inc.
4. DynaFluid Ltd.
5. Leonard Valve Company.
6. Strahman Valves, Inc.
7. T & S Brass.
8. **<Insert manufacturer's name>**.
9. or approved equal.

B. Single-Temperature-Water Hose Stations **<Insert drawing designation if any>**:

1. Standard: ASME A112.18.1.
2. Cabinet: Stainless-steel enclosure with exposed valve handle, hose connection, and hose rack. Include thermometer in front.
3. Hose-Rack Material: Stainless steel.
4. Body Material: Bronze **[with stainless-steel wetted parts]**.
5. Body Finish: Rough bronze **[, chrome plated]**.
6. Mounting: **[Wall, with reinforcement]** **[Floor, with stainless-steel pedestal]**.
7. Supply Fittings: **[NPS 1/2 (DN 15)]** **[NPS 3/4 (DN 20)]** gate, globe, or ball valve and check valve and **[NPS 1/2 (DN 15)]** **[NPS 3/4 (DN 20)]** copper, water tubing. Omit check valve if check stop is included with fitting.
8. Hose: Manufacturer's standard, for service fluid, temperature, and pressure; **[25 feet (7.6 m)]** **[50 feet (15 m)]** **<Insert dimension>** long.

9. Nozzle: With hand-squeeze, on-off control.
10. Vacuum Breaker:
 - a. Integral or factory-installed, nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
 - b. Garden-hose thread complying with ASME B1.20.7 on outlet.

C. Hot- and Cold-Water Hose Stations <Insert drawing designation if any>:

1. Standard: ASME A112.18.1.
2. Faucet Type: [**Blending**] [**Thermostatic mixing**] valve.
3. Cabinet: Stainless-steel enclosure with exposed valve handles, hose connection, and hose rack. Include thermometer in front.
4. Hose-Rack Material: Stainless steel.
5. Body Material: Bronze[**with stainless-steel wetted parts**].
6. Body Finish: Rough bronze[**or chrome plated**].
7. Mounting: [**Wall, with reinforcement**] [**Floor, with stainless-steel pedestal**].
8. Supply Fittings: Two [**NPS 1/2 (DN 15)**] [**NPS 3/4 (DN 20)**] gate, globe, or ball valves and check valves and [**NPS 1/2 (DN 15)**] [**NPS 3/4 (DN 20)**] copper, water tubing. Omit check valves if check stops are included with fitting.
9. Hose: Manufacturer's standard, for service fluid, temperature, and pressure; [**25 feet (7.6 m)**] [**50 feet (15 m)**] <Insert dimension> long.
10. Nozzle: With hand-squeeze, on-off control.
11. Vacuum Breaker: Integral or factory-installed, nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052; and garden-hose thread complying with ASME B1.20.7 on outlet.

D. Cold-Water and Steam Hose Stations <Insert drawing designation if any>:

1. Standard: ASME A112.18.1.
2. Faucet Type: [**Blending**] [**Thermostatic mixing**] valve.
3. Cabinet: Stainless-steel enclosure with exposed valve handles, hose connection, and hose rack. Include thermometer in front.
4. Hose-Rack Material: Stainless steel.
5. Body Material: Bronze[**with stainless-steel wetted parts**].
6. Body Finish: Rough bronze[**or chrome plated**].
7. Mounting: [**Wall, with reinforcement**] [**Floor, with stainless-steel pedestal**].
8. Supply Fittings: Two [**NPS 1/2 (DN 15)**] [**NPS 3/4 (DN 20)**] gate, globe, or ball valves and check valves and [**NPS 1/2 (DN 15)**] [**NPS 3/4 (DN 20)**] copper, water tubing. Omit check valves if check stops are included with fitting.
9. Hose: Manufacturer's standard, for service fluid, temperature, and pressure; [**25 feet (7.6 m)**] [**50 feet (15 m)**] <Insert dimension> long.
10. Nozzle: With hand-squeeze, on-off control.
11. Vacuum Breaker:
 - a. Integral or factory-installed, nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.

- b. Garden-hose thread complying with ASME B1.20.7 on outlet.

2.11 HOSE BIBBS

A. Hose Bibbs <Insert drawing designation if any>:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig (860 kPa).
7. Vacuum Breaker: Integral[or field-installation,] nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze, or chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle or operating key.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.
16. Interior Mixing: Bronze or brass, wall mounted, double service faucet with hose thread spout, integral stops, chrome plated where exposed with handwheels, and vacuum breaker in conformance with ASSE 1011.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Woodford.
2. Josam Manufacturing Company.
3. Jay R. Smith Manufacturing Company.
4. Zurn Industries.
5. <Insert manufacturer's name>.
6. or approved equal.

2.12 WALL HYDRANTS

A. Nonfreeze Wall Hydrants <Insert drawing designation if any>:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Prier Products, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

- e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products.
 - g. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - h. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
 - i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
 - j. **<Insert manufacturer's name>**.
 - k. or approved equal.
2. Standard: ASME A112.21.3M for [**concealed**] -outlet, self-draining wall hydrants.
 3. Pressure Rating: 125 psig (860 kPa).
 4. Operation: Loose key.
 5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
 6. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25).
 7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
 8. Box: Deep, flush mounted, lockable, with cover.
 9. Box and Cover Finish: [**Chrome plated**] **<Insert finish>**.
- B. Nonfreeze, Hot- and Cold-Water Wall Hydrants **<Insert drawing designation if any>**:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Josam Company.
 - b. Prier Products, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products.
 - f. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - g. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.
 2. Standard: ASME A112.21.3M for [**concealed**] -outlet, self-draining wall hydrants.
 3. Pressure Rating: 125 psig (860 kPa).
 4. Operation: Loose key.
 5. Casing and Operating Rods: Of length required to match wall thickness. Include wall clamps.
 6. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25).
 7. Outlet: Concealed.
 8. Box: Deep, flush mounted, lockable, with cover.
 9. Box and Cover Finish: [**Chrome plated**] **<Insert finish>**.
 10. Vacuum Breaker:

- a. Nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
- b. Garden-hose thread complying with ASME B1.20.7 on outlet.

11. Operating Keys(s): **[One]** **[Two]** with each wall hydrant.

C. Vacuum Breaker Wall Hydrants <Insert drawing designation if any>:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Arrowhead Brass Products.
- b. Mansfield Plumbing Products LLC.
- c. McDonald, A. Y. Mfg. Co.
- d. Prier Products, Inc.
- e. Smith, Jay. R. Mfg. Co.; Division of Smith Industries, Inc.
- f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
- g. Woodford Manufacturing Company; a division of WCM Industries, Inc.
- h. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
- i. **<Insert manufacturer's name>**.
- j. or approved equal.

2. Standard: ASSE 1019, Type A or Type B.
3. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
4. Classification: **[Type A, for automatic draining with hose removed or]**Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
5. Pressure Rating: **125 psig** (860 kPa).
6. Operation: **[Loose key]** **[or]** **[wheel handle]**.
7. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
8. Inlet: **NPS 1/2 or NPS 3/4** (DN 15 or DN 20).
9. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.13 GROUND HYDRANTS

A. Nonfreeze Ground Hydrants <Insert drawing designation if any>:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Josam Company.
- b. MIFAB, Inc.
- c. Murdock-Super Secur; a division of Acorn Engineering Company.
- d. Prier Products, Inc.
- e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

- f. Tyler Pipe; Wade Div.
 - g. Watts Drainage Products.
 - h. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - i. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
 - j. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
 - k. **<Insert manufacturer's name>**.
 - l. or approved equal.
2. Standard: ASME A112.21.3M.
 3. Type: Nonfreeze, concealed-outlet ground hydrant with box.
 4. Operation: Loose key.
 5. Casing and Operating Rod: Of at least length required for burial of valve below frost line.
 6. Inlet: **NPS 3/4 (DN 20)**.
 7. Outlet: Garden-hose thread complying with ASME B1.20.7.
 8. Drain: Designed with hole to drain into ground when shut off.
 9. Box: **[Standard] [Deep]** pattern with cover.
 10. Box and Cover Finish: **[Rough] [Polished nickel] <Insert finish>** bronze.
 11. Operating Key(s): **[One] [Two]** with each ground hydrant.
 12. Vacuum Breaker: ASSE 1011.

2.14 POST HYDRANTS

A. Nonfreeze, Draining-Type Post Hydrants **<Insert drawing designation if any>**:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. MIFAB, Inc.
 - b. Prier Products, Inc.
 - c. Simmons Manufacturing Co.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products.
 - g. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - h. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
 - i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
 - j. **<Insert manufacturer's name>**.
 - k. or approved equal.
2. Standard: ASME A112.21.3M.
 3. Type: Nonfreeze, exposed-outlet post hydrant.
 4. Operation: Loose key.
 5. Casing and Operating Rod: Of at least length required for burial of valve below frost line.

6. Casing: Bronze with casing guard.
 7. Inlet: **NPS 3/4 (DN 20)**.
 8. Outlet: Garden-hose thread complying with ASME B1.20.7.
 9. Drain: Designed with hole to drain into ground when shut off.
 10. Vacuum Breaker:
 - a. Nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
 - b. Garden-hose thread complying with ASME B1.20.7 on outlet.
 11. Operating Key(s): **[One] [Two]** with each loose-key-operation wall hydrant.
- B. Nonfreeze, Nondraining-Type Post Hydrants **<Insert drawing designation if any>**:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Murdock-Super Secur; a division of Acorn Engineering Company.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.
 2. Operation: Lever-piston operating mechanism and nondraining water-storage reservoir, designed without drain.
 3. Length: As required for burial of valve below frost line.
 4. Inlet: **NPS 1 (DN 25)** threaded.
 5. Outlet:
 - a. **NPS 1 (DN 25)** outlet and coupling plug for **1-inch (25-mm)** hose.
 - b. **NPS 1 by NPS 3/4 (DN 25 by DN 20)** adapter with nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
 - c. Garden-hose thread complying with ASME B1.20.7 on outlet.
 - d. **NPS 1 by NPS 3/4 (DN 25 by DN 20)** adapter with nonremovable, drainable, hose-connection backflow preventer complying with ASSE 1052.
 - e. Garden-hose thread complying with ASME B1.20.7 on outlet.
- C. Freeze-Resistant Sanitary Yard Hydrants **<Insert drawing designation if any>**:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Hoepfner Products.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.
 2. Standard: ASSE 1057, Type 5 for nondraining hydrants.
 3. Operation: Wheel handle.
 4. Head: Copper alloy, with pail hook.
 5. Inlet: **NPS 3/4-inch (DN 20)** threaded inlet and inlet nozzle, galvanized-steel riser, and venturi.
 6. Canister: **[Plastic] [Zinc-plated steel]** with atmospheric-vent device.

7. Vacuum Breaker:

- a. Removable hose-connection backflow preventer complying with ASSE 1052.
- b. Garden-hose thread complying with ASME B1.20.7 on outlet for field installation.

2.15 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves <Insert drawing designation if any>:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
3. Size: NPS 3/4 (DN 20).
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves <Insert drawing designation if any>:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4 (DN 20).
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 (DN 20) threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves <Insert drawing designation if any>:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig (1380-kPa) minimum CWP or Class 125.
3. Size: NPS 3/4 (DN 20).
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 (DN 6) side outlet with cap.

2.16 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters <Insert drawing designation if any>:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. AMTROL, Inc.
 - b. Josam Company.

- c. MIFAB, Inc.
 - d. Precision Plumbing Products, Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products.
 - i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
 - j. **<Insert manufacturer's name>**.
 - k. or approved equal.
2. Standard: ASSE 1010 or PDI-WH 201.
 3. Type: Provide in all stainless steel construction, metal-bellows type with pressurized metal cushioning chamber, precharged, suitable for operation in temperature range -100 to +300 degrees F and maximum 250 psig working pressure.
 4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.17 AIR VENTS

A. Bolted-Construction Automatic Air Vents **<Insert drawing designation if any>**:

1. Body: Bronze.
2. Pressure Rating and Temperature: **125-psig (860-kPa)** minimum pressure rating at **140 deg F (60 deg C)**.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: **[NPS 3/8 (DN 10)] [NPS 1/2 (DN 15)]** minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents **<Insert drawing designation if any>**:

1. Body: Stainless steel.
2. Pressure Rating: **150-psig (1035-kPa)** minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: **NPS 3/8 (DN 10)** minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.18 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device **<Insert drawing designation if any>**:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. E & S Valves.
 - b. Josam Co.
 - c. MIFAB, Inc.

- d. Precision Plumbing Products, Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - i. Zurn Industries, Inc.
 - j. **<Insert manufacturer's name>**.
 - k. or approved equal.
2. Standard: ASSE 1018.
 3. Pressure Rating: 125 psig (860 kPa) minimum.
 4. Body: Bronze, with atmospheric-vented drain chamber.
 5. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
 6. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
 7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device **<Insert drawing designation if any>**:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.
2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 (DN 10) minimum, trap makeup connection.
3. Size: NPS 1-1/4 (DN 32) minimum.
4. Material: Chrome-plated, cast brass.

2.19 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems **<Insert drawing designation if any>**:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Precision Plumbing Products, Inc.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.
2. Standard: ASSE 1044.
3. Piping: NPS 3/4, ASTM B 88, Type L (DN 20, ASTM B 88M, Type B); copper, water tubing.
4. Cabinet: **[Recessed]** **[Surface]**-mounted steel box with stainless-steel cover.
5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.

- a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Vacuum Breaker: ASSE 1001.
7. Number Outlets: **[Four]** **[Six]** **[Eight]** **<Insert number>**.
8. Size Outlets: **[NPS 1/2 (DN 15)]** **[NPS 5/8 (DN 18)]**.

2.20 SPECIALTY VALVES

- A. Comply with requirements for general-duty metal valves in Section 220523 "General-Duty Valves for Plumbing Piping."
- B. CPVC Union Ball Valves:
 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. American Valve, Inc.
 - b. Asahi/America.
 - c. Colonial Engineering, Inc.
 - d. Georg Fischer LLC; GF Piping Systems.
 - e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
 - f. IPEX.
 - g. NIBCO Inc.
 - h. Spears Manufacturing Company.
 - i. Thermoplastic Valves Inc.
 - j. **<Insert manufacturer's name>**.
 - k. or approved equal.
 2. Description:
 - a. Standard: MSS SP-122.
 - b. Pressure Rating and Temperature: **[125 psig (860 kPa)]** **[150 psig (1035 kPa)]** **<Insert value>** at **[73 deg F (23 deg C)]** **<Insert temperature>**.
 - c. Body Material: CPVC.
 - d. Body Design: Union type.
 - e. End Connections for Valves **NPS 2 (DN 50)** and Smaller: Detachable, **[socket]** **[or]** **[threaded]**.
 - f. End Connections for Valves **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Detachable, **[socket]** **[socket or threaded]** **[threaded]** **[flanged]**.
 - g. Ball: CPVC; full port.
 - h. Seals: PTFE or EPDM-rubber O-rings.
 - i. Handle: Tee shaped.
- C. PVC Union Ball Valves:
 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. American Valve, Inc.
- b. Asahi/America.
- c. Colonial Engineering, Inc.
- d. Georg Fischer LLC; GF Piping Systems.
- e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
- f. IPEX.
- g. Jomar International.
- h. KBI Company.
- i. Legend Valve.
- j. McDonald, A. Y. Mfg. Co.
- k. NIBCO Inc.
- l. Spears Manufacturing Company.
- m. Thermoplastic Valves Inc.
- n. **<Insert manufacturer's name>**.
- o. or approved equal.

2. Description:

- a. Standard: MSS SP-122.
- b. Pressure Rating and Temperature: [125 psig (860 kPa)] [150 psig (1035 kPa)] **<Insert value>** at [73 deg F (23 deg C)] **<Insert temperature>**.
- c. Body Material: PVC.
- d. Body Design: Union type.
- e. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, **[socket] [or] [threaded]**.
- f. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, **[socket] [socket or threaded] [threaded] [flanged]**.
- g. Ball: PVC; full port.
- h. Seals: PTFE or EPDM-rubber O-rings.
- i. Handle: Tee shaped.

D. CPVC Non-Union Ball Valves:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. American Valve, Inc.
- b. Asahi/America.
- c. KBI Company.
- d. Legend Valve.
- e. NIBCO Inc.
- f. Spears Manufacturing Company.
- g. Thermoplastic Valves Inc.
- h. **<Insert manufacturer's name>**.
- i. or approved equal.

2. Description:

- a. Standard: MSS SP-122.

- b. Pressure Rating and Temperature: [125 psig (860 kPa)] [150 psig (1035 kPa)] <Insert value> at [73 deg F (23 deg C)] <Insert temperature>.
- c. Body Material: CPVC.
- d. Body Design: Non-union type.
- e. End Connections: Socket or threaded.
- f. Ball: CPVC; full or reduced port.
- g. Seals: PTFE or EPDM-rubber O-rings.
- h. Handle: Tee shaped.

E. PVC Non-Union Ball Valves:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. American Valve, Inc.
- b. Asahi/America.
- c. Colonial Engineering, Inc.
- d. Georg Fischer LLC; GF Piping Systems.
- e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
- f. IPEX.
- g. Jomar International.
- h. KBI Company.
- i. Legend Valve.
- j. McDonald, A. Y. Mfg. Co.
- k. NIBCO Inc.
- l. Spears Manufacturing Company.
- m. Thermoplastic Valves Inc.
- n. <Insert manufacturer's name>.
- o. or approved equal.

2. Description:

- a. Standard: MSS SP-122.
- b. Pressure Rating and Temperature: [125 psig (860 kPa)] [150 psig (1035 kPa)] <Insert value> at [73 deg F (23 deg C)] <Insert temperature>.
- c. Body Material: PVC.
- d. Body Design: Non-union type.
- e. End Connections: Socket or threaded.
- f. Ball: PVC; full or reduced port.
- g. Seals: PTFE or EPDM-rubber O-rings.
- h. Handle: Tee shaped.

F. CPVC Butterfly Valves:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Georg Fischer LLC; GF Piping Systems.
- b. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
- c. NIBCO Inc.

- d. Spears Manufacturing Company.
- e. Thermoplastic Valves Inc.
- f. **<Insert manufacturer's name>**.
- g. or approved equal.

2. Description:

- a. Pressure Rating and Temperature: [125 psig (860 kPa)] [150 psig (1035 kPa)] **<Insert value>** at [73 deg F (23 deg C)] **<Insert temperature>**.
- b. Body Material: CPVC.
- c. Body Design: Lug or wafer type.
- d. Seat: EPDM rubber.
- e. Seals: PTFE or EPDM-rubber O-rings.
- f. Disc: CPVC.
- g. Stem: Stainless steel.
- h. Handle: Lever.

G. PVC Butterfly Valves:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. American Valve, Inc.
- b. Asahi/America.
- c. Colonial Engineering, Inc.
- d. Georg Fischer LLC; GF Piping Systems.
- e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
- f. IPEX.
- g. Legend Valve.
- h. NIBCO Inc.
- i. Spears Manufacturing Company.
- j. Thermoplastic Valves Inc.
- k. **<Insert manufacturer's name>**.
- l. or approved equal.

2. Description:

- a. Pressure Rating and Temperature: [125 psig (860 kPa)] [150 psig (1035 kPa)] **<Insert value>** at [73 deg F (23 deg C)] **<Insert temperature>**.
- b. Body Material: PVC.
- c. Body Design: Lug or wafer type.
- d. Seat: EPDM rubber.
- e. Seals: PTFE or EPDM-rubber O-rings.
- f. Disc: PVC.
- g. Stem: Stainless steel.
- h. Handle: Lever.

H. CPVC Ball Check Valves:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. American Valve, Inc.
- b. Asahi/America.
- c. Colonial Engineering, Inc.
- d. Georg Fischer LLC; GF Piping Systems.
- e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
- f. IPEX.
- g. NIBCO Inc.
- h. Spears Manufacturing Company.
- i. Thermoplastic Valves Inc.
- j. **<Insert manufacturer's name>**.
- k. or approved equal.

2. Description:

- a. Pressure Rating and Temperature: [125 psig (860 kPa)] [150 psig (1035 kPa)] **<Insert value>** at [73 deg F (23 deg C)] **<Insert temperature>**.
- b. Body Material: CPVC.
- c. Body Design: Union-type ball check.
- d. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, **[socket] [or] [threaded]**.
- e. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, **[socket] [socket or threaded] [threaded] [flanged]**.
- f. Ball: CPVC.
- g. Seals: EPDM- or FKM-rubber O-rings.

I. PVC Ball Check Valves:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. American Valve, Inc.
- b. Asahi/America.
- c. Colonial Engineering, Inc.
- d. Georg Fischer LLC; GF Piping Systems.
- e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
- f. IPEX.
- g. Legend Valve.
- h. NIBCO Inc.
- i. Spears Manufacturing Company.
- j. Thermoplastic Valves Inc.
- k. **<Insert manufacturer's name>**.
- l. or approved equal.

2. Description:

- a. Pressure Rating and Temperature: [125 psig (860 kPa)] [150 psig (1035 kPa)] **<Insert value>** at [73 deg F (23 deg C)] **<Insert temperature>**.

- b. Body Material: PVC.
- c. Body Design: Union-type ball check.
- d. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, **[socket] [or] [threaded]**.
- e. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, **[socket] [socket or threaded] [threaded] [flanged]**.
- f. Ball: PVC.
- g. Seals: EPDM- or FKM-rubber O-rings.

J. CPVC Gate Valves:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Georg Fischer LLC; GF Piping Systems.
- b. Spears Manufacturing Company.
- c. **<Insert manufacturer's name>**.
- d. or approved equal.

2. Description:

- a. Pressure Rating and Temperature: **[125 psig (860 kPa)] [150 psig (1035 kPa)] <Insert value>** at **[73 deg F (23 deg C)] <Insert temperature>**.
- b. Body Material: CPVC.
- c. Body Design: Nonrising stem.
- d. End Connections for Valves NPS 2 (DN 50) and Smaller: **[Socket] [or] [threaded]**.
- e. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): **[Socket] [Socket or threaded] [Threaded] [Flanged]**.
- f. Gate and Stem: Plastic.
- g. Seals: EPDM rubber.
- h. Handle: Wheel.

K. PVC Gate Valves:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Asahi/America.
- b. Georg Fischer LLC; GF Piping Systems.
- c. KBI Company.
- d. Spears Manufacturing Company.
- e. **<Insert manufacturer's name>**.
- f. or approved equal.

2. Description:

- a. Pressure Rating and Temperature: **[125 psig (860 kPa)] [150 psig (1035 kPa)] <Insert value>** at **[73 deg F (23 deg C)] <Insert temperature>**.
- b. Body Material: PVC.

- c. Body Design: Nonrising stem.
- d. End Connections for Valves **NPS 2 (DN 50)** and Smaller: **[Socket] [or] [threaded]**.
- e. End Connections for Valves **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: **[Socket] [Socket or threaded] [Threaded] [Flanged]**.
- f. Gate and Stem: Plastic.
- g. Seals: EPDM rubber.
- h. Handle: Wheel.

2.21 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Flex-Hose Co., Inc.
- 2. Flexicraft Industries.
- 3. Flex Pression, Ltd.
- 4. Flex-Weld Incorporated.
- 5. Hyspan Precision Products, Inc.
- 6. Mercer Gasket & Shim, Inc.
- 7. Metraflex, Inc.
- 8. Proco Products, Inc.
- 9. TOZEN Corporation.
- 10. Unaflex.Universal Metal Hose; a Hyspan company.
- 11. **<Insert manufacturer's name>**.
- 12. or approved equal.

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

- 1. Working-Pressure Rating: Minimum **[200 psig (1380 kPa)] [250 psig (1725 kPa)]**.
- 2. End Connections **NPS 2 (DN 50)** and Smaller: Threaded copper pipe or plain-end copper tube.
- 3. End Connections **NPS 2-1/2 (DN 65)** and Larger: Flanged copper alloy.

C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

- 1. Working-Pressure Rating: Minimum **[200 psig (1380 kPa)] [250 psig (1725 kPa)]**.
- 2. End Connections **NPS 2 (DN 50)** and Smaller: Threaded steel-pipe nipple.
- 3. End Connections **NPS 2-1/2 (DN 65)** and Larger: Flanged steel nipple.

2.22 WATER METERS

A. Displacement-Type Water Meters:

- 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. AALIANT; a Venture Measurement product line.ABB.Badger Meter, Inc.
- b. Carlon Meter.
- c. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
- d. Schlumberger Limited; Water Services.
- e. Sensus.
- f. **<Insert manufacturer's name>**.
- g. or approved equal.

2. Description:

- a. Standard: AWWA C700.
- b. Pressure Rating: **150-psig** (1035-kPa) working pressure.
- c. Body Design: Nutating disc; totalization meter.
- d. Registration: In **gallons** (liters) or **cubic feet** (cubic meters) as required by utility company.
- e. Case: Bronze.
- f. End Connections: Threaded.

B. Turbine-Type Water Meters:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. AALIANT; a Venture Measurement product line.
- b. ABB.
- c. Badger Meter, Inc.
- d. Hays Fluid Controls.
- e. Master Meter, Inc.
- f. McCrometer, Inc.
- g. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
- h. Schlumberger Limited; Water Services.
- i. SeaMetrics Inc.
- j. Sensus.
- k. **<Insert manufacturer's name>**.
- l. or approved equal.

2. Description:

- a. Standard: AWWA C701.
- b. Pressure Rating: [**150-psig** (1035-kPa)] **<Insert value>** working pressure.
- c. Body Design: Turbine; totalization meter.
- d. Registration: In **gallons** (liters) or **cubic feet** (cubic meters) as required by utility company.
- e. Case: Bronze.
- f. End Connections for Meters **NPS 2** (DN 50) and Smaller: Threaded.
- g. End Connections for Meters **NPS 2-1/2** (DN 65) and Larger: Flanged.

C. Compound-Type Water Meters:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. ABB.
- b. Badger Meter, Inc.
- c. Master Meter, Inc.
- d. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
- e. Schlumberger Limited; Water Services.
- f. Sensus.
- g. **<Insert manufacturer's name>**.
- h. or approved equal.

2. Description:

- a. Standard: AWWA C702.
- b. Pressure Rating: **150-psig** (1035-kPa) working pressure.
- c. Body Design: With integral mainline and bypass meters; totalization meter.
- d. Registration: In **gallons** (liters) or **cubic feet** (cubic meters) as required by utility company.
- e. Case: Bronze.
- f. Pipe Connections: Flanged.

D. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

E. Remote Registration System: Encoder type complying with AWWA C707; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

2.23 SUMPS

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Harrison Plastic Systems.
- b. Lifetime Fiberglass Tank Company.
- c. **<Insert manufacturer's name>**
- d. or approved equal.

B. **[Precast concrete specified in Division 03] [Precast concrete] [Epoxy coated fabricated steel] [Glass fiber reinforced encased with 8 inches reinforced concrete]** with required openings and drainage fittings, and supports for level controls, piping, etc.

C. Cover: 3/8 inch thick checkered steel plate with gasket seal frames and anchor bolts, with gas-tight connections for controls, fluid, and vent piping. Provide cover lifting lugs or recessed threaded sleeves for lifting eye-bolts.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- B. Install water regulators with inlet and outlet shutoff valves[**and bypass with memory-stop balancing valve**]. Install pressure gages on inlet and outlet.
- C. Install water-control valves with inlet and outlet shutoff valves[**and bypass with globe valve**]. Install pressure gages on inlet and outlet.
- D. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve.
- E. Install balancing valves in locations where they can easily be adjusted.
- F. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- G. Install Y-pattern strainers for water on supply side of each [**control valve**] [**water pressure-reducing valve**] [**solenoid valve**] [**and**] [**pump**].
- H. Install outlet boxes recessed in wall or surface mounted on wall. Install **2-by-4-inch (38-by-89-mm)** fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."
- I. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
1. Install cabinet-type units recessed in or surface mounted on wall as specified. Install **2-by-4-inch (38-by-89-mm)** fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."
- J. Install ground hydrants with [**1 cu. yd. (0.75 cu. m)**] **<Insert dimension>** of crushed gravel around drain hole.

1. Set ground hydrants with box flush with grade.
 2. Set post hydrants in concrete paving or in [1 cu. ft.] **[Insert other]** of concrete block at grade.
- K. Install draining-type post hydrants with [1 cu. yd. (0.75 cu. m)] **<Insert dimension>** of crushed gravel around drain hole. Set post hydrants in concrete paving or in [1 cu. ft. (0.03 cu. m)] **<Insert dimension>** of concrete block at grade.
- L. Set nonfreeze, nondraining-type post hydrants in concrete or pavement.
- M. Set freeze-resistant yard hydrants with riser pipe in concrete or pavement. Do not encase canister in concrete.
- N. Install water-hammer arresters in water piping according to PDI-WH 201.
- O. Install air vents at high points of water piping. **[Install drain piping and discharge onto floor drain.]**
- P. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- Q. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- R. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.
- S. Install trap seal primer on all traps that have the potential for drying out, such as storage rooms, vestibules, and chases.
- T. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- U. Install water hammer arrestors complete with accessible isolation valve **[on hot and cold water supply piping to lavatories, sinks, and washing machine outlets].**
- V. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.
- W. Fasten recessed-type plumbing specialties to reinforcement built into walls.
- X. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties. Use carriers when possible.
- Y. Install individual shutoff valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve is not indicated. Install shutoff valves in accessible

locations. Refer to other Division 22 Sections for general-duty ball, butterfly, check, gate, and globe valves.

- Z. Install air vents at piping high points. Include ball, gate, or globe valve in inlet [**and drain piping from outlet to floor drain**].
- AA. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- BB. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.
- C. Install piping adjacent to equipment to allow service and maintenance.
- D. Connect plumbing specialties to piping specified in other Division 22 Sections.
- E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- F. Connect plumbing specialties and devices that require power according to Division 26 Sections.

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Pressure vacuum breakers.
 - 2. Intermediate atmospheric-vent backflow preventers.
 - 3. Reduced-pressure-principle backflow preventers.
 - 4. Double-check, backflow-prevention assemblies.
 - 5. Carbonated-beverage-machine backflow preventers.
 - 6. Dual-check-valve backflow preventers.
 - 7. Reduced-pressure-detector, fire-protection, backflow-preventer assemblies.
 - 8. Double-check, detector-assembly backflow preventers.
 - 9. Water pressure-reducing valves.
 - 10. Calibrated balancing valves.
 - 11. Primary, thermostatic, water mixing valves.
 - 12. Manifold, thermostatic, water mixing-valve assemblies.

13. Photographic-process, thermostatic, water mixing-valve assemblies.
14. Primary water tempering valves.
15. Outlet boxes.
16. Hose stations.
17. Supply-type, trap-seal primer valves.
18. Trap-seal primer systems.

- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

1. Test each [**pressure vacuum breaker**] [**reduced-pressure-principle backflow preventer**] [**double-check, backflow-prevention assembly**] [**and**] [**double-check, detector-assembly backflow preventer**] <Insert type> according to authorities having jurisdiction and the device's reference standard.

- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled trap seal primer systems and their installation, including piping and electrical connections. Report results in writing.

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- C. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

- D. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION **221119**

SECTION 221123 - DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. In-line, sealless centrifugal pumps.
 - 2. Horizontally mounted, in-line, separately coupled centrifugal pumps.
 - 3. Horizontally mounted, in-line, close-coupled centrifugal pumps.
 - 4. Vertically mounted, in-line, close-coupled centrifugal pumps.
- B. Related Sections include the following:
 - 1. Section 221123.13 "Domestic-Water Packaged Booster Pumps" for booster systems.
 - 2. Section 332100 "Water Supply Wells" for well pumps.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 1. Include dimension drawings indicating components and connections to other equipment and piping.
 - 2. Indicate pump type, capacity, impeller size, power requirements, and affected adjacent construction.
 - 3. Submit certified pump curves showing pump performance characteristics with

4. pump and system operating point plotted. Include NPSH curve when applicable.
4. Include data substantiating that materials comply with requirements.

B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.

1. Wiring Diagrams: Power, signal, and control wiring.

C. LEED Submittals:

1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1, without amendments, Section 7 - "Service Water Heating."

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water pumps to include in emergency, operation and maintenance manuals.

1. Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Minimum one (1) or 10% of quantity pumps delivered.

B. Mechanical Seals: [**One (1)**] <Insert number> set mechanical seal(s) for each pump.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of hydronic pumps and are based on the specific system indicated.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

- D. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
- B. Store pumps in dry location.
- C. Retain protective covers for flanges and protective coatings during storage.
- D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
- E. Provide temporary inlet and outlet caps. Maintain caps in place until installation.
- F. Retain shipping flange protective covers and protective coatings during storage.
- G. Protect bearings and couplings against damage.
- H. Comply with pump manufacturer's written rigging instructions for handling.

1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Statically and dynamically balance rotating parts.
- B. Construction to permit complete servicing without breaking piping or motor connections.
- C. Pumps to operate at nominal 1750 rpm unless specified otherwise.
- D. Pump connections to be flanged.

2.2 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

1. [Armstrong Pumps Inc.](#)
2. [Bell & Gossett Domestic Pump; ITT Corporation.](#)
3. [Grundfos Pumps Corp.](#)
4. [TACO Incorporated.](#)
5. [WILO USA LLC - WILO Canada Inc.](#)
6. **<Insert manufacturer's name>.**
7. or approved equal.

B. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.

C. Pump Construction:

1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
2. Casing: Bronze, with threaded or companion-flange connections.
3. Impeller: Bronze
4. Motor: Single speed, unless otherwise indicated.

D. Capacities and Characteristics:

1. Capacity: **<Insert gpm (L/s)>.**
2. Total Dynamic Head: **<Insert feet (kPa)>.**
3. Minimum Working Pressure: **125 psig (860 kPa).**
4. Maximum Continuous Operating Temperature: **220 deg F (104 deg C).**
5. Inlet and Outlet Size: **<Insert NPS (DN)>.**
6. Pump Speed: **<Insert rpm>.**
7. Pump Control: **[Pressure switch] [Thermostat] [Timer].**
8. Motor Horsepower: **<Insert value>.**
9. Electrical Characteristics:
 - a. Volts: 120.
 - b. Phases: Single.
 - c. Hertz: 60.
 - d. Full-Load Amperes: **<Insert value>.**
 - e. Minimum Circuit Ampacity: **<Insert value>.**
 - f. Maximum Overcurrent Protection: **<Insert value> A.**

2.3 HORIZONTALLY MOUNTED, IN-LINE, SEPARATELY COUPLED CENTRIFUGAL PUMPS

A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

1. [Bell & Gossett Domestic Pump; ITT Corporation.](#)
 2. [Marshall Engineered Products Co.](#)
 3. [TACO Incorporated.](#)
 4. [Thrush Co. Inc.](#)
 5. [Weinman Division: Crane Pumps & Systems.](#)
 6. **<Insert manufacturer's name>.**
 7. or approved equal.
- B. Description: Factory-assembled and -tested, in-line, single-stage, separately coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shafts mounted horizontal.
- C. Pump Construction:
1. Casing: Radially split with threaded companion-flange connections for pumps with **NPS 2 (DN 50)** pipe connections and flanged connections for pumps with **NPS 2-1/2 (DN 65)** pipe connections.
 2. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.
 3. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve.
 4. Coupling: Flexible.
 5. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
 6. Bearings: Oil-lubricated; bronze-journal or ball type.
 7. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
- D. Motor: Single speed, with grease-lubricated ball bearings; and **[resiliently]** **[or]** **[rigidly]** mounted to pump casing.
- E. Capacities and Characteristics:
1. Capacity: **<Insert gpm (L/s)>.**
 2. Total Dynamic Head: **<Insert feet (kPa)>.**
 3. Casing Material: **[Bronze]** **[Cast iron]**.
 4. Impeller Material: **[ASTM B 584, cast bronze]** **[ASTM B 584, cast bronze or stainless steel]** **[Stainless steel]**.
 5. Minimum Working Pressure: **[125 psig (860 kPa)]** **[175 psig (1200 kPa)]**.
 6. Maximum Continuous Operating Temperature: **225 deg F (107 deg C)**.
 7. Inlet and Outlet Size: **<Insert NPS (DN)>.**
 8. Pump Speed: **<Insert rpm>.**
 9. Pump Control: **[Pressure switch]** **[Thermostat]** **[Timer]**.
 10. Motor Horsepower: **<Insert value>.**
 11. Electrical Characteristics:
 - a. Volts: **[120]** **[240]** **<Insert value>.**
 - b. Phases: **[Single]** **[Three]**.
 - c. Hertz: 60.
 - d. Full-Load Amperes: **<Insert value>.**
 - e. Minimum Circuit Ampacity: **<Insert value>.**
 - f. Maximum Overcurrent Protection: **<Insert value> A.**

2.4 HORIZONTALLY MOUNTED, IN-LINE, CLOSE-COUPLED CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. [Alyan Pump Co.](#)
2. [Armstrong Pumps Inc.](#)
3. [Bell & Gossett Domestic Pump; ITT Corporation.](#)
4. [Marshall Engineered Products Co.](#)
5. [PACO Pumps; Grundfos Pumps Corporation, U.S.A.](#)
6. [Pentair Pump Group; Aurora Pump.](#)
7. [TACO Incorporated.](#)
8. [Thrush Company, Inc.](#)
9. **<Insert manufacturer's name>.**
10. or approved equal.

B. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted horizontal.

C. Pump Construction:

1. Casing: Radially split with threaded companion-flange connections for pumps with **NPS 2 (DN 50)** pipe connections and flanged connections for pumps with **NPS 2-1/2 (DN 65)** pipe connections.
2. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.
3. Shaft and Shaft Sleeve: Steel shaft with deflector, with copper-alloy shaft sleeve. Include water slinger on shaft between motor and seal.
4. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
5. Bearings: Oil-lubricated; bronze-journal or ball type.
6. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.

D. Motor: Single speed, with grease-lubricated ball bearings; and resiliently or rigidly mounted to pump casing.

E. Capacities and Characteristics:

1. Capacity: **<Insert gpm (L/s)>.**
2. Total Dynamic Head: **<Insert feet (kPa)>.**
3. Casing Material: **[Bronze] [Cast iron].**
4. Impeller Material: **[ASTM B 584, cast bronze] [ASTM B 584, cast bronze or stainless steel] [Stainless steel].**
5. Minimum Working Pressure: **175 psig (1200 kPa).**
6. Maximum Continuous Operating Temperature: **225 deg F (107 deg C).**
7. Inlet and Outlet Size: **<Insert NPS (DN)>.**
8. Pump Control: **[Pressure switch] [Thermostat] [Timer].**
9. Pump Speed: **<Insert rpm>.**
10. Motor Horsepower: **<Insert value>.**

11. Electrical Characteristics:
 - a. Volts: [120] [240] <Insert value>.
 - b. Phases: [Single] [Three].
 - c. Hertz: 60.
 - d. Full-Load Amperes: <Insert value>.
 - e. Minimum Circuit Ampacity: <Insert value>.
 - f. Maximum Overcurrent Protection: <Insert value> A.

2.5 VERTICALLY MOUNTED, IN-LINE, CLOSE-COUPLED CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. [Alyan Pump Co.](#)
2. [Armstrong Pumps Inc.](#)
3. [Bell & Gossett Domestic Pump; ITT Corporation.](#)
4. [Federal Pump Corp.](#)
5. [Flo Fab inc.](#)
6. [Grundfos Pumps Corp.](#)
7. [Marshall Engineered Products Co.](#)
8. [PACO Pumps; Grundfos Pumps Corporation, U.S.A.](#)
9. [Peerless Pump, Inc.](#)
10. [Pentair Pump Group; Aurora Pump.](#)
11. [TACO Incorporated.](#)
12. [Thrush Co. Inc.](#)
13. [Weinman Division; Crane Pumps & Systems.](#)
14. <Insert manufacturer's name>.
15. or approved equal.

B. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted vertical.

C. Pump Construction:

1. Casing: Radially split, cast iron, with wear rings and threaded companion-flange connections for pumps with NPS 2 (DN 50) pipe connections and flanged connections for pumps with NPS 2-1/2 (DN 65) pipe connections. [**Include pump manufacturer's base attachment for mounting pump on concrete base.**]
2. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.
3. Shaft and Shaft Sleeve: [**Stainless-steel or steel**] [**Stainless-steel**] shaft, with copper-alloy shaft sleeve.
4. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket. Include water slinger on shaft between motor and seal.
5. Bearings: Oil-lubricated; bronze-journal or ball type.
6. Shaft Coupling: Flexible or rigid type if pump is provided with coupling.

- D. Motor: Single speed, with grease-lubricated ball bearings; and rigidly mounted to pump casing.
- E. Capacities and Characteristics:
1. Capacity: <Insert gpm (L/s)>.
 2. Total Dynamic Head: <Insert feet (kPa)>.
 3. Casing Material: **[Bronze]** **[Cast iron]**.
 4. Impeller Material: **[ASTM B 584, cast bronze]** **[ASTM B 584, cast bronze or stainless steel]** **[Stainless steel]**.
 5. Minimum Operating Pressure: **175 psig** (1200 kPa).
 6. Maximum Continuous Operating Temperature: **225 deg F** (107 deg C).
 7. Inlet and Outlet Size: <Insert NPS (DN)>.
 8. Pump Control: **[Pressure switch]** **[Thermostat]** **[Timer]**.
 9. Pump Speed: <Insert rpm>.
 10. Motor Horsepower: <Insert value>.
 11. Electrical Characteristics:
 - a. Volts: **[120]** **[240]** <Insert value>.
 - b. Phases: **[Single]** **[Three]**.
 - c. Hertz: 60.
 - d. Full-Load Amperes: <Insert value>.
 - e. Minimum Circuit Ampacity: <Insert value>.
 - f. Maximum Overcurrent Protection: <Insert value> A.

2.6 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.7 CONTROLS

- A. Pressure Switches: Electric, adjustable for control of **[water-supply]** <Insert **application**> pump.
1. Type: Water-immersion pressure sensor, for installation in piping.
 2. Enclosure: NEMA 250, **[Type 4X]** <Insert type>.
 3. Operation of Pump: On or off.
 4. Transformer: Provide if required.
 5. Power Requirement: **[24 V, ac]** **[120 V, ac]** <Insert power>.
 6. Settings: Start pump at <Insert pressure> and stop pump at <Insert pressure>.
- B. Thermostats: Electric; adjustable for control of **[hot-water circulation]** <Insert **application**> pump.

1. Type: Water-immersion temperature sensor, for installation in piping.
 2. Range: [50 to 125 deg F (10 to 52 deg C)] [65 to 200 deg F (18 to 93 deg C)] [100 to 240 deg F (38 to 116 deg C)] <Insert range>.
 3. Enclosure: NEMA 250, [Type 4X] <Insert type>.
 4. Operation of Pump: On or off.
 5. Transformer: Provide if required.
 6. Power Requirement: [24 V, ac] [120 V, ac] <Insert power>.
 7. Settings: Start pump at [105 deg F (41 deg C)] [110 deg F (43 deg C)] [115 deg F (46 deg C)] <Insert temperature> and stop pump at [120 deg F (49 deg C)] [125 deg F (52 deg C)] <Insert temperature>.
- C. Timers: Electric, for control of [hot-water circulation] <Insert application> pump.
1. Type: Programmable, [seven-day] <Insert time> clock with manual override on-off switch.
 2. Enclosure: NEMA 250, [Type 1] <Insert type>, suitable for wall mounting.
 3. Operation of Pump: On or off.
 4. Transformer: Provide if required.
 5. Power Requirement: [24-V ac] [120-V ac] <Insert power>.
 6. Programmable Sequence of Operation: [Up to two on-off cycles each day for seven days] <Insert operational sequence>.
- D. Time-Delay Relays: Electric, for control of hot-water circulation pump between water heater and connected hot-water storage tank.
1. Type: Adjustable time-delay relay.
 2. Range: Up to five minutes.
 3. Setting: Five minutes.
 4. Enclosure: NEMA 250, [Type 4X] <Insert type>.
 5. Operation of Pump: On or off.
 6. Transformer: Provide if required.
 7. Power Requirement: [24-V ac] [120-V ac] <Insert power>.
 8. Programmable Sequence of Operation: Limit pump operation to periods of burner operation plus maximum five minutes after the burner stops.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install in accordance with manufacturer's instructions.

- C. Provide drains for bases and stuffing boxes piped to and discharging into floor drains.
- D. Provide line sized gate valve and strainer on suction and line sized soft seated check valve and globe or plug valve on discharge. For duplex pump units, check valves shall be spring-closed type.
- E. Decrease from line size, with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and over.
- F. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- G. Ensure shaft length allows sump pumps to be located minimum 24 inches below lowest invert into sump pit and minimum 6 inches clearance from bottom of sump pit.
- H. Provide air cock and drain connection on horizontal pump casings.
- I. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
- J. Align and verify alignment of base mounted pumps prior to start-up.
- K. Install in-line, sealless centrifugal pumps with shaft horizontal unless otherwise indicated.
- L. Install horizontally mounted, in-line, **[separately coupled] [and] [close-coupled]** centrifugal pumps with shaft(s) horizontal.
- M. Install vertically mounted, in-line, close-coupled centrifugal pumps with shaft vertical.
- N. Pump Mounting: Install vertically mounted, in-line, close-coupled centrifugal pumps with cast-iron base mounted on concrete base using **[elastomeric pads] [elastomeric mounts] [restrained spring isolators] <Insert device>**. Comply with requirements for concrete base specified in **[Section 033000 "Cast-in-Place Concrete. "] [Section 033053 "Miscellaneous Cast-in-Place Concrete. "]**
 - 1. Minimum Deflection: **[1/4 inch (6 mm)] [1 inch (25 mm)] <Insert dimension>**.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around the full perimeter of concrete base.
 - 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
- O. Install continuous-thread hanger rods and **[spring hangers] [spring hangers with vertical-limit stop]** of size required to support pump weight.

1. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
 2. Comply with requirements for hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- P. Install pressure switches in water supply piping.
- Q. Install thermostats in hot-water return piping.
- R. Install timers [**on wall in engineer's office**] <Insert location>.
- S. Install time-delay relays in piping between water heaters and hot-water storage tanks.
- T. Provide qualified millwright to check, align, and certify base mounted pumps prior to start-up.

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps to allow service and maintenance.
- C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
 - a. Horizontally mounted, in-line, separately coupled centrifugal pumps.
 - b. Horizontally mounted, in-line, close-coupled centrifugal pumps.
 - c. Vertically mounted, in-line, close-coupled centrifugal pumps.
 - d. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."
 2. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping" and comply with requirements for strainers specified in Section 221119 "Domestic Water Piping Specialties."
 3. Install pressure gage[**and snubber**] at suction of each pump and pressure gage[**and snubber**] at discharge of each pump. Install at integral pressure-gage tapplings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Comply with requirements for pressure gages and snubbers specified in Section 220519 "Meters and Gages for Plumbing Piping."

- D. Connect **[pressure switches,] [thermostats,] [time-delay relays,] [and] [timers]** to pumps that they control.
- E. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

3.4 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to assist Contractor and perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check piping connections for tightness.
 - 3. Clean strainers on suction piping.
 - 4. Set **[pressure switches,] [thermostats,] [timers,] [and] [time-delay relays]** for automatic starting and stopping operation of pumps.
 - 5. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
 - 6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
 - 7. Start motor.
 - 8. Open discharge valve slowly.
 - 9. Adjust temperature settings on thermostats.
 - 10. Adjust timer settings.

3.6 ADJUSTING

- A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature set points.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION **221123**

SECTION 221123.13 - DOMESTIC-WATER PACKAGED BOOSTER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Simplex, constant-speed booster pumps.
 - 2. Multiplex, constant-speed booster pumps.
 - 3. Simplex, variable-speed booster pumps.
 - 4. Multiplex, variable-speed booster pumps.
- B. Related Sections:
 - 1. Section 221123 "Domestic Water Pumps" for domestic-water circulation pumps.
 - 2. Section 221223 "Facility Indoor Potable-Water Storage Tanks" for separate hydropneumatic domestic-water tanks for multiplex booster pumps.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. VFC: Variable-frequency controller(s).

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Booster pumps shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7] <Insert requirement>**.
 - 1. The term "withstand" means "the booster pump will remain in place without separation of any parts from the booster pump when subjected to the seismic forces specified[**and the booster pump will be fully operational after the seismic event**]."

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. **[Include construction details, material descriptions, and dimensions of individual components and profiles.] [Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories for each type of product indicated.]**
1. Include certified performance curves, final impeller dimensions. Indicate pump's operating point on curves.
 2. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For booster pumps. Include plans, elevations, sections, details, and attachments to other work. Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For booster pumps, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Submit sample of product warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For booster pumps to include in emergency, operation, and maintenance manuals.
1. Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Perform Work in accordance with Denver codes and standards.
- B. Provide pumps with manufacturer's name, model number, and rating/capacity identified.
- C. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.
- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of hydronic pumps and are based on the specific system indicated. Refer to Division 01 requirements.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
- F. ASME Compliance: Comply with ASME B31.9 for piping.
- G. UL Compliance for Packaged Pumping Systems:
 - 1. UL 508, "Industrial Control Equipment."
 - 2. UL 508A, "Industrial Control Panels."
 - 3. UL 778, "Motor-Operated Water Pumps."
 - 4. UL 1995, "Heating and Cooling Equipment."
- H. Booster pumps shall be listed and labeled as packaged pumping systems by testing agency acceptable to authorities having jurisdiction.
- I. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
- B. Store pumps in dry location.
- C. Retain protective coatings and flange's protective covers during storage.
- D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
- E. Comply with pump manufacturer's written rigging instructions.

1.10 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Divisio 03.

1.11 WARRANTY

A. Provide minimum five (5) year warranty for domestic-water packaged booster pumps.

1.12 EXTRA STOCK

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Provide minimum one (1) or 10% of quantity pumps delivered.
2. Mechanical Seals: [**One (1)**] <Insert number> mechanical seal(s) for each pump.

1.13 CONSTRUCTION WASTE MANAGEMENT

A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Statically and dynamically balance rotating parts.
- B. Construction to permit complete servicing without breaking piping or motor connections.
- C. Pumps to operate at nominal 1750 rpm unless specified otherwise.
- D. Pump connections to be flanged.

2.2 SIMPLEX, CONSTANT-SPEED BOOSTER PUMPS

A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

1. [AMTROL, Inc.](#)
 2. [Armstrong Pumps Inc.](#)
 3. [Bell & Gossett Domestic Pump; ITT Corporation.](#)
 4. [Canariis Corporation.](#)
 5. [Goulds Pumps; ITT Corporation.](#)
 6. [Grundfos Pumps Corporation U.S.A.](#)
 7. [Hydronic Modules Corporation.](#)
 8. [ITT Flowtronex.](#)
 9. [Metron, Inc.](#)
 10. [Metropolitan Industries, Inc.](#)
 11. [Paco Pumps.](#)
 12. [Thrush Co., Inc.](#)
 13. [TIGERFLOW Systems, Inc.](#)
 14. <Insert manufacturer's name>.
 15. or approved equal.
- B. Description: Factory-assembled and -tested, fluid-handling system for domestic water, with pump, piping, valves, specialties, and controls, and mounted on base.
- C. Pump:
1. Type: End suction as defined in HI 1.1-1.2 and HI 1.3 for end-suction, close-coupled, single-stage, overhung-impeller, centrifugal pump.
 2. Casing: Radially split; **[bronze] [cast iron] [stainless steel]**.
 3. Impeller: Closed, **[ASTM B 584 cast bronze] [stainless steel] <Insert material>**; statically and dynamically balanced and keyed to shaft.
 4. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve and deflector.
 5. Seal: Mechanical.
 6. Orientation: Mounted **[horizontally] [or] [vertically]**.
- D. Motor: Single speed, with **[grease-lubricated] [or] [pre-greased, permanently shielded]**, ball-type bearings, and directly mounted to pump casing. Select motor that will not overload through full range of pump performance curve.
- E. Piping: **[Copper tube and copper fittings] [Stainless-steel pipe and fittings] [Stainless-steel pipe and fitting headers and copper tube and copper fittings between headers and pump] [Galvanized-steel pipe and cast-iron fittings]**.
- F. Valves:
1. Shutoff Valves **NPS 2 (DN 50)** and smaller: **[Gate valve] [or] [two-piece, full-port ball valve]**, in pump suction and discharge piping.
 2. Shutoff Valves **NPS 2-1/2 (DN 65)** and Larger: **[Gate valve] [or] [lug-type butterfly valve]**, in pump suction and discharge piping.
 3. Check Valve **NPS 2 (DN 50)** and smaller: **[Silent] [or] [swing]** type in pump discharge piping.
 4. Check Valve **NPS 2-1/2 (DN 65)** and Larger: Silent type in pump discharge piping.
 5. Control Valve: Adjustable, automatic, **[pilot-operated] [or] [direct-acting]**, pressure-reducing type in pump discharge piping.

6. Control Valve: Combination adjustable, automatic, [**pilot-operated**] [**or**] [**direct-acting**] pressure-reducing-and-check type in pump discharge piping.
 7. Thermal-Relief Valve: Temperature-and-pressure relief type in pump discharge piping.
- G. Dielectric Fittings: With insulating material isolating joined dissimilar metals.
- H. Hydropneumatic Tank: Precharged[, **ASME-construction**,] diaphragm or bladder tank made of materials complying with NSF 61.
- I. Control Panel: Factory installed and connected as an integral part of booster pump; automatic for single-pump, constant-speed operation, with load control and protection functions.
1. Control Logic: [**Electromechanical system with switches, relays**] [**Solid-state system with transducers, programmable microprocessor**], and other devices in the controller.
 2. Motor Controller: NEMA ICS 2, general-purpose, Class A, full-voltage, combination-magnetic type with undervoltage release feature, motor-circuit-protector-type disconnect, and short-circuit protective device.
 - a. Control Voltage: [**24**] [**120**]-V ac, with integral control-power transformer.
 3. Motor Controller: NEMA ICS 2, solid-state, reduced-voltage type.
 - a. Control Voltage: [**24**] [**120**]-V ac, with integral control-power transformer.
 4. Enclosure: NEMA 250, [**Type 1**] [**Type 3R**] [**Type 4**] [**Type 12**] <Insert type>.
 5. Motor Overload Protection: Overload relay in each phase.
 6. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
 7. Pump Operation: [**Current-**] [**or**] [**pressure-**] sensing method.
 - a. Time Delay: Controls pump on-off operation; adjustable from [**1 to 300**] <Insert value> seconds.
 8. Instrumentation: Suction and discharge pressure gages.
 9. Light: Running light for pump.
 10. Thermal-bleed cutoff.
 11. [**Low-suction-pressure**] [**Water-storage-tank, low-level**] cutout.
 12. High-suction-pressure cutout.
 13. Low-discharge-pressure cutout.
 14. High-discharge-pressure cutout.
 15. Building Automation System Interface: Provide auxiliary contacts for interface to [**BACnet**] [**LonWorks**] <Insert system> building automation system. Building automation systems are specified in Section 230900 "Instrumentation and Control for HVAC." Include the following:
 - a. On-off status of pump.
 - b. Alarm status.

J. Base: Structural steel.

K. Capacities and Characteristics:

1. Minimum Pressure Rating: [125 psig (860 kPa)] [150 psig (1035 kPa)] <Insert value>.
2. Booster-Pump Capacity: <Insert gpm (L/s)>.
3. Total Dynamic Head: <Insert feet (kPa)>.
4. Speed: <Insert rpm>.
5. Minimum Inlet Pressure: <Insert psig (kPa)>.
6. Maximum Inlet Pressure: <Insert psig (kPa)>.
7. Discharge Pressure: <Insert psig (kPa)>.
8. Low-Suction-Pressure Shutoff: <Insert psig (kPa)>.
9. High-Suction-Pressure Shutoff: <Insert psig (kPa)>.
10. Low-Discharge-Pressure Shutoff: <Insert psig (kPa)>.
11. High-Discharge-Pressure Shutoff: <Insert psig (kPa)>.
12. Inlet Size: <Insert NPS (DN)>.
13. Outlet Size: <Insert NPS (DN)>.
14. Control Valve:
 - a. Minimum Size: <Insert NPS (DN)>.
 - b. Maximum Pressure Drop: <Insert psig (kPa)>.
15. Electrical Characteristics:
 - a. Motor Horsepower: <Insert value>.
 - b. Volts: [120] [240] [277] [480] <Insert value>.
 - c. Phases: [Single] [Three].
 - d. Hertz : 60.
 - e. Full-Load Amperes: <Insert value>.
 - f. Minimum Circuit Ampacity: <Insert value>.
 - g. Maximum Overcurrent Protection: <Insert amperage>.
16. Hydropneumatic Tank:
 - a. Minimum Water Volume: <Insert gal. (L)> capacity.
 - b. Pressure Rating: [125 psig (860 kPa)] [150 psig (1035 kPa)] [250 psig (1725 kPa)] <Insert value>.
 - c. Air Precharge: <Insert psig (kPa)>.

2.3 MULTIPLEX, CONSTANT-SPEED BOOSTER PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. [Armstrong Pumps Inc.](#)
2. [Bell & Gossett Domestic Pump; ITT Corporation.](#)
3. [Canariis Corporation.](#)
4. [Goulds Pumps; ITT Corporation.](#)

5. [Grundfos Pumps Corporation U.S.A.](#)
6. [Hydronic Modules Corporation.](#)
7. [ITT Flowtronex.](#)
8. [Metron, Inc.](#)
9. [Metropolitan Industries, Inc.](#)
10. [Paco Pumps.](#)
11. [Patterson Pump Company; a subsidiary of the Gorman-Rupp Company.](#)
12. [SyncroFlo, Inc.](#)
13. [Thrush Co., Inc.](#)
14. [TIGERFLOW Systems, Inc.](#)
15. **<Insert manufacturer's name>.**
16. or approved equal.

B. Description: Factory-assembled and -tested, fluid-handling system for domestic water, with pumps, piping, valves, specialties, and controls, and mounted on base.

C. Pumps:

1. Type: End suction as defined in HI 1.1-1.2 and HI 1.3 for end-suction, close-coupled, single-stage, overhung-impeller, centrifugal pump.
2. Casing: Radially split; **[bronze] [cast iron] [stainless steel]**.
3. Impeller: Closed, **[ASTM B 584 cast bronze] [stainless steel] <Insert material>**; statically and dynamically balanced and keyed to shaft.
4. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve and deflector.
5. Seal: Mechanical.
6. Orientation: Mounted **[horizontally] [or] [vertically]**.

D. Pumps:

1. Type: End suction as defined in HI 1.1-1.2 and HI 1.3 for end-suction, frame-mounted, separately coupled, single-stage, overhung-impeller, centrifugal pump. **[Include back-pullout design.]**
2. Casing: Radially split; **[bronze] [cast iron] [stainless steel]**.
3. Impeller: Closed, **[ASTM B 584 cast bronze] [stainless steel] <Insert material>**; statically and dynamically balanced and keyed to shaft.
4. Shaft and Shaft Sleeve: Stainless-steel **[or steel]** shaft, with copper-alloy shaft sleeve and deflector.
5. Seal: Mechanical.
6. Bearing: **[Grease-lubricated] [or] [pre-greased, permanently shielded]** ball type.
7. Coupling: Flexible, with metal guard.

E. Pumps:

1. Type: In line, single stage as defined in HI 1.1-1.2 and HI 1.3 for in-line, single-stage, close-coupled, overhung-impeller, centrifugal pump.
2. Casing: Radially split; **[bronze] [cast iron] [stainless steel]**.
3. Impeller: Closed, **[ASTM B 584 cast bronze] [stainless steel] <Insert material>**; statically and dynamically balanced and keyed to shaft.

4. Shaft and Shaft Sleeve: Stainless-steel[**or steel**] shaft, with copper-alloy shaft sleeve.
5. Seal: Mechanical.
6. Bearing: [**Grease-lubricated**] [**or**] [**pre-greased, permanently shielded**] ball type.

F. Pumps:

1. Type: Vertical, multistage as defined in HI 1.1-1.2 and HI 1.3 for in-line, multistage, separately coupled, overhung-impeller, centrifugal pump.
2. Casing: Cast-iron or steel base and stainless-steel chamber.
3. Impeller: Closed, stainless steel; statically and dynamically balanced and keyed to shaft.
4. Shaft: Stainless steel.
5. Seal: Mechanical.
6. Bearing: Water-lubricated sleeve type.

G. Pumps:

1. Type: Vertical, can, as defined in HI 2.1-2.2 and HI 2.3 for in-line, barrel or can, lineshaft, vertical pump.
2. Impeller: Closed, stainless steel; statically and dynamically balanced and keyed to shaft.
3. Bowls: [**Epoxy-coated cast iron**] [**Cast iron**] <Insert material>.
4. Shaft: Stainless steel.
5. Seals: Mechanical and stuffing-box types.
6. Bearings: Water-lubricated bushing type.

H. Motors: Single speed, with [**grease-lubricated**] [**or**] [**pre-greased, permanently shielded**], ball-type bearings. Select motors that will not overload through full range of pump performance curve.

I. Piping: [**Copper tube and copper fittings**] [**Stainless-steel pipe and fittings**] [**Stainless-steel pipe and fitting headers and copper tube and copper fittings between headers and pump**] [**Galvanized-steel pipe and cast-iron fittings**].

J. Valves:

1. Shutoff Valves **NPS 2 (DN 50)** and smaller: [**Gate valve**] [**or**] [**two-piece, full-port ball valve**], in each pump's suction and discharge piping.
2. Shutoff Valves **NPS 2-1/2 (DN 65)** and Larger: [**Gate valve**] [**or**] [**lug-type butterfly valve**], in each pump's suction and discharge piping[**and in inlet and outlet headers**].
3. Check Valves **NPS 2 (DN 50)** and smaller: [**Silent**] [**or**] [**swing**] type in each pump's discharge piping.
4. Check Valves **NPS 2-1/2 (DN 65)** and Larger: Silent type in each pump's discharge piping.
5. Control Valves: Adjustable, automatic, [**pilot-operated**] [**or**] [**direct-acting**], pressure-reducing type in each pump's discharge piping.

6. Control Valves: Combination adjustable, automatic, **[pilot-operated]** **[or]** **[direct-acting]** pressure-reducing-and-check type in each pump's discharge piping.
 7. Thermal-Relief Valve: Temperature-and-pressure relief type in pump's discharge header piping.
- K. Dielectric Fittings: With insulating material isolating joined dissimilar metals.
- L. Control Panel: Factory installed and connected as an integral part of booster pump; automatic for multiple-pump, constant-speed operation, with load control and protection functions.
1. Control Logic: **[Electromechanical system with switches, relays]** **[Solid-state system with transducers, programmable microprocessor]**, and other devices in the controller.
 2. Motor Controller: NEMA ICS 2, general-purpose, Class A, full-voltage, combination-magnetic type with undervoltage release feature, motor-circuit-protector-type disconnect, and short-circuit protective device.
 - a. Control Voltage: **[24]** **[120]**-V ac, with integral control-power transformer.
 3. Motor Controller: NEMA ICS 2, solid-state, reduced-voltage type.
 - a. Control Voltage: **[24]** **[120]**-V ac, with integral control-power transformer.
 4. Enclosure: NEMA 250, **[Type 1]** **[Type 3R]** **[Type 4]** **[Type 12]** **<Insert type>**.
 5. Motor Overload Protection: Overload relay in each phase.
 6. Starting Devices: Hand-off-automatic selector switch for each pump in cover of control panel, plus pilot device for automatic control.
 - a. Duplex, Automatic, Alternating Starter: Switches lead pump to lag main pump and to two-pump operation.
 - b. Triplex, Sequence (Lead-Lag-Lag) Starter: Switches lead pump to one lag main pump and to three-pump operation.
 7. Pump Operation and Sequencing: **[Current-]** **[or]** **[pressure-]** sensing method.
 - a. Time Delay: Controls pump on-off operation; adjustable from **[1 to 300]** **<Insert value>** seconds.
 8. Instrumentation: Suction and discharge pressure gages.
 9. Lights: Running light for each pump.
 10. Alarm Signal Device: Sounds alarm when backup pumps are operating.
 - a. Time Delay: Controls alarm operation; adjustable from **[1 to 300]** **<Insert value>** seconds, with **[automatic]** **[manual]** reset.
 11. Thermal-bleed cutoff.
 12. **[Low-suction-pressure]** **[Water-storage-tank, low-level]** cutout.
 13. High-suction-pressure cutout.
 14. Low-discharge-pressure cutout.

15. High-discharge-pressure cutout.
16. Building Automation System Interface: Provide auxiliary contacts for interface to **[BACnet] [LonWorks] <Insert system>** building automation system. Building automation systems are specified in Section 230900 "Instrumentation and Control for HVAC." Include the following:
 - a. On-off status of each pump.
 - b. Alarm status.

M. Base: Structural steel.

N. Capacities and Characteristics:

1. Minimum Pressure Rating: **[150 psig (1035 kPa)] [250 psig (1725 kPa)] <Insert value>**.
2. Booster-Pump Capacity: **<Insert gpm (L/s)>**.
3. Minimum Inlet Pressure: **<Insert psig (kPa)>**.
4. Maximum Inlet Pressure: **<Insert psig (kPa)>**.
5. Discharge Pressure: **<Insert psig (kPa)>**.
6. Low-Suction-Pressure Shutoff: **<Insert psig (kPa)>**.
7. High-Suction-Pressure Shutoff: **<Insert psig (kPa)>**.
8. Low-Discharge-Pressure Shutoff: **<Insert psig (kPa)>**.
9. High-Discharge-Pressure Shutoff: **<Insert psig (kPa)>**.
10. Header Size: **<Insert NPS (DN)>**.
11. Lead Pump:
 - a. Capacity: **<Insert gpm (L/s)>**.
 - b. Total Dynamic Head: **<Insert feet (kPa)>**.
 - c. Speed: **<Insert rpm>**.
 - d. Control Valve:
 - 1) Minimum Size: **<Insert NPS (DN)>**.
 - 2) Maximum Pressure Drop: **<Insert psig (kPa)>**.
 - e. Electrical Characteristics:
 - 1) Motor Horsepower: **<Insert value>**.
 - 2) Volts: **[120] [240] [277] [480] <Insert value>**.
 - 3) Phases: **[Single] [Three]**.
 - 4) Hertz: 60.
12. Each of **[Two] <Insert number>** Lag Pumps:
 - a. Capacity: **<Insert gpm (L/s)>**.
 - b. Total Dynamic Head: **<Insert feet (kPa)>**.
 - c. Speed: **<Insert rpm>**.
 - d. Control Valve:
 - 1) Minimum Size: **<Insert NPS (DN)>**.
 - 2) Maximum Pressure Drop: **<Insert psig (kPa)>**.

- e. Electrical Characteristics:
 - 1) Motor Horsepower: <Insert value>.
 - 2) Volts: [120] [240] [277] [480] <Insert value>.
 - 3) Phases: [Single] [Three].
 - 4) Hertz: 60.

13. Booster-Pump Electrical Characteristics:

- a. Full-Load Amperes: <Insert value>.
- b. Minimum Circuit Ampacity: <Insert value>.
- c. Maximum Overcurrent Protection: <Insert amperage>.

2.4 SIMPLEX, VARIABLE-SPEED BOOSTER PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. [Canariis Corporation](#).
- 2. [Delta P Systems, Inc.](#)
- 3. [Grundfos Pumps Corporation U.S.A.](#)
- 4. [Hydronic Modules Corporation](#).
- 5. [ITT Flowtronex](#).
- 6. [Metron, Inc.](#)
- 7. [TIGERFLOW Systems, Inc.](#)
- 8. <Insert manufacturer's name>.
- 9. or approved equal.

B. Description: Factory-assembled and -tested, fluid-handling system for domestic water, with pump, piping, valves, specialties, and controls, and mounted on base.

C. Pump:

- 1. Type: End suction as defined in HI 1.1-1.2 and HI 1.3 for end-suction, close-coupled, single-stage, overhung-impeller, centrifugal pump.
- 2. Casing: Radially split; [bronze] [cast iron] [stainless steel].
- 3. Impeller: Closed, [ASTM B 584 cast bronze] [stainless steel] <Insert material>; statically and dynamically balanced and keyed to shaft.
- 4. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve and deflector.
- 5. Seal: Mechanical.
- 6. Orientation: Mounted [horizontally] [or] [vertically].

D. Motor: Single speed, with [grease-lubricated] [or] [pre-greased, permanently shielded], ball-type bearings, and directly mounted to pump casing. Select motor that will not overload through full range of pump performance curve.

E. Piping: [Copper tube and copper fittings] [Stainless-steel pipe and fittings] [Stainless-steel pipe and fitting headers and copper tube and copper fittings between headers and pump] [Galvanized-steel pipe and cast-iron fittings].

- F. Valves:
1. Shutoff Valves **NPS 2 (DN 50)** and Smaller: [**Gate valve**] [or] [**two-piece, full-port ball valve**], in pump suction and discharge piping.
 2. Shutoff Valves **NPS 2-1/2 (DN 65)** and Larger: [**Gate valve**] [or] [**lug-type butterfly valve**], in pump suction and discharge piping.
 3. Check Valve **NPS 2 (DN 50)** and Smaller: [**Silent**] [or] [**swing**] type in pump discharge piping.
 4. Check Valve **NPS 2-1/2 (DN 65)** and Larger: Silent type in pump discharge piping.
 5. Thermal-Relief Valve: Temperature-and-pressure relief type in pump discharge piping.
- G. Dielectric Fittings: With insulating material isolating joined dissimilar metals.
- H. Hydropneumatic Tank: Precharged[, **ASME-construction,**] diaphragm or bladder tank made of materials complying with NSF 61.
- I. Control Panel: Factory installed and connected as an integral part of booster pump; automatic for single-pump, variable-speed operation, with load control and protection functions.
1. Control Logic: Solid-state system with transducers, programmable microprocessor, VFC, and other devices in the controller.
 2. Motor Controller: NEMA ICS 2, variable-frequency, solid-state type.
 - a. Control Voltage: [**24**] [**120**]-V ac, with integral control-power transformer.
 3. Enclosure: NEMA 250, [**Type 1**] [**Type 3R**] [**Type 4**] [**Type 12**] <Insert type>.
 4. Motor Overload Protection: Overload relay in each phase.
 5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
 6. Pump Operation: Pressure-sensing method.
 - a. Time Delay: Controls pump on-off operation; adjustable from [**1 to 300**] <Insert value> seconds.
 7. VFC: Voltage-source, pulse-width, modulating-frequency converter; installed in control panel.
 8. Manual Bypass: Magnetic contactor arranged to transfer to constant-speed operation upon VFC failure.
 9. Instrumentation: Suction and discharge pressure gages.
 10. Light: Running light for pump.
 11. Thermal-bleed cutoff.
 12. [**Low-suction-pressure**] [**Water-storage-tank, low-level**] cutout.
 13. High-suction-pressure cutout.
 14. Low-discharge-pressure cutout.
 15. High-discharge-pressure cutout.
 16. Building Automation System Interface: Provide auxiliary contacts for interface to [**BACnet**] [**LonWorks**] <Insert system> building automation system. Building

automation systems are specified in Section 230900 "Instrumentation and Control for HVAC." Include the following:

- a. On-off status of each pump.
- b. Alarm status.

J. Base: Structural steel.

K. Capacities and Characteristics:

1. Minimum Pressure Rating: [125 psig (860 kPa)] [150 psig (1035 kPa)] <Insert value>.
2. Booster-Pump Capacity: <Insert gpm (L/s)>.
3. Total Dynamic Head: <Insert feet (kPa)>.
4. Speed: <Insert rpm>.
5. Minimum Inlet Pressure: <Insert psig (kPa)>.
6. Maximum Inlet Pressure: <Insert psig (kPa)>.
7. Discharge Pressure: <Insert psig (kPa)>.
8. Low-Suction-Pressure Shutoff: <Insert psig (kPa)>.
9. High-Suction-Pressure Shutoff: <Insert psig (kPa)>.
10. Low-Discharge-Pressure Shutoff: <Insert psig (kPa)>.
11. High-Discharge-Pressure Shutoff: <Insert psig (kPa)>.
12. Inlet Size: <Insert NPS (DN)>.
13. Outlet Size: <Insert NPS (DN)>.
14. Electrical Characteristics:
 - a. Motor Horsepower: <Insert value>.
 - b. Volts: [120] [240] [277] [480] <Insert value>.
 - c. Phases: [Single] [Three].
 - d. Hertz: 60.
 - e. Full-Load Amperes: <Insert value>.
 - f. Minimum Circuit Ampacity: <Insert value>.
 - g. Maximum Overcurrent Protection: <Insert amperage>.
15. Hydropneumatic Tank:
 - a. Minimum Water Volume: <Insert gal. (L)> capacity.
 - b. Pressure Rating: [125 psig (860 kPa)] [150 psig (1035 kPa)] [250 psig (1725 kPa)] <Insert value>.
 - c. Air Precharge: <Insert psig (kPa)>.

2.5 MULTIPLEX, VARIABLE-SPEED BOOSTER PUMPS

A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

1. [Armstrong Pumps Inc.](#)
2. [Bell & Gossett Domestic Pump; ITT Corporation.](#)
3. [Canariis Corporation.](#)

4. [Delta P Systems, Inc.](#)
 5. [Goulds Pumps; ITT Corporation.](#)
 6. [Grundfos Pumps Corporation U.S.A.](#)
 7. [ITT Flowtronex.](#)
 8. [Metron, Inc.](#)
 9. [Patterson Pump Company; a subsidiary of the Gorman-Rupp Company.](#)
 10. [SyncroFlo, Inc.](#)
 11. [TIGERFLOW Systems, Inc.](#)
 12. <Insert manufacturer's name>.
 13. or approved equal.
- B. Description: Factory-assembled and -tested, fluid-handling system for domestic water, with pumps, piping, valves, specialties, and controls, and mounted on base.
- C. Pumps:
1. Type: End suction as defined in HI 1.1-1.2 and HI 1.3 for end-suction, close-coupled, single-stage, overhung-impeller, centrifugal pump.
 2. Casing: Radially split; [bronze] [cast iron] [stainless steel].
 3. Impeller: Closed, [ASTM B 584 cast bronze] [stainless steel] <Insert material>; statically and dynamically balanced and keyed to shaft.
 4. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve and deflector.
 5. Seal: Mechanical.
 6. Orientation: Mounted [horizontally] [or] [vertically].
- D. Pumps:
1. Type: End suction as defined in HI 1.1-1.2 and HI 1.3 for end-suction, frame-mounted, separately coupled, single-stage, overhung-impeller, centrifugal pump. [Include back-pullout design.]
 2. Casing: Radially split; [bronze] [cast iron] [stainless steel].
 3. Impeller: Closed, [ASTM B 584 cast bronze] [stainless steel] <Insert material>; statically and dynamically balanced and keyed to shaft.
 4. Shaft and Shaft Sleeve: Stainless-steel[or steel] shaft, with copper-alloy shaft sleeve and deflector.
 5. Seal: Mechanical.
 6. Bearing: [Grease-lubricated] [or] [pre-greased, permanently shielded] ball type.
 7. Coupling: Flexible, with metal guard.
- E. Pumps:
1. Type: In line, single stage as defined in HI 1.1-1.2 and HI 1.3 for in-line, single-stage, close-coupled, overhung-impeller, centrifugal pump.
 2. Casing: Radially split; [bronze] [cast iron] [stainless steel].
 3. Impeller: Closed, [ASTM B 584 cast bronze] [stainless steel] <Insert material>; statically and dynamically balanced and keyed to shaft.
 4. Shaft and Shaft Sleeve: Stainless-steel[or steel] shaft, with copper-alloy shaft sleeve.
 5. Seal: Mechanical.

6. Bearing: [**Grease-lubricated**] [or] [**pre-greased, permanently shielded**] ball type.

F. Pumps:

1. Type: Vertical, multistage as defined in HI 1.1-1.2 and HI 1.3 for in-line, multistage, separately coupled, overhung-impeller, centrifugal pump.
2. Casing: Cast-iron or steel base and stainless-steel chamber.
3. Impeller: Closed, stainless steel; statically and dynamically balanced and keyed to shaft.
4. Shaft: Stainless steel.
5. Seal: Mechanical.
6. Bearing: Water-lubricated sleeve type.

G. Pumps:

1. Type: Vertical, can, as defined in HI 2.1-2.2 and HI 2.3 for in-line, barrel, or can, lineshaft, vertical pump.
2. Impeller: Closed, stainless steel; statically and dynamically balanced and keyed to shaft.
3. Bowls: [**Epoxy-coated cast iron**] [**Cast iron**] <Insert material>.
4. Shaft: Stainless steel.
5. Seals: Mechanical and stuffing-box types.
6. Bearings: Water-lubricated bushing type.

- H. Motors: Single speed, with [**grease-lubricated**] [or] [**pre-greased, permanently shielded**], ball-type bearings. Select motors that will not overload through full range of pump performance curve.

- I. Piping: [**Copper tube and copper fittings**] [**Stainless-steel pipe and fittings**] [**Stainless-steel pipe and fitting headers and copper tube and copper fittings between headers and pump**] [**Galvanized-steel pipe and cast-iron fittings**].

J. Valves:

1. Shutoff Valves **NPS 2 (DN 50)** and Smaller: [**Gate valve**] [or] [**two-piece, full-port ball valve**], in each pump's suction and discharge piping.
2. Shutoff Valves **NPS 2-1/2 (DN 65)** and Larger: [**Gate valve**] [or] [**lug-type butterfly valve**], in each pump's suction and discharge piping[**and in inlet and outlet headers**].
3. Check Valves **NPS 2 (DN 50)** and Smaller: [**Silent**] [or] [**swing**] type in each pump's discharge piping.
4. Check Valves **NPS 2-1/2 (DN 65)** and Larger: Silent type in each pump's discharge piping.
5. Thermal-Relief Valve: Temperature-and-pressure relief type in pump's discharge header piping.

- K. Dielectric Fittings: With insulating material isolating joined dissimilar metals.

- L. Control Panel: Factory installed and connected as an integral part of booster pump; automatic for multiple-pump, variable-speed operation, with load control and protection functions.
1. Control Logic: Solid-state system with transducers, programmable microprocessor, VFC, and other devices in controller. Install VFC for pump motors larger than 25 hp in separate panel; same type as motor control panel enclosure.
 2. Motor Controller: NEMA ICS 2, variable-frequency, solid-state type.
 - a. Control Voltage: **[24] [120]**-V ac, with integral control-power transformer.
 3. Enclosure: NEMA 250, **[Type 1] [Type 3R] [Type 4] [Type 12] <Insert type>**.
 4. Motor Overload Protection: Overload relay in each phase.
 5. Starting Devices: Hand-off-automatic selector switch for each pump in cover of control panel, plus pilot device for automatic control.
 - a. Duplex, Automatic, Alternating Starter: Switches lead pump to lag main pump and to two-pump operation.
 - b. Triplex, Sequence (Lead-Lag-Lag) Starter: Switches lead pump to one lag main pump and to three-pump operation.
 6. Pump Operation and Sequencing: **[Pressure-sensing method] [or] [flow-sensing method] [Pressure-sensing method for lead pump and flow-sensing method for lag pumps]**.
 - a. Time Delay: Controls pump on-off operation; adjustable from **[1 to 300] <Insert value>** seconds.
 7. VFC: Voltage-source, pulse-width, modulating-frequency converter for **[each] [lead]** pump.
 8. Manual Bypass: Magnetic contactor arranged to transfer to constant-speed operation upon VFC failure.
 9. Instrumentation: Suction and discharge pressure gages.
 10. Lights: Running light for each pump.
 11. Alarm Signal Device: Sounds alarm when backup pumps are operating.
 - a. Time Delay: Controls alarm operation; adjustable from **[1 to 300] <Insert value>** seconds, with **[automatic] [manual]** reset.
 12. Thermal-bleed cutoff.
 13. **[Low-suction-pressure] [Water-storage-tank, low-level]** cutout.
 14. High-suction-pressure cutout.
 15. Low-discharge-pressure cutout.
 16. High-discharge-pressure cutout.
 17. Building Automation System Interface: Provide auxiliary contacts for interface to **[BACnet] [LonWorks] <Insert system>** building automation system. Building automation systems are specified in Section 230900 "Instrumentation and Control for HVAC." Include the following:

- a. On-off status of each pump.
 - b. Alarm status.
- M. Base: Structural steel.
- N. Capacities and Characteristics:
1. Minimum Pressure Rating: [150 psig (1035 kPa)] [250 psig (1725 kPa)] **<Insert value>**.
 2. Booster-Pump Capacity: **<Insert gpm (L/s)>**.
 3. Minimum Inlet Pressure: **<Insert psig (kPa)>**.
 4. Maximum Inlet Pressure: **<Insert psig (kPa)>**.
 5. Discharge Pressure: **<Insert psig (kPa)>**.
 6. Low-Suction-Pressure Shutoff: **<Insert psig (kPa)>**.
 7. High-Suction-Pressure Shutoff: **<Insert psig (kPa)>**.
 8. Low-Discharge-Pressure Shutoff: **<Insert psig (kPa)>**.
 9. High-Discharge-Pressure Shutoff: **<Insert psig (kPa)>**.
 10. Header Size: **<Insert NPS (DN)>**.
 11. Lead Pump:
 - a. Capacity: **<Insert gpm (L/s)>**.
 - b. Total Dynamic Head: **<Insert feet (kPa)>**.
 - c. Speed: **<Insert rpm>**.
 - d. Electrical Characteristics:
 - 1) Motor Horsepower: **<Insert value>**.
 - 2) Volts: [120] [240] [277] [480] **<Insert value>**.
 - 3) Phases: [Single] [Three].
 - 4) Hertz: 60.
 12. Each of [Two] **<Insert number>** Lag Pumps:
 - a. Capacity: **<Insert gpm (L/s)>**.
 - b. Total Dynamic Head: **<Insert feet (kPa)>**.
 - c. Speed: **<Insert rpm>**.
 - d. Electrical Characteristics:
 - 1) Motor Horsepower: **<Insert value>**.
 - 2) Volts: [120] [240] [277] [480] **<Insert value>**.
 - 3) Phases: [Single] [Three].
 - 4) Hertz: 60.
 13. Booster-Pump Electrical Characteristics:
 - a. Full-Load Amperes: **<Insert value>**.
 - b. Minimum Circuit Ampacity: **<Insert value>**.
 - c. Maximum Overcurrent Protection: **<Insert amperage>**.

2.6 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in NFPA 70.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for booster pumps to verify actual locations of piping connections before booster-pump installation.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Equipment Mounting:
 - 1. Install booster pumps on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in [**Section 033000 "Cast-in-Place Concrete."**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete."**]
 - 2. Comply with requirements for vibration isolation and seismic control devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment"
 - 3. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
- C. Support connected domestic-water piping so weight of piping is not supported by booster pumps.
- D. Provide drains for bases and stuffing boxes piped to and discharging into floor drains,
- E. Provide air cock and drain connection on horizontal pump casings.
- F. Provide line sized gate valve and strainer on suction and line sized soft seated check valve and globe or plug valve on discharge. For duplex pump units, check valves shall be spring-closed type.
- G. Decrease from line size, with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and over.

- H. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- I. Qualified millwright to check, align, and certify base mounted pumps prior to start-up.

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect domestic-water piping to booster pumps. Install suction and discharge pipe equal to or greater than size of system suction and discharge **[headers] [piping]**.
 - 1. Install shutoff valves on piping connections to booster-pump suction and discharge **[headers] [piping]**. Install ball, butterfly, or gate valves same size as suction and discharge **[headers] [piping]**. Comply with requirements for general-duty valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."
 - 2. Install union, flanged, or grooved-joint connections on suction and discharge **[headers] [piping]** at connection to domestic-water piping. Comply with requirements for unions and flanges specified in Section 221116 "Domestic Water Piping."
 - 3. Install valved bypass, same size as and between piping, at connections to booster-pump suction and discharge **[headers] [piping]**. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."
 - 4. Install flexible connectors, same size as piping, on piping connections to booster-pump suction and discharge **[headers] [piping]**. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."
 - 5. Install piping adjacent to booster pumps to allow service and maintenance.

3.4 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to assist Contractor and inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:

1. Perform visual and mechanical inspection.
2. Leak Test: After installation, charge booster pump and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start booster pumps to confirm proper motor rotation and booster-pump operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Pumps and controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to assist Contractor and perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. **<Insert startup steps if any>**.

3.7 ADJUSTING

A. Adjust booster pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust pressure set points.

C. Occupancy Adjustments: When requested within [12] **<Insert number>** months of date of Substantial Completion, provide on-site assistance in adjusting booster pump to suit actual occupied conditions. Provide up to [two] **<Insert number>** visits to Project during other-than-normal occupancy hours for this purpose.

3.8 DEMONSTRATION

A. **[Engage a factory-authorized service representative to train] [Train]** Owner's maintenance personnel to adjust, operate, and maintain booster pumps.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION **221123.13**

SECTION 221219 - FACILITY GROUND-MOUNTED, POTABLE-WATER STORAGE TANKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes welded-steel **[reservoirs]** **[standpipes]** for storage of **[domestic]** **[and]** **[fire-suppression]** water.
- B. This Section includes bolted-steel **[reservoirs]** **[standpipes]** for storage of **[domestic]** **[and]** **[fire-suppression]** water.
- C. This Section includes wire- or strand-wound, concrete, surface water-storage tanks for storage of **[domestic]** **[and]** **[fire-suppression]** water.
- D. This Section includes circular, prestressed-concrete, surface water-storage tanks for storage of **[domestic]** **[and]** **[fire-suppression]** water.
- E. Related Sections include the following:
 - 1. Section 221216 "Facility Elevated, Potable-Water Storage Tanks" for multiple-column, elevated water-storage tanks and for single-pedestal, elevated water-storage tanks.
- F. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. Reservoir: Flat-bottomed, cylindrical, surface water-storage tank with shell height equal to or less than its diameter.
- B. Standpipe: Flat-bottomed, cylindrical, surface water-storage tank with shell height greater than its diameter.
- C. CR: Chlorosulfonated polyethylene synthetic rubber.
- D. NR: Natural rubber.

- E. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Surface water-storage tank, including structural reinforcement and foundation, shall be capable of withstanding the effects of dead and live gravity loads and winds of [100 mph (161 km/h)] <Insert value>.
- B. Seismic Performance: Surface water-storage tank, including structural reinforcement and foundation, shall be capable of withstanding the effects of earthquake motions determined according to authorities having jurisdiction.
- C. Thermal Movements: Surface water-storage tank, including structural reinforcement and foundation, shall allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): [120 deg F (67 deg C), ambient; 180 deg F (100 deg C)] <Insert temperature>, material surfaces.

1.5 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, accessories, appurtenances, and furnished specialties for each surface water-storage tank indicated.
 - 1. Include data substantiating that materials comply with requirements.
- B. Include manufacturer's installation and testing instructions. Drawings shall include critical dimensions and show locations of all fittings and accessories; including manways, [ladders,] [hold-down straps,] [floating suctions,] and appurtenances.
- C. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details for each surface water-storage tank, including the following:
 - 1. Tank, roof, and shell openings.
 - 2. Safety railings and ladders.
 - 3. Plans, elevations, sections, details, and attachments to other work.
 - 4. Structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 5. Power, signal, and control wiring.
- D. Submit tank strapping charts after tanks are erected and field measurements have been made.
- E. Provide calculations for buoyancy of floating suction swingline.

- F. Contractor shall also provide a complete set of fabrication and erection drawings of the tanks at the Site, which are to be kept up to date as as-constructed drawings during erection. At completion of erection, submit corrected as-constructed erection drawings to DEN Project Manager.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Welding certificates.
- C. Bacteriological test results.
- D. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For the following to include in emergency, operation, and maintenance manuals:
 - 1. Obstruction lighting.
 - 2. Lightning protection.
 - 3. Cathodic protection.
 - 4. Tank heaters.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employ a qualified structural engineer to prepare calculations, Shop Drawings, and other structural data for fabrication and erection of surface water-storage tanks.
 - 1. Engineering Responsibility: Preparation of data for surface water-storage tanks, accessories, specified appurtenances, and concrete supports and foundations, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code--Steel."
 - 2. AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."

- C. Pipe Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with AWWA D100, "Welded Steel Tanks for Water Storage," and with AWWA M42, "Steel Water-Storage Tanks," for welded-steel, surface water-storage tanks.
- F. Comply with AWWA D103, "Factory-Coated Bolted Steel Tanks for Water Storage," and with AWWA M42, "Steel Water-Storage Tanks," for bolted-steel, surface water-storage tanks.
- G. Comply with AWWA D110, "Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks," for concrete, surface water-storage tanks with steel diaphragm.
- H. Comply with AWWA D110, "Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks," for cast-in-place-concrete, surface water-storage tanks with vertical prestressed reinforcement.
- I. Comply with AWWA D115, "Circular Prestressed Concrete Water Tanks with Circumferential Tendons," for concrete, surface water-storage tanks with circumferential tendons.
- J. Comply with NFPA 22, "Water Tanks for Private Fire Protection," for surface water-storage tanks for fire-suppression water supply.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Comply with manufacturer's rigging and installation instructions.
- B. Special Precautions:
 - 1. The tank erector shall give special consideration to, and include adequate provisions for, prevention of tank shell damage during erection, due to high winds. Suitable structural bracing of the shell, both internally and externally, shall be provided and used at all times to prevent damage from winds.
 - 2. If damage from winds does occur, such as shell buckling or collapse, repairs shall be expedited by Contractor to ensure minimal or no negative impact to the construction schedule. All additional materials required shall be provided and repair work performed at no cost to DEN. Any construction schedule time extensions resulting from wind damage shall result in no additional cost to DEN.
 - 3. Any necessary repairs shall be performed in accordance with applicable standards as a minimum. Additionally, all damaged plates shall be replaced at the discretion of DEN. Final acceptance of any required repairs shall be by DEN. Note that visible defects, resulting from wind damage and allowed by the applicable standards may not be acceptable to DEN, potentially requiring repair or replacement of shell or bottom plates at no cost to DEN.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 STEEL TANKS, GENERAL

- A. Tank: Closed type, of heavy gage welded steel (0.25 inch minimum thickness), with shop applied exterior prime coat.
1. All shell seams shall be made by butt welding; lap joints are not acceptable. Weld joints shall be ground smooth.
- B. Construct tank with nozzles, manways, **[floating suction,]** **[and internal ladders]** as detailed on the drawings. **[Include railed top access platforms as detailed, along with tappings for installation of accessories. Manufacturer shall include railed catwalks and access stairway as specified and shown on the drawings, with fabrication and assembly of all exterior access appurtenances in conformance with Division 05 requirements.]**
1. All manways shall be furnished complete with gaskets, bolts, and covers.
- C. Provide fill, pump-out, **[drainable sump,]** and vent provisions as detailed. Include hold-down straps and turnbuckles as required for anchorage to supporting construction shown on the drawings.
- D. Provide grounding lug for each tank (1-1/2" x 1-1/2" x 1/4" steel, with 1/2" drilled hole), welded to bottom of tank adjacent to supporting pier for connection to grounding system under Division 26 work as indicated. Grounding lug shall not be painted.
- E. Interior Finishes:
1. Interior surfaces shall be coated by the manufacturer.
 2. Interior ferrous metal surfaces shall be protected by polyurethane coating as specified in Section 220505 "Coatings and Corrosion Protection".
 3. Protective wood covers shall be bolted to all flange nozzles and all tank couplings shall be plugged to protect interior of tank until installation.
- F. Interior Finishes:
1. Interior surfaces shall be coated by the manufacturer.
 2. Interior ferrous metal surfaces shall be coated with material meeting the requirements of MIL C 4556D. Refer to Section 220505 "Coatings and Corrosion Protection".
 3. Total dry film thickness shall be 6.0 mils minimum.

4. Protective wood covers shall be bolted to all flange nozzles and all tank couplings shall be plugged to protect interior of tank until installation.
5. Color shall be white.

G. Exterior Surfaces:

1. The exterior of the tank, including manhole cover and extensions, shall be cleaned and coated in accordance with Section **[220505 "Coatings and Corrosion Protection]" [Division 09]** requirements

H. Fittings-Threaded - NPT:

1. All standard threaded fittings of 4-inch or smaller diameter shall be 4-inch half couplings. Reducers shall be used for smaller final connections.
2. Thread Standards: All threaded fittings shall have machine tolerances in accordance with the ANSI standard for each fitting size.

I. Ladders: Shall be **[standard carbon steel] [galvanized carbon steel] [or stainless steel]** and shall be supplied by the tank manufacturer. Refer to drawings for location.

J. Lifting Lugs: Provide lifting lugs on all tanks. Lugs shall be capable of withstanding weight of tank with a safety factor of 3 to 1.

2.2 MATERIALS

A. Material shall be carbon steel tank plate in conformance with standards referenced above, and suitable for the minimum design temperature of minus 25 degrees F.

B. Pipe and fittings:

1. Steel Pipe: Steel pipe shall be Grade B, black, welded or seamless pipe ASTM A 53; or API 5L. Sizes smaller than 2-inches shall be Schedule 80. Sizes 2-inch and larger shall be Schedule 40 for sizes up to and including 10 inches.
2. Welding Fittings: Welding fittings shall conform to ANSI B16.9 and ASTM A 234, Grade WPB for use with carbon steel pipe. Welding outlets shall be standard weight forged steel conforming to ASTM A 181, Grade 1.
3. Forged Welding Flanges: Flanges shall be carbon steel conforming to ANSI B16.5, Class 150, except as otherwise specified. Flanged facings shall correspond to the equipment to which the piping is joined. Materials shall conform to the requirements of ASTM A 181 or to ASTM A 105.
4. Bolting: Flange bolts and nuts shall conform to the requirements of ASTM A 307, Grade B, square bolt heads and hexagon nuts.
5. Threaded Steel Fittings: Threaded fittings, shall be Pressure Class 3000 conforming to ANSI B16.11. Fittings material shall be ASTM A 105.
6. Nipples: Carbon Steel pipe nipples shall be of the same material as the pipe they join and shall conform to the requirements of ASTM A 733.
7. Gaskets: Gaskets for use with flanged connections shall be 1/8 inch thick.

2.3 WELDED-STEEL [RESERVOIRS] [STANDPIPES]

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Tank and Construction Co.
2. Brown Tank & Steel.
3. Caldwell Tanks, Inc.
4. Chicago Bridge & Iron Company N.V.
5. Fisher Tank Company.
6. Maguire Iron, Inc.
7. Pittsburg Tank & Tower Co., Inc.
8. Superior Tank Co., Inc.
9. <Insert manufacturer's name.>
10. or approved equal.

B. Description: Welded-steel plates, bolts, rods, and reinforcing steel; designed and fabricated according to [AWWA D100 and AWWA M42] [AWWA D100, AWWA M42, and NFPA 22].

1. Capacity: [50,000 gal. (189 cu. m)] [5,000,000 gal. (18 930 cu. m)] <Insert capacity>.
2. Shell Roof: [Conical] [Dome] [Ellipsoidal] welded steel and self-supporting.
3. Shell Roof: Conical with[knuckle and] column-rafter support.
4. Reservoir Shell Diameter: <Insert diameter in feet (m).>
5. Standpipe Shell Height: <Insert height in feet (m)> from top of foundation to [lower capacity] [overflow] level.
6. Range of Head: <Insert height in feet (m)> from lower capacity level to overflow level.
7. Pipe Connection: Match size of water-distribution pipe.
8. Overflow Piping: ASTM A 53/A 53M, Grade B, Schedule 40, welded-steel pipe with ASTM A 234/A 234M, Grade WPB, Schedule 40, carbon-steel butt-weld fittings.
9. Roof Hatch: Steel, hinged cover, 24 by 15 inches (600 by 380 mm) minimum with 4-inch (100-mm) neck and 2-inch (50-mm) downward overlap with hasp and lock, located over interior ladder and adjacent to exterior ladder.
10. Roof Manhole: Steel, removable, 20-inch- (500-mm-) minimum-diameter cover with 4-inch (100-mm) neck and 2-inch- (50-mm-) downward overlap with hasp and lock. Construct opening with capability of supporting ventilation fan.
11. Shell Sidewall Manholes: Two, steel, [circular, 24 inches (600 mm) in diameter] [elliptical, 18 by 22 inches (450 by 560 mm) minimum].
12. Painter's Accessories: Include [lugs] [couplings] [rail] inside and outside tank for painting.
13. Tank Vent: Steel pipe with stainless-steel screen, constructed to prevent entrance of rain,[insects,] birds, and animals.[Include pressure-vacuum screened vent or separate pressure-vacuum relief mechanism to maintain clear screen.]
14. Foundation: Reinforced concrete. Refer to Section 033000 "Cast-in-Place Concrete."

2.4 BOLTED-STEEL [RESERVOIRS] [STANDPIPES]

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Tank Company, Inc.; Bolted Tank Sales and Service.
2. Columbian TecTank.
3. Engineered Storage Products Company.
4. Pittsburg Tank & Tower Co., Inc.
5. Superior Tank Co., Inc.
6. **<Insert manufacturer's name.>**
7. or approved equal.

B. Description: Bolted-steel plates, bolts, rods, and reinforcing steel; designed and fabricated according to [AWWA D100 and AWWA M42] [AWWA D100, AWWA M42, and NFPA 22].

1. Capacity: [4000 gal. (15 cu. m)] [160,000 gal. (605 cu. m)] **<Insert capacity>**.
2. Shell Roof: Comply with AWWA D103.
3. Reservoir Shell Diameter: **<Insert feet (m)>**
4. Standpipe Shell Height: **<Insert height in feet (m)>** from top of foundation to **[lower capacity] [overflow]** level.
5. Range of Head: **<Insert height in feet (m)>** from lower capacity level to overflow level.
6. Pipe Connection: Match size of water-distribution pipe.
7. Overflow Piping: ASTM A 53/A 53M, Grade B, Schedule 40, welded-steel pipe with ASTM A 234/A 234M, Grade W.B., Schedule 40, carbon-steel butt-weld fittings.
8. Roof Hatch: Steel, hinged cover, **24 by 15 inches (600 by 380 mm)** minimum with **4-inch (100-mm)** neck and **2-inch (50-mm)** downward overlap with hasp and lock, located over interior ladder and adjacent to exterior ladder.
9. Roof Manhole: Steel, removable, **20-inch- (500-mm-)** minimum-diameter cover with **4-inch (100-mm)** neck and **2-inch- (50-mm-)** downward overlap with hasp and lock. Construct opening with capability of supporting ventilation fan.
10. Shell Sidewall Manholes: Two, steel, **[circular, 24 inches (600 mm) in diameter] [elliptical, 18 by 22 inches (450 by 560 mm) minimum]**.
11. Painter's Accessories: Include **[lugs] [couplings] [rail]** inside and outside tank for painting.
12. Tank Vent: Steel pipe with stainless-steel screen, constructed to prevent entrance of rain, **[insects,]** birds, and animals. **[Include pressure-vacuum screened vent or separate pressure-vacuum relief mechanism to maintain clear screen.]**
13. Foundation: Reinforced concrete. Refer to Section 033000 "Cast-in-Place Concrete."

2.5 WIRE- OR STRAND-WOUND, CONCRETE, SURFACE WATER-STORAGE TANKS

A. Manufacturers: Subject to compliance with requirements, provide products by one of

the following:

1. Crom Corporation (The).
 2. DYK Incorporated; BBR Licensee.
 3. Natgun Corporation.
 4. Preload Inc.
 5. **<Insert manufacturer's name.>**
 6. or approved equal.
- B. Comply with AWWA D110[**and NFPA 22**].
- C. Tank Capacity: [100,000 gal. (379 cu. m)] [40,000,000 gal. (151 400 cu. m)] **<Insert capacity>**.
- D. Tank Height: **<Insert feet (m).>**
- E. Tank Wall Diameter: **<Insert feet (m).>**
- F. Tank Floor: Reinforced, cast-in-place concrete.
- G. Tank Wall:
1. Materials: Cast-in-place concrete, with at least 7 sacks of Portland cement to 1 cu. yd. (0.76 cu. m) of concrete sand in mixer and with vertical prestressed reinforcement. Superplasticizers are prohibited.
 2. Wall-Base Joint Sealant: ASTM C 920, Class 25, Type S, Grade P or NS, polyurethane.
 3. Threadbars: Hot-dip galvanized steel, 1.25 to 1.375 inches (31 to 35 mm) in diameter.
 4. Wire: Hot-dip galvanized.
- H. Tank Wall:
1. Materials: Shotcrete, with at least 10 sacks of Portland cement to 1 cu. yd. (0.76 cu. m) of concrete sand in mixer. Include steel diaphragm. Air-entrainment admixtures and superplasticizers are prohibited.
 2. Wall-Base Joint Sealant: ASTM C 920, Class 25, Type S, Grade P or NS, polyurethane.
 3. Diaphragm: Galvanized-steel sheet, at least 0.017 inch (0.43 mm) thick, complying with ASTM A 924/A 924M. Height of sheet shall be same as wall height.
 4. Diaphragm Sealants: ASTM C 920, Type M, polysulfide; ASTM C 920, Class 25, Type M, Grade P or NS, polyurethane; or ASTM C 881/C 881M, Type III, Grade 1, epoxy or double-fold vertical joints with mechanical seamer.
 5. Wire: Hot-dip galvanized.
- I. Tank Wall:

1. Materials: Precast concrete, with at least 7 sacks of Portland cement to 1 cu. yd. (0.76 cu. m) of concrete sand in mixer and with vertical prestressed reinforcement. Include steel diaphragm. Superplasticizers are prohibited.
 2. Wall-Base Joint Sealant: ASTM C 920, Class 25, Type S, Grade P or NS, polyurethane.
 3. Diaphragm: Galvanized-steel sheet, at least 0.017 inch (0.43 mm) thick, complying with ASTM A 924/A 924M. Height of sheet shall be same as wall height.
 4. Diaphragm Sealants: ASTM C 920, Type M, polysulfide; ASTM C 920, Class 25, Type M, Grade P or NS, polyurethane; or ASTM C 881/C 881M, Type III, Grade 1, epoxy or double-fold vertical joints with mechanical seamer.
 5. Wire: Hot-dip galvanized.
- J. Tank Wall:
1. Materials: Cast-in-place concrete, with at least 7 sacks of Portland cement to 1 cu. yd. (0.76 cu. m) of concrete sand in mixer and with vertical prestressed reinforcement. Include steel diaphragm. Superplasticizers are prohibited.
 2. Wall-Base Joint Sealant: ASTM C 920, Class 25, Type S, Grade P or NS, polyurethane.
 3. Diaphragm: Galvanized-steel sheet, at least 0.017 inch (0.43 mm) thick, complying with ASTM A 924/A 924M. Height of sheet shall be same as wall height.
 4. Diaphragm Sealants: ASTM C 920, Type M, polysulfide; ASTM C 920, Class 25, Type M, Grade P or NS, polyurethane; or ASTM C 881/C 881M, Type III, Grade 1, epoxy or double-fold vertical joints with mechanical seamer.
 5. Wire: Hot-dip galvanized.
- K. Domed Tank Roof: Reinforced, **[cast-in-place] [precast] [shotcrete]** concrete, with at least 7 sacks of Portland cement to 1 cu. yd. (0.76 cu. m) of concrete sand in mixer. Air-entrainment admixtures are permitted. Superplasticizers are prohibited.
- L. Flat Tank Roof: Reinforced, **[cast-in-place] [precast]** concrete, with at least 7 sacks of Portland cement to 1 cu. yd. (0.76 cu. m) of concrete sand in mixer. Air-entrainment admixtures are permitted. Superplasticizers are prohibited.
- M. Reinforcing Steel: ASTM A 767/A 767M, **Grade 60** (Grade 240), zinc-coated billet steel bars.
- N. Waterstops: Ribbed, PVC, **6 and 9 inches wide by 3/8 inch** (150 and 225 mm wide by 10 mm) thick.
- O. Bearing Pads:
1. Material: **[NR] [ASTM D 2240, CR, with durometer hardness of 40 to 50]**.
 2. Minimum Thickness: **1 inch** (25 mm) under walls and **1/2 inch** (13 mm) under roof.
 3. Minimum Width: **3 inches** (75 mm) under walls and **2 inches** (50 mm) under roof.
- P. Sponge Filler: ASTM D 1056, Types 2A1 through 2A4, closed-cell CR; or ASTM D 1752, Type I, sponge rubber.

- Q. Bolts, Nuts, Washers, and Expansion Sleeve Inserts: Stainless steel.
- R. Construction and Maintenance Hatch: **[Aluminum] [Galvanized-steel]** frame and cover at least **3/16 inch (5 mm)** thick, **48-by-48-inch- (1200-by-1200-mm-)** minimum-size, hinged cover with a **4-inch (100-mm)** neck and **2-inch (50-mm)** downward overlap and having a hasp and lock.**[Locate top of hatch above grade.]**
- S. Personnel Hatch: **[Aluminum] [Galvanized-steel]** frame and cover at least **3/16 inch (5 mm)** thick, **30-inch- (760-mm-)** minimum, square hinged cover with a **4-inch (100-mm)** neck and **2-inch (50-mm)** downward overlap and having a hasp and lock. Construct opening with capability of supporting ventilation fan.**[Locate top of hatch above grade.]**
- T. Tank Vents: **[Fiberglass] [Galvanized-steel]** pipe with **[aluminum] [stainless-steel]** screen, constructed to prevent entrance of rain,**[insects,]** birds, and animals.**[Include pressure-vacuum screened vent or separate pressure-vacuum relief mechanism to maintain clear screen.]**
- U. Tank Interior Surface Sealer: Cementitious coating modified with acrylic or styrene-acrylic based polymer.
- 2.6 CIRCULAR, PRESTRESSED-CONCRETE, SURFACE WATER-STORAGE TANKS
- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
1. Crom Corporation (The).
 2. DYK Incorporated; BBR Licensee.
 3. Natgun Corporation.
 4. Preload Inc.
 5. **<Insert manufacturer's name.>**
 6. or approved equal.
- B. Comply with AWWA D115**[and NFPA 22]**.
- C. Tank Capacity: **[100,000 gal. (379 cu. m)] [40,000,000 gal. (151 400 cu. m)] <Insert capacity>**.
- D. Tank Height: **<Insert feet (m).>**
- E. Tank Wall Diameter: **<Insert feet (m).>**
- F. Tank Floor: Reinforced, cast-in-place concrete.
- G. Tank Wall:
1. Materials: Cast-in-place concrete, with at least 7 sacks of Portland cement to **1 cu. yd. (0.76 cu. m)** of concrete sand in mixer and with vertical prestressed reinforcement. Superplasticizers are prohibited.

2. Wall-Base Joint Sealant: ASTM C 920, Class 25, Type S, Grade P or NS, polyurethane.
 3. Wire: Hot-dip galvanized.
- H. Domed Tank Roof: Reinforced, **[cast-in-place] [precast] [shotcrete]** concrete, with at least 7 sacks of Portland cement to **1 cu. yd. (0.76 cu. m)** of concrete sand in mixer. Air-entrainment admixtures are permitted. Superplasticizers are prohibited.
- I. Flat Tank Roof: Reinforced, **[cast-in-place] [precast]** concrete, with at least 7 sacks of Portland cement to **1 cu. yd. (0.76 cu. m)** of concrete sand in mixer. Air-entrainment admixtures are permitted. Superplasticizers are prohibited.
- J. Reinforcing Steel: ASTM A 767/A 767M, **Grade 60 (Grade 240)**, zinc-coated billet steel bars.
- K. Waterstops: Ribbed, PVC, **6 and 9 inches wide by 3/8 inch (150 and 225 mm wide by 10 mm)** thick.
- L. Bearing Pads:
 1. Material: **[NR] [ASTM D 2240, CR, with durometer hardness of 40 to 50]**.
 2. Minimum Thickness: **1 inch (25 mm)** under walls and **1/2 inch (13 mm)** under roof.
 3. Minimum Width: **3 inches (75 mm)** under walls and **2 inches (50 mm)** under roof.
- M. Sponge Filler: ASTM D 1056, Types 2A1 through 2A4, closed-cell CR; or ASTM D 1752, Type I, sponge rubber.
- N. Bolts, Nuts, Washers, and Expansion Sleeve Inserts: Stainless steel.
- O. Construction and Maintenance Hatch: **[Aluminum] [Galvanized-steel]** frame and cover at least **3/16 inch (5 mm)** thick, **48-by-48-inch- (1200-by-1200-mm-)** minimum-size, hinged cover with a **4-inch (100-mm)** neck and **2-inch (50-mm)** downward overlap and having a hasp and lock. **[Locate top of hatch above grade.]**
- P. Personnel Hatch: **[Aluminum] [Galvanized-steel]** frame and cover at least **3/16 inch (5 mm)** thick, **30-inch- (760-mm-)** minimum, square hinged cover with a **4-inch (100-mm)** neck and **2-inch (50-mm)** downward overlap and having a hasp and lock. Construct opening with capability of supporting ventilation fan. **[Locate top of hatch above grade.]**
- Q. Tank Vents: **[Fiberglass] [Galvanized-steel]** pipe with **[aluminum] [stainless-steel]** screen, constructed to prevent entrance of rain, **[insects,]** birds, and animals. **[Include pressure-vacuum screened vent or separate pressure-vacuum relief mechanism to maintain clear screen.]**
- R. Tank Interior Surface Sealer: Cementitious coating modified with acrylic or styrene-acrylic based polymer.

2.7 PAINT MATERIALS

- A. Paint: Comply with AWWA D102.
- B. Primer: Tank fabricator's standard epoxy-polyamide paint.
- C. Tank Shell Interior Finish Paint: Tank fabricator's standard epoxy-polyamide paint complying with NSF 61 and compatible with prime coat.
- D. Tank Shell Exterior Intermediate Paint: Tank fabricator's standard, two-component epoxy paint compatible with prime and finish paint. Intermediate coat shall have a slight color contrast with finish coat.
- E. Tank Shell Exterior Finish Paint: Tank fabricator's standard urethane paint.
 - 1. Color: [**As selected by DEN Project Manager** from tank manufacturer's paint chart] <Insert color>.

2.8 SHOP PAINTING

- A. Factory coating according to AWWA D103.
- B. Tank Shell Interior Finish Coat: Comply with NSF 61.
- C. Tank Shell Exterior Finish Coat: Factory coating according to AWWA D103.

2.9 SURFACE WATER-STORAGE TANK APPURTENANCES

- A. Water-Level Controls: Automatic controls for maintaining water level in tank, with valves, piping, and audible and visual alarms to indicate the following:
 - 1. High- and low-water levels.
 - 2. Tank overflowing or tank not filling.
 - 3. <Insert required alarms.>
- B. Obstruction Lighting: Comply with requirements of authorities having jurisdiction.
- C. Lightning Protection: Comply with requirements in Section 264113 "Lightning Protection for Structures."
- D. Cathodic Protection: Comply with requirements in Section 264200 "Cathodic Protection" and with AWWA D104.
- E. Tank Heaters: Comply with NFPA 22 and with capacity to maintain 42 deg F (6 deg C) water temperature inside surface water-storage tank.

PART 3 - EXECUTION

3.1 STEEL, SURFACE WATER-STORAGE TANK INSTALLATION

- A. Erect tank shell, accessories, and appurtenances according to AWWA D100 and AWWA M42 and manufacturer's instructions.
- B. Fabricate steel plate sections in the shop. Erect tank shell by welding plate sections in the field.
- C. Fabricate tank sections and drill or punch bolt holes in the shop. Install bolts during field erection of tank.
- D. Set top of reinforced-concrete foundation at least **6 inches (150 mm)** above finish grade.
- E. Install roof hatch near exterior ladder.
- F. Install roof manhole near center of roof.
- G. Install tank vent at center of roof.
- H. Install two manholes in tank wall near grade.

3.2 CONCRETE, SURFACE WATER-STORAGE TANK INSTALLATION

- A. Tank Wall: Construct tank wall and install accessories and appurtenances according to AWWA D110 and the following:
 - 1. **[Construct cast-in-place] [Erect precast]** core wall with steel diaphragm. Install solid neoprene bearing pad and **9-inch- (225-mm-)** wide waterstop between wall and wall footing.
 - 2. Install steel diaphragm. Apply shotcrete to interior of diaphragm to form core wall.
 - a. Seal vertical joints in diaphragm with polysulfide, polyurethane, or epoxy sealant; or double-fold with a mechanical seamer.
 - b. Sand blast exterior of core wall to provide a well-pitted surface free from curing compounds, laitance, and form oils. Use **1.5 lb (7.3 kg)** of silica sand (No. 16 grit) per square **foot (meter)** of surface area.
 - c. After sandblasting, wind wires or strands around exterior of core wall separating wires by at least 2.5 wire diameters or **3/8 inch (10 mm)** to ensure that mortar will be located between wires. Do not install wires at horizontal level of pipe penetrations.
 - d. After installation of wires or strands, apply at least 3 coats of wet-mix shotcrete to exterior of tank wall in layers of at least **3/8 inch (10 mm)** thick for a minimum total thickness of **1-1/2 inches (38 mm)**. Apply shotcrete when temperature range is at least **35 deg F (2 deg C)** and rising to a

- maximum temperature of **95 deg F (35 deg C)**. Do not apply shotcrete if temperature is **40 deg F (5 deg C)** and falling.
- e. Fill voids in wall-to-base joint and seal around waterstops, base pads, and sponge fillers with polyurethane filler.
- B. Tank Wall: Construct tank wall and install accessories and appurtenances according to AWWA D115 and the following:
1. Install vertical prestressed wall with threadbars and screw nut anchors.
 2. Sand blast exterior of core wall to provide well-pitted surface free from curing compounds, laitance, and form oils. Use **1.5 lb (7.3 kg)** of silica sand (No. 16 grit) per square **foot (meter)** of surface area.
 3. Apply at least 3 coats of wet-mix shotcrete to exterior of tank wall in layers of at least **3/8 inch (10 mm)** thick for a minimum total thickness of **1-1/2 inches (38 mm)**. Apply shotcrete when temperature range is at least **35 deg F (2 deg C)** and rising to a maximum temperature of **95 deg F (35 deg C)**. Do not apply shotcrete if temperature is **40 deg F (5 deg C)** and falling.
- C. Floor: Reinforced, cast-in-place concrete. Slope floor 1.0 to 1.5 percent from highest point to water outlet pipe. Pour monolithically without cold joints and provide mechanical float finish.
- D. Dome Roof: Install reinforced, cast-in-place concrete with circumferential prestressing.[**Place 6-inch (150-mm) waterstop between roof and wall.**]
1. Install curb on roof perimeter with at least 6 downspouts spaced 60 degrees and no more than **50 feet (15 m)** apart.
- E. Flat Slab Roof: Install reinforced, cast-in-place concrete with drop panels and support having reinforced, cast-in-place concrete columns. Place solid neoprene bearing pads[**and 6-inch (150-mm) waterstop**] between roof and wall. If voids are present between wall and roof after use of solid bearing pads, fill voids with closed-cell CR pads and soft mastic.
1. Install curb on roof perimeter with at least 6 downspouts spaced 60 degrees and no more than **50 feet (15 m)** apart.
- F. Install construction and maintenance hatch near **[wall] [ladder]**.
- G. Install ventilators at highest point of roof.[**Install others where indicated.**]
- 3.3 CONNECTIONS
- A. Connect tanks to water-distribution piping.
- B. Connect drains to storm-drainage piping.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 SURFACE PREPARATION OF STEEL TANKS

- A. Surface preparation is specified in [**Section 099113 "Exterior Painting."**] [**Section 099600 "High-Performance Coatings."**]
- B. Field Cleaning: After erecting tank shell, remove burrs, dirt, and construction debris and repair damaged finishes. Remove weld splatter, sharp edges on weld seams, and scabs and slivers by grinding. Remove weld flux, slag, fins, and laminations.
- C. Field Surface Preparation: After field cleaning, prepare steel surfaces where shop prime coat has been damaged, according to Specifications listed above for shop cleaning, and remove dust or residue from cleaned surfaces.
- D. If surface develops rust before prime coat is applied, repeat field surface preparation.

3.5 FIELD PAINTING

- A. Surface preparation is specified in [**Section 099113 "Exterior Painting."**] [**Section 099600 "High-Performance Coatings."**]
- B. Apply paint according to AWWA D102.
- C. Prime-Coat Touchup: Apply primer to cleaned areas and where shop finish has been damaged during shipping, handling, and erection. Apply prime coat to a dry film thickness of **3.0 to 5.0 mils** (0.08 to 0.13 mm) for tank interior and to a dry film thickness of **2.0 to 3.0 mils** (0.05 to 0.08 mm) for exterior tank and support surfaces.
- D. Tank Shell Interior Finish Coats: Apply 2 coats of interior finish paint above bottom ring to a dry film thickness of **4.0 to 5.0 mils** (0.1 to 0.13 mm). Apply interior finish paint to surfaces below bottom ring to a dry film thickness of **8.0 to 10.0 mils** (0.2 to 0.25 mm).
- E. Tank Shell[**and Steel Support**] Exterior Coats: Apply intermediate paint to a dry film thickness of **2.0 to 3.0 mils** (0.05 to 0.08 mm). Apply finish paint to a dry film thickness of **2.0 to 3.0 mils** (0.05 to 0.08 mm).
- F. Concrete tanks do not require painting.
- G. Paint concrete, surface water-storage tanks according to [**Section 099113 "Exterior Painting."**] [**Section 099600 "High-Performance Coatings."**]
- H. Tank Exterior Lettering[**and Logo**]: Apply [**one coat**] [**two coats**] of urethane paint to a dry film thickness of **2.0 to 3.0 mils** (0.05 to 0.08 mm)[**for each application**].
- I. Overflow Pipe: Paint pipe exterior that is outside tank and structure as indicated for tank exterior.

- J. Exterior Ladders: Paint as indicated for tank shell exterior.
- K. Do not paint if ambient temperature is less than **50 deg F (10 deg C)** or is expected to drop below **40 deg F (5 deg C)** in the next 18 hours. Do not paint if temperature of steel surface is higher than **125 deg F (52 deg C)**. Do not apply paint if surfaces are wet or damp, if precipitation is expected, or if relative humidity will exceed 85 percent. Do not spray paint when wind velocity exceeds **15 mph (24 km/h)**. Maintain at least a 24-hour waiting period between coats. Provide adequate ventilation in tank during painting to maintain clear atmosphere and provide explosion-proof flood lighting and spot lighting.
- L. Complete daily painting to allow time for paint to dry before condensation is expected.

3.6 SURFACE WATER-STORAGE TANK APPURTENANCE INSTALLATION

- A. Install and adjust water-level control valves, piping, and alarms.
- B. Install obstruction lighting according to authorities having jurisdiction.
- C. Install lightning protection according Section 264113 "Lightning Protection for Structures."
- D. Install cathodic protection according to Section 264200 "Cathodic Protection" and AWWA D104.
- E. Install tank heaters according to NFPA 22.

3.7 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified testing agency to perform the following field quality-control testing:
 - 1. Tank Weld Test: Use radiographic method according to AWWA D100. Repair failures and retest.
 - 2. Leak Test: Comply with AWWA D100[**and NFPA 22**]. Fill tanks with potable water and test for leaks after installation. Repair leaks and retest until no leaks exist.
 - a. Water will be furnished by Owner.
 - 3. Leak Test: Comply with AWWA D103[**and NFPA 22**]. Fill tanks with potable water and test for leaks after installation. Repair leaks and retest until no leaks exist.
 - a. Water will be furnished by Owner.
 - 4. Leak Test: Comply with [**AWWA D110**] [**AWWA D115**] [**and NFPA 22**]. Fill tanks with potable water and test for leaks after installation. Repair leaks and retest until no leaks exist.

- a. Water will be furnished by Owner.
 - 5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - B. Remove and replace malfunctioning units and retest as specified above.
- 3.8 CLEANING
- A. Clean interior and exterior of surface water-storage tanks.
 - B. Disinfect surface water-storage tanks according to **[AWWA C652] [requirements of authorities having jurisdiction]**.
 - C. The tanks shall be left in a completely clean and dry state. Close all manways and all uncovered openings with plywood covers fastened in a manner suitable for a permanent connection. Damage caused to the tank by the entry of foreign substances prior to coatings application shall be remedied by the Contractor at no additional cost to DEN.
- 3.9 DEMONSTRATION
- A. Engage a factory-authorized service representative to assist Contractor and train Owner's maintenance personnel to adjust, operate, and maintain the system, including the following. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice. Refer to Section 017900 "Demonstration and Training".
 - 1. Obstruction lighting.
 - 2. Water-level controls.
 - 3. Tank heaters.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 221219

SECTION 221223 - FACILITY INDOOR POTABLE-WATER STORAGE TANKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel, pressure, potable-water storage tanks.
 - 2. Steel, nonpressure, potable-water storage tanks.
 - 3. Steel, floating-wafer, potable-water storage tanks.
 - 4. Steel, precharged, potable-water storage tanks.
 - 5. Insulated, steel, potable-water storage tanks.
 - 6. Plastic, pressure, potable-water storage tanks.
 - 7. Plastic, nonpressure, potable-water storage tanks.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. HDPE: High-density polyethylene plastic.
- B. LDPE: Low-density polyethylene plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Steel water tanks shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7] <Insert requirement>.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[**and the unit will be fully operational after the seismic event**]."
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water storage tanks.
 - 2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
 - 3. Include data substantiating that materials comply with requirements.
- B. Include manufacturer's installation and testing instructions. Drawings shall include critical dimensions and show locations of all fittings and accessories; including manways, [**ladders,**] [**hold-down straps,**] [**floating suctions,**] and appurtenances.
- C. Submit tank strapping charts after tanks are erected and field measurements have been made.
- D. Contractor shall also provide a complete set of fabrication and erection drawings of the tanks at the Site, which are to be kept up to date as as-constructed drawings during erection. At completion of erection, as-constructed erection drawings shall be provided to DEN Project Manager.

1.6 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For steel water storage tanks, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Product Certificates: For each type of potable-water storage tank, from manufacturer.
- C. Source quality-control reports.
- D. Purging and disinfecting reports.
- E. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. ASME Compliance for Steel Tanks: Fabricate and label steel, ASME-code, potable-water storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

- B. ASME Compliance for FRP Tanks: Fabricate and label FRP, ASME-code, potable-water storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section X, "Fiber-Reinforced Plastic Pressure Vessels."
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic potable-water storage tanks and components. Include appropriate NSF marking.
- D. Comply with NSF 61, "Drinking Water System Components - Health Effects," for potable-water storage tanks. Include appropriate NSF marking.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Comply with manufacturer's rigging and installation instructions.
- B. Special Precautions:
 - 1. The tank erector shall give special consideration to, and include adequate provisions for, prevention of tank shell damage during erection, due to high winds. Suitable structural bracing of the shell, both internally and externally, shall be provided and used at all times to prevent damage from winds.
 - 2. If damage from winds does occur, such as shell buckling or collapse, repairs shall be expedited by Contractor to ensure minimal or no negative impact to the construction schedule. All additional materials required shall be provided and repair work performed at no cost to DEN. Any construction schedule time extensions resulting from wind damage shall result in no additional cost to DEN.
 - 3. Any necessary repairs shall be performed in accordance with applicable standards. Additionally, all damaged plates shall be replaced at the discretion of DEN. Final acceptance of any required repairs shall be by DEN. Note that visible defects, resulting from wind damage and allowed by applicable standards may not be acceptable to DEN, potentially requiring repair or replacement of shell or bottom plates at no cost to DEN.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 STEEL TANKS, GENERAL

- A. Tank: Closed type, of heavy gage welded steel (0.25 inch minimum thickness), with shop applied exterior prime coat.
1. All shell seams shall be made by butt welding; lap joints are not acceptable. Weld joints shall be ground smooth.
- B. Construct tank with nozzles, manways, [**floating suction**s,] [**and internal ladders**] as detailed on the drawings. [**Include railed top access platforms as detailed, along with tappings for installation of accessories. Manufacturer shall include railed catwalks and access stairway as specified and shown on the drawings, with fabrication and assembly of all exterior access appurtenances in conformance with Division 05 requirements.**]
1. All manways shall be furnished complete with gaskets, bolts and covers.
- C. Provide fill, pump-out, [**drainable sump**,] and vent provisions as detailed. Include hold-down straps and turnbuckles as required for anchorage to supporting construction shown on the drawings.
- D. Provide grounding lug for each tank (1-1/2" x 1-1/2" x 1/4" steel, with 1/2" drilled hole), welded to bottom of tank adjacent to supporting pier for connection to grounding system under Division 26 work as indicated. Grounding lug shall not be painted.
- E. Interior Finishes:
1. Interior surfaces shall be coated by the manufacturer.
 2. Interior ferrous metal surfaces shall be protected by polyurethane coating as specified in Section 220505 "Coatings and Corrosion Protection".
 3. Protective wood covers shall be bolted to all flange nozzles and all tank couplings shall be plugged to protect interior of tank until installation.
- F. Interior Finishes:
1. Interior surfaces shall be coated by the manufacturer.
 2. Interior ferrous metal surfaces shall be coated with material meeting the requirements of MIL C 4556D. Refer to Section 220505 "Coatings and Corrosion Protection".
 3. Total dry film thickness shall be 6.0 mils minimum.
 4. Protective wood covers shall be bolted to all flange nozzles and all tank couplings shall be plugged to protect interior of tank until installation.
 5. Color shall be white.
- G. Exterior Surfaces:
1. The exterior of the tank, including manhole cover and extensions, shall be cleaned and coated in accordance with Section [**220505 "Coatings and**

Corrosion Protection]" [Division 09] requirements

H. Fittings-Threaded - NPT:

1. All standard threaded fittings of 4-inch or smaller diameter shall be 4-inch half couplings. Reducers shall be used for smaller final connections.
2. Thread Standards: All threaded fittings shall have machine tolerances in accordance with the ANSI standard for each fitting size.

I. Ladders: Shall be standard carbon steel or stainless steel and shall be supplied by the tank manufacturer. Refer to drawings for location.

J. Lifting Lugs: Provide lifting lugs on all tanks. Lugs shall be capable of withstanding weight of tank with a safety factor of 3 to 1.

2.2 MATERIALS

A. Material shall be carbon steel tank plate in conformance with standards referenced above, and suitable for the minimum design temperature of minus 25 degrees F.

B. Pipe and fittings:

1. Steel Pipe: Steel pipe shall be Grade B, black, welded or seamless pipe ASTM A 53; or API 5L. Sizes smaller than 2-inches shall be Schedule 80. Sizes 2-inch and larger shall be Schedule 40 for sizes up to and including 10 inches.
2. Welding Fittings: Welding fittings shall conform to ANSI B16.9 and ASTM A 234, Grade WPB for use with carbon steel pipe. Welding outlets shall be standard weight forged steel conforming to ASTM A 181, Grade 1.
3. Forged Welding Flanges: Flanges shall be carbon steel conforming to ANSI B16.5, Class 150, except as otherwise specified. Flanged facings shall correspond to the equipment to which the piping is joined. Materials shall conform to the requirements of ASTM A 181 or to ASTM A 105.
4. Bolting: Flange bolts and nuts shall conform to the requirements of ASTM A 307, Grade B, square bolt heads and hexagon nuts.
5. Threaded Steel Fittings: Threaded fittings, shall be Pressure Class 3000 conforming to ANSI B16.11. Fittings material shall be ASTM A 105.
6. Nipples: Carbon Steel pipe nipples shall be of the same material as the pipe they join and shall conform to the requirements of ASTM A 733.
7. Gaskets: Gaskets for use with flanged connections shall be 1/8 inch thick.

2.3 STEEL, PRESSURE, POTABLE-WATER STORAGE TANKS

A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

1. Adamson Global Technology Corporation.
2. Aldrich Company, Inc.
3. Cemline Corporation.

4. Flo Fab inc.
 5. GSW Water Heating.
 6. HESCO Bastion Ltd.
 7. Lochinvar Corporation.
 8. Precision Boilers.
 9. PVI Industries, LLC.
 10. Raypak.
 11. RBI; a Mestek company.
 12. RECO USA.
 13. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 14. State Industries, Inc.
 15. Weben-Jarco, Inc.
 16. Wendland Manufacturing Corp.
 17. Wessels Company.
 18. Wood, John Co.
 19. **<Insert manufacturer's name>**.
 20. or approved equal.
- B. Description: Steel, [**horizontal**] [**vertical**], pressure-rated tank with cylindrical sidewalls.
- C. Fabricate supports and attachments to tank with reinforcement strong enough to resist tank movement during seismic event when tank supports are anchored to building structure.
- D. Construction: [**ASME code, steel**] [**Steel**], constructed with nontoxic welded joints, for [**125-psig (860-kPa)**] [**150-psig (1035-kPa)**] **<Insert value>** working pressure.
- E. Manhole: Watertight, for tank more than [**36 inches (915 mm)**] **<Insert dimension>** in diameter; same pressure rating as tank.
- F. Tappings: Factory-fabricated[**stainless**] steel, welded to tank[**before testing and labeling**].
1. **NPS 2 (DN 50)** and Smaller: ASME B1.20.1, with female thread.
 2. **NPS 2-1/2 (DN 65)** and Larger: ASME B16.5, flanged.
- G. Specialties and Accessories: Include tappings in tank and the following:
1. Pressure relief valve.
 2. Pressure gage.
 3. Thermometer.
 4. Air-charging connection.
 5. Gage glass, brass fittings, compression stops, and gage-glass guard.
- H. Horizontal Tank Supports: Factory-fabricated steel saddles, welded to tank[**before testing and labeling**].
- I. Vertical Tank Supports: Factory-fabricated steel legs or steel skirt, welded to tank[**before testing and labeling**].

- J. Tank Interior Finish: Materials and thicknesses complying with NSF 61 barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
1. Lining Material: [**Cement**] [**Copper**] <Insert material>.
 2. Coating: [**Epoxy resin**] [**Galvanized**] [**Glass**] [**Nickel**] <Insert coating>.
- K. Exterior Coating: [**Galvanized**] [**Manufacturer's standard enamel paint**] [**Primer paint**] <Insert coating>.

2.4 STEEL, NONPRESSURE, POTABLE-WATER STORAGE TANKS

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
1. Adamson Global Technology Corporation.
 2. Highland Tank & Manufacturing Company, Inc.
 3. RECO USA.
 4. Steel Tank and Fabricating.
 5. Wood, John Co.
 6. <Insert manufacturer's name>.
 7. or approved equal.
- B. Description: Steel, [**horizontal**] [**vertical**], nonpressure-rated tank with cylindrical sidewalls.
- C. Fabricate supports and attachments to tank with reinforcement strong enough to resist tank movement during seismic event when tank supports are anchored to building structure.
- D. Construction: Steel, constructed with nontoxic welded joints.
- E. Manhole: Watertight, for tank more than [**36 inches (915 mm)**] <Insert dimension> in diameter.
- F. Cover for Open Tank: [**Plastic**] [**Steel, with lining same as or similar to tank lining and**] with shape that encloses top of tank.
- G. Tappings: Factory-fabricated[**stainless**] steel, welded to tank.
1. **NPS 2 (DN 50)** and Smaller: ASME B1.20.1, with female thread.
 2. **NPS 2-1/2 (DN 65)** and Larger: ASME B16.5, flanged.
- H. Specialties and Accessories: Include tappings in the tank and the following:
1. Vacuum relief valve.
 2. Free air vent with insect screen.
 3. Thermometer.
 4. Gage glass, brass fittings, compression stops, and gage-glass guard.

- I. Horizontal Tank Supports: Factory-fabricated steel saddles, welded to tank[**before testing and labeling**].
 - J. Vertical Tank Supports: Factory-fabricated steel legs or steel skirt, welded to tank[**before testing and labeling**].
 - K. Tank Interior Finish: Materials and thicknesses complying with NSF 61 barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
 - 1. Lining Material: [**Cement**] [**Copper**] <Insert material>.
 - 2. Coating: [**Epoxy resin**] [**Galvanized**] [**Glass**] [**Nickel**] <Insert coating>.
 - L. Exterior Coating: [**Galvanized**] [**Manufacturer's standard enamel paint**] [**Primer paint**] <Insert coating>.
- 2.5 STEEL, FLOATING-WAFER, POTABLE-WATER STORAGE TANKS
- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1. Cemline Corporation.
 - 2. State Industries, Inc.
 - 3. Wood, John Co.
 - 4. <Insert manufacturer's name>.
 - 5. or approved equal.
 - B. Description: Steel, vertical, pressure-rated tank with cylindrical sidewalls and with floating-wafer separator.
 - C. Fabricate supports and attachments to tank with reinforcement strong enough to resist tank movement during seismic event when tank supports are anchored to building structure.
 - D. Construction: [**ASME code, steel**] [**Steel**], constructed with nontoxic welded joints, for [**125-psig (860-kPa)**] [**150-psig (1035-kPa)**] <Insert value> working pressure.
 - E. Manhole: Watertight, for tank more than [**36 inches (915 mm)**] <Insert dimension> in diameter; same pressure rating as tank.
 - F. Floating Wafer: Nontoxic plastic, of diameter to match tank.
 - G. Tappings: Factory-fabricated[**stainless**] steel, welded to tank[**before testing and labeling**].
 - 1. **NPS 2 (DN 50)** and Smaller: ASME B1.20.1, with female thread.
 - 2. **NPS 2-1/2 (DN 65)** and Larger: ASME B16.5, flanged.
 - H. Specialties and Accessories: Include tappings in tank and the following:

1. Pressure relief valve.
2. Pressure gage.
3. Thermometer.
4. Air-charging connection.
5. Gage glass, brass fittings, compression stops, and gage-glass guard.

- I. Vertical Tank Supports: Factory-fabricated steel legs or steel skirt, welded to tank[**before testing and labeling**].
- J. Tank Interior Finish: Materials and thicknesses complying with NSF 61 barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
1. Lining Material: [**Copper**] <Insert material>.
 2. Coating: [**Epoxy resin**] [**Galvanized**] [**Glass**] [**Nickel**] <Insert coating>.
- K. Exterior Coating: [**Galvanized**] [**Manufacturer's standard enamel paint**] [**Primer paint**] <Insert coating>.

2.6 STEEL, PRECHARGED, POTABLE-WATER STORAGE TANKS

A. Steel, Precharged, Diaphragm, Water Storage Tanks:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. AMTROL, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Flexcon Industries; Plumbing & Heating Division.
 - d. Flo Fab inc.
 - e. Myers; Pentair Pump Group.
 - f. State Industries, Inc.
 - g. Taco, Inc.
 - h. Wessels Company.
 - i. <Insert manufacturer's name>.
 - j. or approved equal.
2. Description: Steel, vertical, pressured-rated tank with cylindrical sidewalls and with air-charging valve and air precharge.
3. Fabricate supports and attachments to tank with reinforcement strong enough to resist tank movement during seismic event when tank supports are anchored to building structure.
4. Operation: Factory-installed, butyl-rubber diaphragm.

B. Steel, Precharged, Bladder, Water Storage Tanks:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Armstrong Pumps, Inc.

- b. Flo Fab inc.
 - c. Taco, Inc.
 - d. Wessels Company.
 - e. Wood, John Co.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
 2. Description: Steel, vertical, pressured-rated tank with cylindrical sidewalls and with air-charging valve and air precharge.
 3. Fabricate supports and attachments to tank with reinforcement strong enough to resist tank movement during seismic event when tank supports are anchored to building structure.
 4. Operation: Factory-installed, butyl-rubber bladder.
- C. Construction: **[ASME code, steel] [Steel]**, constructed with nontoxic welded joints, for **[125-psig (860-kPa)] [150-psig (1035-kPa)] <Insert value>** working pressure.
- D. Tappings: Factory-fabricated **[stainless]** steel, welded to tank **[before testing and labeling]**.
1. **NPS 2 (DN 50)** and Smaller: ASME B1.20.1, with female thread.
 2. **NPS 2-1/2 (DN 65)** and Larger: ASME B16.5, flanged.
- E. Specialties and Accessories: Include tappings in tank and the following:
1. Pressure gage.
 2. **<Insert required specialties>**.
- F. Vertical Tank Supports: Factory-fabricated steel legs or steel skirt, welded to tank **[before testing and labeling]**.
- G. Tank Interior Finish: Materials and thicknesses complying with NSF 61 barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
1. Lining Material: **[Cement] [Copper] <Insert material>**.
 2. Coating: **[Epoxy resin] [Galvanized] [Glass] [Nickel] <Insert coating>**.
- H. Exterior Coating: **[Galvanized] [Manufacturer's standard enamel paint] [Primer paint] <Insert coating>**.
- 2.7 INSULATED, STEEL, POTABLE-WATER STORAGE TANKS
- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
1. GSW Water Heating.
 2. HESCO Bastion Ltd.
 3. Laars Heating Systems Company.
 4. Lochinvar Corporation.

5. Precision Boilers.
 6. PVI Industries, LLC.
 7. RBI; a Mestek company.
 8. Rheem Manufacturing Company.
 9. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 10. State Industries, Inc.
 11. Vaughn Manufacturing Corporation.
 12. Wessels Company.
 13. **<Insert manufacturer's name>**.
 14. or approved equal.
- B. Description: Steel, vertical, pressure-rated tank with cylindrical sidewalls.
- C. Fabricate supports and attachments to tank with reinforcement strong enough to resist tank movement during seismic event when tank supports are anchored to building structure.
- D. Construction: **[ASME code, steel] [Steel]**, constructed with nontoxic welded joints, for **[125-psig (860-kPa)] [150-psig (1035-kPa)] <Insert value>** working pressure.
- E. Manhole: Watertight, for tank more than **[36 inches (915 mm)] <Insert dimension>** in diameter; same pressure rating as tank.
- F. Tappings: Factory-fabricated **[stainless]** steel, welded to tank **[before testing and labeling]**.
1. **NPS 2 (DN 50)** and Smaller: ASME B1.20.1, with female thread.
 2. **NPS 2-1/2 (DN 65)** and Larger: ASME B16.5, flanged.
- G. Specialties and Accessories: Include tappings in tank and the following:
1. Pressure relief valve.
 2. Pressure gage.
 3. Thermometer.
 4. Air-charging connection.
 5. Gage glass, brass fittings, compression stops, and gage-glass guard.
- H. Vertical Tank Supports: Factory-fabricated steel legs or steel skirt, welded to tank **[before testing and labeling]**.
- I. Tank Interior Finish: Materials and thicknesses complying with NSF 61 barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
1. Lining Material: **[Cement] [Copper] <Insert material>**.
 2. Coating: **[Epoxy resin] [Galvanized] [Glass] [Nickel] <Insert coating>**.
- J. Insulation: Factory-installed fiberglass or polyurethane foam; surrounding entire tank except connections and other openings; suitable for tank operating temperature; and complying with ASHRAE/IESNA 90.1.

- K. Jacket: Steel, with manufacturer's standard finish unless otherwise indicated.

2.8 PLASTIC, PRESSURE, POTABLE-WATER STORAGE TANKS

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

1. Pentair, Inc.; Park International Water Group.
2. Tankinetics, Inc.
3. **<Insert manufacturer's name>**.
4. or approved equal.

- B. Description: FRP, vertical, pressure-rated tank with cylindrical sidewalls.

- C. Construction: **[ASME code, composite FRP] [Composite FRP], [contact-molded] [or] [filament-wound]**, thermosetting-resin tank for **[100-psig (690-kPa)] [125-psig (860-kPa)] [150-psig (1035-kPa)] <Insert value>** working pressure.

1. Tank Lining Material: Nontoxic **[HDPE] [LDPE] <Insert material>** complying with NSF 61 barrier materials for potable-water tanks.

- D. Manhole: Watertight, for tank more than **[36 inches (915 mm)] <Insert dimension>** in diameter; same pressure rating as tank.

- E. Tappings: Factory-fabricated, FRP flanged-end nozzle.

1. **NPS 2 (DN 50)** and Smaller: Include plastic-to-steel transition fitting from tank nozzle flange to ASME B1.20.1, female thread.
2. **NPS 2-1/2 (DN 65)** and Larger: ASME B16.5, flanged.

- F. Specialties and Accessories: Include tappings in tank and the following:

1. Pressure relief valve.
2. Pressure gage.
3. Thermometer.

- G. Vertical Tank Supports: Factory-fabricated steel legs or FRP skirt attached by FRP brackets to tank sidewall.

- H. Tank Interior Finish: Materials and thicknesses complying with NSF 61 barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.

2.9 PLASTIC, NONPRESSURE, POTABLE-WATER STORAGE TANKS

- A. FRP Potable-Water Storage Tanks:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Amprotec, Inc.; Tank System Division.
 - b. Belding Tank Technologies, Inc.
 - c. L. F. Manufacturing, Inc.
 - d. Palmer Manufacturing and Tank Company.
 - e. **<Insert manufacturer's name>**.
 - f. or approved equal.
2. Description: FRP, vertical, nonpressure-rated water tank; complying with NSF 61 barrier materials for potable-water tanks.
 3. Construction: [**ASTM D 3299, filament-wound**] [or] [**ASTM D 4097, contact-molded**] FRP.
 4. Tappings: Factory-fabricated, FRP flanged-end nozzle.
 - a. **NPS 2 (DN 50)** and Smaller: Include plastic-to-steel transition fitting from tank nozzle flange to ASME B1.20.1, female thread.
 - 1) [**Exception: Tappings may be threaded FRP coupling integral with nozzle for connections for plastic piping.**]
 - b. **NPS 2-1/2 (DN 65)** and Larger: Flanged.
 5. Vertical Tank Support: Separate factory-fabricated steel stand capable of supporting tank.

B. PE Potable-Water Storage Tanks:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Amprotec, Inc.; Tank System Division.
 - b. Assmann Corporation of America.
 - c. Chem-Tainer Industries.
 - d. Poly Processing Company.
 - e. Premier Plastics Inc.
 - f. Snyder Industries, Inc.
 - g. Steel Tank and Fabricating.
 - h. TolPlast Company, Inc.
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
2. Description: PE, vertical, flat-bottom, nonpressure-rated water tank; complying with NSF 61 barrier materials for potable-water tanks.
3. Construction: ASTM D 1998, molded PE.
4. Tappings: Factory-fabricated bulkhead fittings attached to tank.
 - a. **NPS 2 (DN 50)** and Smaller: With female thread.
 - b. **NPS 2-1/2 (DN 65)** and Larger: Flanged.
5. Vertical Tank Support: Separate factory-fabricated steel stand capable of supporting entire bottom of tank.

- C. Manhole: Watertight, for tank more than [36 inches (915 mm)] <Insert dimension> in diameter.
- D. Cover for Open Tank: Plastic, same as or similar to tank material and with shape that encloses top of tank.
- E. Specialties and Accessories: Include tapings in the tank and the following:
 - 1. Vacuum relief valve.
 - 2. Free air vent with insect screen.
 - 3. Thermometer.
 - 4. Gage glass, brass fittings, compression stops, and gage-glass guard.

2.10 SOURCE QUALITY CONTROL

- A. Test and inspect potable-water storage tanks according to the following tests and inspections and prepare test reports:
 - 1. Pressure Testing for ASME-Code, Potable-Water Storage Tanks: Hydrostatically test to ensure structural integrity and freedom from leaks. Fill tanks with water, vent air, pressurize to 1-1/2 times tank pressure rating, disconnect test equipment, hold pressure for 30 minutes with no drop in pressure, and check for leaks.
 - 2. Pressure Testing for Non-ASME-Code, Pressure, Potable-Water Storage Tanks: Hydrostatically test to ensure structural integrity and freedom from leaks at pressure of [50 psig (345 kPa)] <Insert value> above system operating pressure, but not less than [150 psig (1035 kPa)] <Insert value>. Fill tanks with water, vent air, pressurize tanks, disconnect test equipment, hold pressure for two hours with no drop in pressure, and check for leaks.
 - 3. Testing for Nonpressure, Potable-Water Storage Tanks: Fill tanks to water operating level to ensure structural integrity and freedom from leaks. Hold water level for two hours with no drop in water level.
- B. Repair or replace tanks that fail test with new tanks, and repeat until test is satisfactory.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install tanks in strict conformity with manufacturer's instructions. **[Install hold-down straps, secured to anchor bolts provided as Division 03 work.]**
- B. Install water storage tanks on concrete bases, level and plumb, firmly anchored. Arrange so devices needing servicing are accessible.
 - 1. Install horizontal tanks on [**concrete piers and factory-fabricated**] [**fabricated steel supports and**] saddles.

- C. Anchor tank supports and tanks to substrate.
 - 1. Use steel or FRP straps over or around plastic tanks.
- D. Install tank seismic restraints.
- E. Install thermometers and pressure gages on water storage tanks and piping if indicated. Thermometers and pressure gages are specified in Section 220519 "Meters and Gages for Plumbing Piping."
- F. Install the following devices on tanks where indicated:
 - 1. Pressure relief valves.
 - 2. Temperature and pressure relief valves.
 - 3. Vacuum relief valves.
 - 4. Tank vents on nonpressure tanks.
 - 5. Connections to accessories.
- G. After installing tanks with factory finish, inspect finishes and repair damages to finishes.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to potable-water storage tanks to allow service and maintenance.
- C. Connect water piping to water storage tanks with unions or flanges and with shutoff valves. Connect tank drains with shutoff valves and discharge over closest floor drains.
 - 1. General-duty valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
 - a. Valves **NPS 2 (DN 50)** and Smaller: Gate or ball.
 - b. Valves **NPS 2-1/2 (DN 65)** and Larger: Gate or butterfly.
 - c. Drain Valves: **NPS 3/4 (DN 20)** gate or ball valve. Include outlet with, or nipple in outlet with, ASME B1.20.7, 3/4-11.5NH thread for garden-hose service, threaded cap, and chain.
 - 2. Water Piping Connections: Make connections to dissimilar metals with dielectric fittings. Dielectric fittings are specified in Section 221116 "Domestic Water Piping."
 - 3. Connect air piping to hydropneumatic tanks with unions or flanges and gate or ball valves. Make connections to dissimilar metals with dielectric fittings, which are specified in Section 221513 "General-Service Compressed-Air Piping."

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform the following final checks before filling:
 - 1. Verify that air precharge in precharged tanks is correct.
 - 2. Test operation of tank accessories and devices.
 - 3. Verify that pressure relief valves have correct setting.
 - a. Manually operate pressure relief valves.
 - b. Adjust pressure settings.
 - 4. Verify that vacuum relief valves are correct size.
 - a. Manually operate vacuum relief valves.
 - b. Adjust vacuum settings.
- B. Filling Procedures: Follow manufacturer's written procedures. Fill tanks with water to operating level.

3.5 CLEANING

- A. Clean and disinfect potable-water storage tanks.
- B. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed, use procedure described in AWWA C652 or as described below:
 - 1. Purge water storage tanks with potable water.
 - 2. Disinfect tanks by one of the following methods:
 - a. Fill tanks with water-chlorine solution containing at least 50 ppm (50 mg/L) of chlorine. Isolate tanks and allow to stand for 24 hours.
 - b. Fill tanks with water-chlorine solution containing at least 200 ppm (200 mg/L) of chlorine. Isolate tanks and allow to stand for three hours.
 - 3. Flush tanks, after required standing time, with clean, potable water until chlorine is not present in water coming from tank.
 - 4. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination made by authorities having jurisdiction shows evidence of contamination.
- C. Prepare written reports for purging and disinfecting activities.

- D. The tanks shall be left in a completely clean and dry state. Close all manways and uncovered openings with plywood covers fastened in a manner suitable for a permanent connection. Damage caused to the tank by the entry of foreign substances prior to coatings application shall be remedied by the Contractor at no additional cost to DEN.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 221223

SECTION 221226 - POTABLE WATER CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. This Section specifies potable water cabinets, accessories, and trim.
- B. Related Requirements:
 - 1. Section 220400 "Basic Plumbing Requirements".
 - 2. Section 221316 "Domestic Water Piping" for piping work.
 - 3. Section 221119 "Domestic Water Piping Specialties" for piping specialties.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 REFERENCES

- A. Applicable Standards:
 - 1. American Society for Testing and Materials (ASTM):
 - a. A167 - Stainless and Heat-Resisting Chromium - Nickel Steel Plate, Sheet, and Strip.
 - b. A480 - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
 - c. E84 - Surface Burning Characteristics of Building Materials.
 - 2. International Building Code (IBC) with the Denver Amendments.
 - 3. International Fire Code (IFC) with the Denver Amendments.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Submit product data and installation instructions for each fixture, faucet,

- specialties, accessories, and trim specified.
- 2. Submit frame paint salt spray test certification and painting specifications and procedures.
- 3. Include data substantiating that materials comply with requirements.

B. Shop Drawings: Submit rough-in drawings. Detail dimensions, rough-in requirements, required clearances, and methods of assembly of components and anchorages.

C. Wiring Diagrams: Submit manufacturer's electrical requirements and wiring diagrams for power supply to units. Clearly differentiate between portions of wiring that are factory installed and field installed portions.

1.5 INFORMATIONAL SUBMITTALS

A. Quality Control Submittals:

- 1. Submit certification of compliance with specified ANSI, UL, FDA, and NSF Standards.
- 2. Submit certification of compliance with performance verification requirements specified in this Section

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Include data in Maintenance Manual specified in DIVISION 01.

B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 EXTRA STOCK

A. Extra Stock:

- 1. Furnish special wrenches and other devices necessary for servicing potable water cabinets, accessories and trim to DEN Project Manager with receipt in a quantity of minimum one (1) device for each ten (10) potable water cabinets.

1.8 QUALITY ASSURANCE

A. Manufacturer's Qualification: Firms regularly engaged in manufacture of potable water cabinets of the type required whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

- 1. Food and Drug Administration (FDA).
- 2. Uniform Plumbing Code (UPC).

3. Underwriter's Laboratories (UL).

1.9 DELIVERY, STORAGE AND HANDLING

- A. Store potable water cabinets where environmental conditions are uniformly maintained within the manufacturer's recommended temperatures to prevent damage.
- B. Store potable water cabinets and trim in the manufacturer's original shipping containers. Do not stack containers or store in such a manner that may cause damage to the fixture or trim.

1.10 SEQUENCE AND SCHEDULING

- A. Schedule rough-in installations with the installation of other building components.

1.11 WARRANTY

- A. Warranty of all equipment described in this Section shall meet warranty requirements of Section 220400 "Basic Plumbing Requirements".

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 POTABLE WATER CABINET MANUFACTURERS

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1. **NMC-WOLLARD, 2021 Truax Blvd., Eau Claire, WI 54703.**
 - 2. **Semler Industries, Inc., 3800 N. Carnation St., Franklin Park, IL 60131-1295.**
 - 3. **J&B Aviation Services, Inc., 2850 Cordelia Road, Fairfield, CA 94534.**
 - 4. **or approved equal.**

2.2 POTABLE WATER CABINETS

- A. General: Furnish and install a potable water cabinet near each loading bridge's rotunda column or as indicated.
 - 1. Each potable water cabinet shall consist of a motorized hose reel, water hose,

valves, pressure regulator, pressure gauge, flushing air gap, cabinet floor drain, aircraft coupling reduced pressure type back flow preventer, heated service cabinet and skirted stand.

2. Components shall be arranged in the cabinet to allow for maintenance and cleaning without removal of any equipment.

B. Cabinet:

1. Cabinet sidewalls, door and top shall be constructed of welded, double wall stainless steel with a 1-inch polystyrene insulation between minimum 16 gage, type 304 stainless steel sheets, #4 finish inside and outside. Interior corners shall be rounded to provide cleanable surface.
2. Cabinet floor shall be constructed of a single sheet of 304 stainless steel, minimum 16 gage.
3. Cabinet floor shall have a 1-1/2-inch drain opening and drain fitting suitable for connection to drain piping located below cabinet.
4. Cabinet doors shall be of same construction as cabinet and shall have a two point latching system. Doors shall be field replaceable.

C. Stand:

1. Cabinet shall be mounted on a skirted stand such that cabinet floor is at least 18-inches above the adjacent apron elevation.
2. Stand shall be fabricated of ASTM A36 structural steel, factory painted with rust inhibiting primer and two coats of paint.
3. Stand shall be skirted with minimum 18 gage, type 304 stainless steel sheets having 1-inch urethane board insulation.

D. Electrical:

1. All components shall be UL listed and of NEMA 3R or 4X construction.
2. Light: Provide 100 watt incandescent equivalent LED light fixture switched within cabinet, with weatherproof guard.
3. Heater: Provide cabinet electric heater(s), minimum 2400 watts total. Heater elements shall be electric panel type enclosed within the cabinet side panels. Heat shall be controlled through thermostat mounted inside cabinet and normally set for 40 degrees F.
4. Warning Light: Provide amber light mounted on top of cabinet with door switch to activate light whenever doors are not fully closed.
5. Power Supply: Contractor shall coordinate required power supply with electrical. Provide any transformers required.
6. Convenience Outlet: Provide a convenience outlet inside the cabinet, 120 VAC, 15 amp, GFI, duplex.

E. Hose Reel:

1. Construction: Stainless steel disks and internals, an aluminum drum, carbon steel frame with epoxy powder paint. Paint color: silver. Frame painting must pass a minimum 500 hr salt spray test.
2. Hose reel shall be electric rewind with minimum 1/2 HP, reversible motor with

- push button control and limit switch.
- 3. Reel shall have auxiliary hand crank and adjustable drag brake.
- 4. Reel shall have 1-inch bronze swing joint and bronze internal piping.
- 5. Reel shall be mounted in the vertical position.
- 6. Drum shall be cadmium plated with chrome plated disc and sprocket.
- 7. Hose: Provide minimum 175 feet of 1-inch drinking water hose complying with FDA-CFR Title 21, parts 170 through 199.
- 8. Hose end nozzle, 3/4-inch, aluminum construction, with dust cap and chain suitable for quick coupling to aircraft connections.
- 9. Shut off valve: 3/4-inch ball valve at hose end nozzle. Handle shall be oriented 90 degrees from standard position.

F. Piping:

- 1. Provide the following piping components, factory assembled within each cabinet:
 - a. Reduced pressure backflow preventer, 1-inch size, equivalent to Watts Series 909 with unions, bronze strainer, and full port bronze ball shutoff valves.
 - b. Pressure regulator, adjustable 25 psi to 75 psi outlet pressure with pressure gauge.
 - c. Flexible hose reel connector, minimum 8-inches long.
 - d. Flushing Air Gap: 3/4-inch stainless steel air gap piped through the cabinet floor and suitable for connecting with hose end nozzle to facilitate hose flushing.
 - e. Shut off valve: 1-inch ball valve at cabinet.

G. Placard:

- 1. ASTM D709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message "POTABLE WATER". Minimum three-inch height. Provide holes for mechanical fastening.
- 2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
- 3. Thickness: 1/8 inch.
- 4. Fasteners: Self-tapping, stainless-steel screws.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify all dimensions by field measurements. Verify that all potable water cabinets may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.
- B. Examine rough-in for potable water and waste piping systems to verify actual locations

of piping connections prior to installing potable water cabinets.

- C. Examine apron, walls, and floors for suitable conditions where potable water cabinets are to be installed.
- D. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install potable water cabinets level and plumb, in accordance with manufacturer's written instructions, rough-in drawings, and applicable codes and regulations, the original design, and the referenced standards.
- B. Fasten potable water cabinets securely to apron, supports, or building structure. Secure supplies behind or within wall construction to provide rigid installation.
- C. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests:
 - 1. Test potable water cabinets to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning units, then retest.
 - 2. Inspect each installed unit for damage. Replace damaged potable water cabinets.

3.4 ADJUSTING

- A. Adjust water pressure at drinking fountains, faucets, shower valves, and flush valves to provide proper flow and stream.
- B. Replace washers of leaking or dripping faucets and stops.

3.5 CLEANING

- A. Clean potable water cabinets, trim, and strainers using manufacturer's recommended cleaning methods and materials.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 221226

SECTION 221313 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe and fittings.
 - 2. Nonpressure and pressure couplings.
 - 3. Expansion joints and deflection fittings.
 - 4. Backwater valves.
 - 5. Cleanouts.
 - 6. Encasement for piping.
 - 7. Manholes.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. PVC: Polyvinyl Chloride.
- B. HDEP: High-Density Polyethylene Pipe.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Expansion joints and deflection fittings.
 - 2. Backwater valves.
 - 3. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For sanitary sewer systems and manholes. Include plans, elevations, sections, details, and frames and covers.
 - 1. Show piping materials, size, locations, and inverts. Include details of underground structures, connections, and cleanouts. Show interface and spatial relationship between piping and proximate structures.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewer system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- B. Profile Drawings: Show system piping in elevation. Draw profiles to horizontal scale of not less than **1 inch equals 50 feet (1:500)** and to vertical scale of not less than **1 inch equals 5 feet (1:50)**. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.
- C. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.
- D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. As-Built Drawings: At project closeout, submit record drawings of installed sanitary sewer piping and products, in accordance with the contract requirements.
 - 1. Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of sanitary sewer system's products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.
- B. Installers Qualifications: Firm with at least three (3) years of successful installation experience on projects with sanitary sewer work similar to that required for this project.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.

1.9 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify DEN Project Manager no fewer than **[seven (7)] <Insert number>** days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without DEN Project Manager's written permission.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PIPES AND PIPE FITTINGS

- A. General: Provide pipes and pipe fittings of one of the following materials. Provide pipe fittings and accessories of same material with joining method as indicated.
- B. Gaskets: AWWA C111, rubber.

2.2 PVC PIPE AND FITTINGS

- A. PVC pipe and fittings shall be AWWA Standard C-900 and shall be furnished with rubber-gasketed separate couplings minimum pressure class shall be 150 psi.
- B. PVC Cellular-Core Sewer Piping:
 1. Pipe: ASTM F 891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints.
 2. Fittings: ASTM D 3034, [**SDR 35**] <Insert SDR>, PVC socket-type fittings.
- C. PVC Corrugated Sewer Piping:
 1. Pipe: ASTM F 949, PVC corrugated pipe with bell-and-spigot ends for gasketed joints.
 2. Fittings: ASTM F 949, PVC molded or fabricated, socket type.
 3. Gaskets: ASTM F 477, elastomeric seals.
- D. PVC Profile Sewer Piping:
 1. Pipe: ASTM F 794, PVC profile, gravity sewer pipe with bell-and-spigot ends for gasketed joints.
 2. Fittings: ASTM D 3034, PVC with bell ends.
 3. Gaskets: ASTM F 477, elastomeric seals.
- E. PVC Type PSM Sewer Piping:

1. Pipe: ASTM D 3034, [**SDR 35**] <Insert **SDR**>, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

F. PVC Gravity Sewer Piping:

1. Pipe and Fittings: ASTM F 679, [**T-1**] [**T-2**] wall thickness, PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F 477, elastomeric seals for gasketed joints.

G. PVC Pressure Piping:

1. Pipe: AWWA C900, [**Class 100**] [**Class 150**] [**and**] [**Class 200**] PVC pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: AWWA C900, [**Class 100**] [**Class 150**] [**and**] [**Class 200**] PVC pipe with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

H. PVC Water-Service Piping:

1. Pipe: ASTM D 1785, [**Schedule 40**] [**and**] [**Schedule 80**] PVC, with plain ends for solvent-cemented joints.
2. Fittings: [**ASTM D 2466, Schedule 40**] [**and**] [**ASTM D 2467, Schedule 80**] PVC, socket type.

2.3 HIGH DENSITY POLYETHYLENE PIPE (HDPE)

A. Materials:

1. High Density Polyethylene pipe shall be corrugated or corrugated with smooth interior and shall conform to the following ASTM standard specifications:
 - a. ASTM F405 Standard Specification for corrugated Polyethylene Tubing and Fittings.
 - b. ASTM F667 Standard Specification for large Diameter Corrugated Polyethylene Tubing and Fittings.
 - c. ASTM D1248 Polyethylene Plastics Molding and Extensions
 - d. HDPE shall also conform to the following:
 - 1) AASHTO standard specifications:
 - a) AASHTO M252 Standard specification for Polyethylene corrugated Tubing and Fittings.
 - b) AASHTO M294 Standard Specification for Corrugated Polyethylene Pipe.

B. Joints:

1. Corrugated and ribbed HDPE pipe shall be connected with mechanical coupling

bands manufactured from the same material as the pipe. Joints shall be installed with gaskets and seals to provide a water-tight joint.

2. Smooth wall HDPE pipe shall be connected by bell and spigot ends. Jointing shall be accomplished by thermal welding, rubber adhesives or chemical adhesive as determined by the DEN Project Manager.

2.4 CONCRETE PIPE AND FITTINGS

- A. Nonreinforced-Concrete Sewer Pipe and Fittings: **ASTM C 14** (ASTM C 14M), **[Class 1]** **[Class 2]** **[Class 3]**, with **[bell-and-spigot]** **[or]** **[tongue-and-groove]** ends for gasketed joints with **ASTM C 443** (ASTM C 443M), rubber gaskets.
- B. Reinforced-Concrete Sewer Pipe and Fittings: **ASTM C 76** (ASTM C 76M).
 1. **[Bell-and-spigot]** **[or]** **[tongue-and-groove]** ends for gasketed joints, with **ASTM C 443** (ASTM C 443M), rubber gaskets.
 2. Class II, **[Wall A]** **[Wall B]** **[Wall C]**.
 3. Class III, **[Wall A]** **[Wall B]** **[Wall C]**.
 4. Class IV, **[Wall A]** **[Wall B]** **[Wall C]**.
 5. Class V, **[Wall A]** **[Wall B]**.

2.5 NONPRESSURE-TYPE TRANSITION COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
 1. For Concrete Pipes: **ASTM C 443** (ASTM C 443M), rubber.
 2. For Fiberglass Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 3. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 4. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- C. Unshielded, Flexible Couplings:
 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Dallas Specialty & Mfg. Co.
 - b. Fernco Inc.
 - c. Logan Clay Pipe.
 - d. Mission Rubber Company; a division of MCP Industries, Inc.
 - e. NDS.
 - f. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.

2. Description: Elastomeric sleeve with[**stainless-steel shear ring and**] corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, Flexible Couplings:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Cascade Waterworks Mfg.
- b. Dallas Specialty & Mfg. Co.
- c. Mission Rubber Company; a division of MCP Industries, Inc.
- d. **<Insert manufacturer's name>**.
- e. or approved equal.

2. Description: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Fernco Inc.
- b. Logan Clay Pipe.
- c. Mission Rubber Company; a division of MCP Industries, Inc.
- d. **<Insert manufacturer's name>**.
- e. or approved equal.

2. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

F. Nonpressure-Type, Rigid Couplings:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. ANACO-Husky.
- b. **<Insert manufacturer's name>**.
- c. or approved equal.

2. Description: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling, molded from ASTM C 1440, TPE material; with corrosion-resistant-metal tension band and tightening mechanism on each end.

2.6 PRESSURE-TYPE PIPE COUPLINGS

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

1. Cascade Waterworks Mfg.

2. Dresser, Inc.
3. Ford Meter Box Company, Inc. (The); Pipe Products Div.
4. JCM Industries, Inc.
5. Romac Industries, Inc.
6. Smith-Blair, Inc.; a Sensus company.
7. Victaulic Depend-O-Lok, Inc.
8. Viking Johnson.
9. **<Insert manufacturer's name>**.

- B. Tubular-Sleeve Couplings: AWWA C219, with center sleeve, gaskets, end rings, and bolt fasteners.
- C. Metal, bolted, sleeve-type, reducing or transition coupling, for joining underground pressure piping. Include [**150-psig (1035-kPa)**] [**200-psig (1380-kPa)**] **<Insert value>** minimum pressure rating and ends of same sizes as piping to be joined.
- D. Center-Sleeve Material: [**Manufacturer's standard**] [**Carbon steel**] [**Stainless steel**] [**Ductile iron**] [**Malleable iron**].
- E. Gasket Material: Natural or synthetic rubber.
- F. Metal Component Finish: Corrosion-resistant coating or material.

2.7 BACKWATER VALVES

- A. PVC Backwater Valves:
- B. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
- a. Canplas LLC.
 - b. IPS Corporation.
 - c. NDS.
 - d. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Zurn Light Commercial Products Operation; Zurn Plumbing Products Group.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
2. Description: Horizontal type; with PVC body, PVC removable cover, and PVC swing check valve.

2.8 CLEANOUTS

- A. PVC Cleanouts:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Canplas LLC.
 - b. IPS Corporation.
 - c. NDS.
 - d. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Zurn Light Commercial Products Operation; Zurn Plumbing Products Group.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
2. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.9 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Material: **[Linear low-density polyethylene film of 0.008-inch (0.20-mm)] [or] [high-density, cross-laminated polyethylene film of 0.004-inch (0.10-mm)]** minimum thickness.
- C. Form: **[Sheet] [or] [tube]**.
- D. Color: **[Black] [or] [natural] <Insert color>**.

2.10 MANHOLES

- A. Standard Precast Concrete Manholes:
 1. Description: **ASTM C 478 (ASTM C 478M)**, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 2. Diameter: **48 inches (1200 mm)** minimum unless otherwise indicated.
 3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
 4. Base Section: **6-inch (150-mm)** minimum thickness for floor slab and **4-inch (100-mm)** minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
 5. Riser Sections: **4-inch (100-mm)** minimum thickness, of length to provide depth indicated.
 6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.
 7. Joint Sealant: **ASTM C 990 (ASTM C 990M)**, bitumen or butyl rubber.
 8. Resilient Pipe Connectors: **ASTM C 923 (ASTM C 923M)**, cast or fitted into manhole walls, for each pipe connection.
 9. Steps: **[Individual FRP steps or FRP ladder] [Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP] [ASTM A 615/A 615M, deformed, 1/2-inch**

(13-mm) **steel reinforcing rods encased in ASTM D 4101, PP] <Insert material>**; wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at **12- to 16-inch (300- to 400-mm)** intervals. Omit steps if total depth from floor of manhole to finished grade is less than **[60 inches (1500 mm)] <Insert dimension>**.

10. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
11. Grade Rings: Reinforced-concrete rings, **6- to 9-inch (150- to 225-mm)** total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Designed Precast Concrete Manholes:

1. Description: ASTM C 913; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.
2. Ballast: Increase thickness of one or more precast concrete sections or add concrete to manhole as required to prevent flotation.
3. Joint Sealant: **ASTM C 990 (ASTM 990M)**, bitumen or butyl rubber.
4. Resilient Pipe Connectors: **ASTM C 923 (ASTM C 923M)**, cast or fitted into manhole walls, for each pipe connection.
5. Steps: **[Individual FRP steps or FRP ladder] [Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP] [ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP] <Insert material>**; wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at **12- to 16-inch (300- to 400-mm)** intervals. Omit steps if total depth from floor of manhole to finished grade is less than **[60 inches (1500 mm)] <Insert dimension>**.
6. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
7. Grade Rings: Reinforced-concrete rings, **6- to 9-inch (150- to 225-mm)** total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

C. Fiberglass Manholes:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Associated Fiberglass Enterprises.
 - b. Containment Solutions, Inc.
 - c. L. F. Manufacturing, Inc.
 - d. **<Insert manufacturer's name>**.

- e. or approved equal.
 2. Description: ASTM D 3753.
 3. Diameter: **48 inches** (1200 mm) minimum unless otherwise indicated.
 4. Ballast: Increase thickness of concrete base as required to prevent flotation.
 5. Base Section: Concrete, **6-inch** (150-mm) minimum thickness.
 6. Resilient Pipe Connectors: **ASTM C 923** (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.
 7. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at **12- to 16-inch** (300- to 400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than **[60 inches (1500 mm)] <Insert dimension>**.
 8. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
 9. Grade Rings: Reinforced-concrete rings, **6- to 9-inch** (150- to 225-mm) total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.
- D. Manhole Frames and Covers:
1. Description: Ferrous; **24-inch** (610-mm) ID by **7- to 9-inch** (175- to 225-mm) riser, with **4-inch-** (100-mm-) minimum-width flange and **26-inch-** (660-mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
 2. Material: [**ASTM A 536, Grade 60-40-18 ductile**] [**ASTM A 48/A 48M, Class 35 gray**] iron unless otherwise indicated.
- E. Manhole-Cover Inserts:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. FRW Industries; a Syneco Systems, Inc. company.
 - b. Knutson Enterprises.
 - c. L. F. Manufacturing, Inc.
 - d. Parson Environmental Products, Inc.
 - e. **<Insert manufacturer's name>**.
 - f. or approved equal.
 2. Description; Manufactured, plastic form, of size to fit between manhole frame and cover and designed to prevent stormwater inflow. Include handle for removal and gasket for gastight sealing.
 3. Type: [**Solid**] [**Drainage with vent holes**] [**Valve**].

2.11 CONCRETE

- A. General: Cast-in-place concrete complying with ACI 318, [ACI 350/350R](#) ([ACI 350M/350RM](#)), and the following:
1. Cement: ASTM C 150, Type II.
 2. Fine Aggregate: ASTM C 33, sand.
 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 4. Water: Potable.
- B. Portland Cement Design Mix: [4000 psi](#) (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.
1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
 2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.
- C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, [4000 psi](#) (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 - a. Invert Slope: [~~1~~] [~~2~~] percent through manhole.
 2. Benches: Concrete, sloped to drain into channel.
 - a. Slope: [~~4~~] [~~8~~] percent.
- D. Ballast and Pipe Supports: Portland cement design mix, [3000 psi](#) (20.7 MPa) minimum, with 0.58 maximum water/cementitious materials ratio.
1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
 2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. General: Install piping and clean-outs in accordance with the Denver Wastewater Management standards, specifications, and as per the standard detail drawings.
- B. Inspect piping before installation to detect apparent defects. Mark defective materials

with white paint and promptly remove from site.

- C. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- D. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- E. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- F. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- G. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- H. Install gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements.
- I. HDPE Pipe: Install in accordance with manufacturer's installation recommendations.
- J. Install gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at minimum slope of [1] [2] <Insert number> percent unless otherwise indicated.
 - 2. Install piping [NPS 6 (DN 150)] <Insert value> and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
 - 3. Install piping with [36-inch (915-mm)] [48-inch (1220-mm)] [60-inch (1520-mm)] [72-inch (1830-mm)] <Insert dimension> minimum cover.
 - 4. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
 - 5. Install PVC cellular-core sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 6. Install PVC corrugated sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 7. Install PVC profile sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 8. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 9. Install PVC gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 10. Install nonreinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

11. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

K. Install force-main, pressure piping according to the following:

1. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
2. Install piping with [36-inch (915-mm)] [48-inch (1220-mm)] [60-inch (1520-mm)] [72-inch (1830-mm)] <Insert dimension> minimum cover.
3. Install PVC pressure piping according to AWWA M23 or to ASTM D 2774 and ASTM F 1668.
4. Install PVC water-service piping according to ASTM D 2774 and ASTM F 1668.

L. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

M. Minimum Cover:

1. Airside Minimum Cover:
 - a. For airside sewer systems subject to aircraft loading on rigid pavement, a minimum depth of cover of 1.50 feet, measured from the bottom of the slab is required. If there is any discrepancy, the contractor should contact DEN Project Manager and correct the discrepancy before installation.

N. Cleaning Piping:

1. Place plugs in ends of uncompleted conduit at end of day or whenever work stops.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods for size and type material being closed. Wood plugs are not acceptable.

O. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.

1. Make inspections after lines have been installed and approximately 2 ft of backfill is in place, and again at completion of project.
2. If inspection indicates poor alignment, debris, displaced pipe, infiltration, or other defects, correct such defects, and reinspect.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure, drainage piping according to the following:

1. Join PVC cellular-core sewer piping according to ASTM D 2321 and ASTM F 891 for solvent-cemented joints.
2. Join PVC corrugated sewer piping according to ASTM D 2321.

3. Join PVC profile sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
 4. Join PVC Type PSM sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
 5. Join PVC gravity sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
 6. Join nonreinforced-concrete sewer piping according to **ASTM C 14** (ASTM C 14M) and ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
 7. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
 8. Join dissimilar pipe materials with nonpressure-type, flexible[**or rigid**] couplings.
- B. Join force-main, pressure piping according to the following:
1. Join PVC pressure piping according to AWWA M23 for gasketed joints.
 2. Join PVC water-service piping according to ASTM D 2855.
 3. Join dissimilar pipe materials with pressure-type couplings.
- C. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
 - a. **[Unshielded] [Shielded]** flexible[**or rigid**]couplings for pipes of same or slightly different OD.
 - b. Unshielded, increaser/reducer-pattern, flexible[**or rigid**]couplings for pipes with different OD.
 - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
 2. Use pressure pipe couplings for force-main joints.
- 3.4 MANHOLE INSTALLATION
- A. General: Install manholes complete with appurtenances and accessories indicated.
 - B. Install precast concrete manhole sections with sealants according to ASTM C 891.
 - C. Install FRP manholes according to manufacturer's written instructions.
 - D. Form continuous concrete channels and benches between inlets and outlet.
 - E. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops **[3 inches (76 mm)]** <Insert dimension> above finished surface elsewhere unless otherwise indicated.
 - F. Install manhole-cover inserts in frame and immediately below cover.

3.5 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318.

3.6 BACKWATER VALVE INSTALLATION

- A. Install horizontal-type backwater valves in piping manholes or pits.
- B. Install combination horizontal and manual gate valves in piping and in manholes.
- C. Install terminal-type backwater valves on end of piping and in manholes. Secure units to sidewalls.

3.7 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 - 1. Use Light-Duty, top-loading classification cleanouts in [**earth or unpaved foot-traffic**] <Insert other> areas.
 - 2. Use Medium-Duty, top-loading classification cleanouts in [**paved foot-traffic**] <Insert other> areas.
 - 3. Use Heavy-Duty, top-loading classification cleanouts in [**vehicle-traffic service**] <Insert other> areas.
 - 4. Use Extra-Heavy-Duty, top-loading classification cleanouts in [**roads**] <Insert area>.
- B. Set cleanout frames and covers in earth in cast-in-place-concrete block, [**18 by 18 by 12 inches (450 by 450 by 300 mm)**] <Insert dimensions> deep. Set with tops [**1 inch (25 mm)**] <Insert dimension> above surrounding grade.
- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.8 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Section 221316 "Sanitary Waste and Vent Piping."
- B. Connect force-main piping to building's sanitary force mains specified in Section 221316 "Sanitary Waste and Vent Piping." Terminate piping where indicated.
- C. Make connections to existing piping and underground manholes.
 - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and

- encase entire wye fitting plus **6-inch (150-mm)** overlap with not less than **6 inches (150 mm)** of concrete with 28-day compressive strength of **3000 psi (20.7 MPa)**.
2. Make branch connections from side into existing piping, **NPS 4 to NPS 20 (DN 100 to DN 500)**. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than **6 inches (150 mm)** of concrete with 28-day compressive strength of **3000 psi (20.7 MPa)**.
 3. Make branch connections from side into existing piping, **NPS 21 (DN 525)** or larger, or to underground manholes by cutting opening into existing unit large enough to allow **3 inches (76 mm)** of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in **6 inches (150 mm)** of concrete for minimum length of **12 inches (300 mm)** to provide additional support of collar from connection to undisturbed ground.
 - a. Use concrete that will attain a minimum 28-day compressive strength of **3000 psi (20.7 MPa)** unless otherwise indicated.
 - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
 4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- D. Connect to **[grease] [oil] [and] [sand]** interceptors specified in Section 221323 "Sanitary Waste Interceptors."

3.9 CLOSING ABANDONED SANITARY SEWER SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
1. Close open ends of piping with at least **[8-inch- (203-mm-)] <Insert dimension>** thick, brick masonry bulkheads.
 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Manholes: Excavate around manhole as required and use either procedure below:
1. Remove manhole and close open ends of remaining piping.
 2. Remove top of manhole down to at least **[36 inches (915 mm)] <Insert dimension>** below final grade. Fill to within **[12 inches (300 mm)] <Insert dimension>** of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

- C. Backfill to grade according to Section 312000 "Earth Moving."

3.10 IDENTIFICATION

- A. Comply with requirements in Section 312000 "Earth Moving" for underground utility identification devices. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.
 - 1. Use[**warning tape or**] detectable warning tape over ferrous piping.
 - 2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.
- B. Reference Section 220553 "Identification for Plumbing Piping and Equipment".

3.11 BACKFILLING

- A. General: Conduct backfilling operations of open-cut trenches closely following laying, jointing, and bedding of pipe, and after initial inspection and testing are completed. Backfill per requirements of Section 312000 "Earth Moving".

3.12 FIELD QUALITY CONTROL

- A. Inspection:
 - 1. The sanitary sewer system shall be inspected by the Contractor's Quality Control Inspector. A record of the inspection including any defects or deviations from the contract shall be submitted to the DEN Project Manager. Any observable defects shall be corrected promptly by the Contractor.
- B. Testing: Contractor's inspection and testing agency shall perform testing of completed piping in accordance with Section 9.00 of the Denver Wastewater Management Division Technical Specifications. The following tests shall be performed on the piping system:

Test:

Exfiltration Test-
Deflection Test-
Infiltration Test-

System Type:

All systems.
Only plastic piping.
Only in case of excessive ground
water.

- C. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately **24 inches (600 mm)** of backfill is in place, and again at completion of Project.
 - 1. Submit separate report for each system inspection.
 - 2. Defects requiring correction include the following:

- a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 4. Reinspect and repeat procedure until results are satisfactory.
- D. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
1. Do not enclose, cover, or put into service before inspection and approval.
 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 4. Submit separate report for each test.
 5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
 - a. Fill sewer piping with water. Test with pressure of at least 10-foot (3-m) head of water, and maintain such pressure without leakage for at least 15 minutes.
 - b. Close openings in system and fill with water.
 - c. Purge air and refill with water.
 - d. Disconnect water supply.
 - e. Test and inspect joints for leaks.
 6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
 - b. Option: Test concrete gravity sewer piping according to ASTM C 924 (ASTM C 924M).
 7. Force Main: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than [150 psig (1035 kPa)] <Insert value>.
 - a. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
 - b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.
 8. Manholes: Perform hydraulic test according to ASTM C 969 (ASTM C 969M).

- E. Leaks and loss in test pressure constitute defects that must be repaired.
- F. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.13 CLEANING

- A. Clean dirt and superfluous material from interior of piping.[**Flush with potable water.**]

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 221313

SECTION 221314 - PROCESS MATERIAL SEWERAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes process material sewerage outside the building.
- B. Related Sections include the following:
 - 1. Section 221313 "Facility Sanitary Sewers" for conventional sanitary sewerage system.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. FPM: Vinylidene fluoride-hexafluoropropylene copolymer rubber.
- B. HDPE: High-density polyethylene plastic.
- C. PE: Polyethylene plastic.
- D. PP: Polypropylene plastic.
- E. PTFE: Polytetrafluoroethylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. PVDF: Polyvinylidene fluoride plastic.
- H. RTRP: Reinforced thermosetting-resin pipe.

1.4 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure-Piping Pressure Rating: 10-foot head of water.
- B. Gravity-Flow, Double-Contained-Piping Pressure Rating: 5-psig air test pressure.

- C. Secondary-Containment Piping: 5-psig air test pressure.
- D. Force-Main, Double-Contained-Piping Pressure Rating: At least equal to system operating pressure, but not less than 100 psig.

1.5 ACTION SUBMITTALS

- A. Product Data: For each product indicated.
 - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: Wiring diagrams for leak-detection system to detail power, signal, and control systems and to differentiate between manufacturer-installed and field-installed wiring.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewerage system piping. Indicate interface and spatial relationship between piping and proximate structures.
- C. Field quality-control test reports: Indicate and interpret test results for compliance with performance requirements.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For neutralization tanks to include in maintenance manuals specified in Division 01.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.8 QUALITY ASSURANCE

- A. Environmental Agency Compliance: Comply with regulations pertaining to hazardous waste systems.
- B. Source Limitations: Obtain pipe, fittings, and joining materials for each piping system through one source from a single manufacturer.
 - 1. Exception: Piping of different manufacturers may be used in same system if indicated, and if suitable transition fittings matching both piping materials are used.

- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of process materials sewerage and are based on the specific system indicated. Other manufacturers' systems with equal performance characteristics may be considered. Refer to Section 012510 "Substitutions."
- D. Provide listing/approval stamp or other marking on piping and specialties made to specified standards.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
- F. ASME Compliance: Comply with ASME B31.3, "Process Piping."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic pipe or fittings in direct sunlight.
- B. Protect pipe, fittings, and seals from dirt and damage.

1.10 PROJECT CONDITIONS

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify DEN Project Manager not less than seven (7) days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without DEN Project Manager's written permission.

1.11 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Neutralization-Tank, Limestone: Equal to 200 percent of amount of required for each tank sump initial charge. Furnish limestone in 50-lb bags.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. High-Silicon-Iron Piping:
 - a. Duriron Co., Inc.; Industrial Products Group; Durco Foundry Products Div.
 - b. **<Insert manufacturer's name>**
 - c. or approved equal.
2. Stainless-Steel Piping:
 - a. Josam Co.; Blucher-Josam Div.
 - b. **<Insert manufacturer's name>**
 - c. or approved equal.
3. Glass Piping:
 - a. QVF Process Systems, Inc.
 - b. Schott Scientific Glass, Inc.
 - c. **<Insert manufacturer's name>**
 - d. or approved equal.
4. PE Piping:
 - a. Chevron Chemical Co.; Plexco Performance Pipe Div.
 - b. CSR PolyPipe.
 - c. Fluid Controls, Inc.
 - d. **<Insert manufacturer's name>**
 - e. or approved equal.
5. PP Drainage Piping:
 - a. Enfield Industrial Corp.
 - b. Orion Fittings, Inc.
 - c. Sloane: R & G Sloane Manufacturing Co., Inc.
 - d. Town & Country Plastics, Inc.
 - e. **<Insert manufacturer's name>**
 - f. or approved equal.
6. PVDF Drainage Piping:
 - a. Orion Fittings, Inc.
 - b. **<Insert manufacturer's name>**
 - c. or approved equal.
7. RTRP Piping:

- a. Ameron; Fiberglass Pipe Group.
 - b. Fibercast Co.
 - c. Fibrex Corp.
 - d. Smith Fiberglass Products, Inc.
 - e. **<Insert manufacturer's name>**
 - f. or approved equal.
8. Double-Contained Piping:
- a. Ameron; Fiberglass Pipe Group.
 - b. Asahi/America, Inc.
 - c. Chevron Chemical Co.; Plexco Performance Pipe Div.
 - d. Enfield Industrial Corp.
 - e. Fibercast Co.
 - f. Fischer: George Fischer, Inc.
 - g. Flo Safe Systems.
 - h. Insul-Tek Piping Systems, Inc.
 - i. Nibco, Inc.; Guardian Div.
 - j. Orion Fittings, Inc.
 - k. Rovanco Corp.
 - l. Smith Fiberglass Products, Inc.
 - m. Thermacor Process, Inc.
 - n. **<Insert manufacturer's name>**
 - o. or approved equal.
9. Secondary-Containment Piping:
- a. Flo Safe Systems.
 - b. Sloane: R & G Sloane Manufacturing Co., Inc.
 - c. **<Insert manufacturer's name>**
 - d. or approved equal.
10. High-Silicon-Iron Specialty Fittings:
- a. Duriron Co., Inc.; Industrial Products Group; Durco Foundry Products Div.
 - b. **<Insert manufacturer's name>**
 - c. or approved equal.
11. Neutralization Tanks:
- a. Koch Engineering Co., Inc.; Knight Div.
 - b. **<Insert manufacturer's name>**
 - c. or approved equal.
12. PE Manholes:
- a. Ayer Sales, Inc.
 - b. CSR PolyPipe.
 - c. Fluid Controls, Inc.
 - d. Plastic Fusion Fabricators, Inc.

- e. **<Insert manufacturer's name>**
- f. or approved equal.

2.2 PIPES AND FITTINGS

- A. High-Silicon-Iron Piping: ASTM A 861; with drainage-pattern fittings, bell-and-spigot joint ends, and calking materials.
- B. Stainless-Steel Drainage Pipe and Fittings: ASME A112.3.1; ASTM A 666, Type 316L, stainless steel; with socket and spigot ends for gasket joints. Include fluoroelastomer lip-seal rubber gaskets shaped to fit socket groove and with plastic backup ring.
- C. Glass Piping: ASTM C 1053, beaded-end pipe and drainage-pattern fittings. Include manufacturer's standard couplings and factory-applied, polystyrene covering.
- D. PE Drainage Piping: ASTM D 2447, Schedule 40 or ASTM D 3035, DR 32.5 pipe and fusion-joint fittings matching pipe.
- E. PE Pressure Piping: ASTM D 2447 or ASTM D 3035 pipe and fusion-joint fittings matching pipe. Include combination of resin, pipe size, and wall thickness that will provide 160- psig minimum sustained water test pressure rating.
- F. PP Drainage Piping: ASTM F 1412, pipe extruded and drainage-pattern fittings molded, with Schedule 40 dimensions, from PP resin complying with ASTM D 4101. Include fusion- or mechanical-joint ends as scheduled in "PIPING APPLICATIONS" Article in Part 3 of this Section.
- G. PP Pressure Piping: Pipe extruded from and fittings molded from PP resin complying with ASTM D 4101. Include SDR 11 or Schedule 80 dimensions and socket, butt-fusion, or threaded fittings as scheduled in "PIPING APPLICATIONS" Article in Part 3 of this Section.
- H. PVC Piping: ASTM D 1785, Schedule 80 pipe and ASTM D 2467, Schedule 80 socket fittings.
- I. PVDF Drainage Piping: Pipe extruded and fittings molded, with Schedule 40 dimensions, from PVDF resin complying with ASTM D 3222. Include drainage-pattern fittings complying ASTM D 3311, except with fusion-joint ends.
- J. PVDF Pressure Piping: Pipe extruded and fittings molded, with Schedule 80 dimensions, from PVDF resin complying with ASTM D 3222. Include fusion-joint or threaded ends as scheduled in "PIPING APPLICATIONS" Article in Part 3 of this Section.
- K. RTRP Sewer Piping: ASTM D 3262, RTRP; with ASTM D 3840, RTRP fittings; and adhesive-bonding materials.
- L. RTRP Pressure Piping: ASTM D 2996, filament-wound or ASTM D 2997, centrifugally cast pipe; with ASTM D 5685, fittings matching pipe; and adhesive-bonding materials.

2.3 JOINING MATERIALS

- A. Couplings: Assemblies with combination of clamps, gaskets, sleeves, and threaded or flanged parts; compatible with piping and system liquid; made by piping manufacturer for joining system piping.
- B. Adapters and Transition Fittings: Assemblies with combination of clamps, couplings, adapters, gaskets, and threaded or flanged parts; compatible with piping and system liquid; made for joining different piping materials.
- C. High-Silicon-Iron Piping: Manufacturer's acid-resistant packing and lead.
- D. Stainless-Steel Piping: Manufacturer's fluoroelastomer rubber gaskets.
- E. Glass Piping Joints: Manufacturer's gaskets, couplings, flanges, bolts and nuts, and adapters.
- F. RTRP Piping Joints: Manufacturer's bonding adhesive.
- G. Double-Contained Piping Joints: Manufacturer's materials for joining carrier piping and secondary-containment piping.
- H. Secondary-Containment Piping Joints: Manufacturer's fastening devices and materials.

2.4 SPECIALTY FITTINGS

- A. High-Silicon-Iron Floor Drains: ASTM A 861, 8-3/4-inch top diameter, with integral flashing flange and weep holes. Include grate and bottom outlet to match connecting pipe.
- B. High-Silicon-Iron Cleanouts: ASTM A 861 fitting; with PTFE gasket and high-silicon-iron closure plug; of design appropriate for piping application.
- C. High-Silicon-Iron Backwater Valves: ASTM A 861, bell-and-spigot, swing-check type. Include high-silicon-iron pipe extension of length to reach floor surface, and high-silicon- iron closure plug.

2.5 DOUBLE-CONTAINED PIPING

- A. Description: Factory-assembled, double-wall-contained piping assembly of carrier piping of size indicated. Include inner carrier pipe and fittings; annular-space, carrier-pipe supports; outer secondary-containment pipe and fittings; and joining materials and fasteners. Include manufacturer's standard piping materials according to the following:
 - 1. Option: Double-contained piping for gravity-flow drainage may be fabricated from drainage pipe and fittings.
 - 2. PE/PE Double-Contained Piping: PE pressure-piping, carrier piping with PE pressure-piping, secondary-containment piping.

3. PP/PP Double-Contained Piping: PP pressure-piping, carrier piping with PP pressure-piping, secondary-containment piping.
4. PP/PVC Double-Contained Piping: PP pressure-piping carrier piping with PVC secondary-containment piping.
5. PVDF/PVDF Double-Contained Piping: PVDF pressure-piping, carrier piping with PVDF pressure-piping, secondary-containment piping.
6. PVDF/PVC Double-Contained Piping: PVDF pressure-piping, carrier piping with PVC secondary-containment piping.
7. RTRP/RTRP Double-Contained Piping: RTRP pressure-piping, carrier piping with RTRP pressure-piping, secondary-containment piping.

2.6 SECONDARY-CONTAINMENT PIPING

- A. Description: Secondary-containment pipe and split fittings with FPM gaskets, clamp and pin fastening devices, and carrier pipe centralizers.

1. Material: HDPE pipe and fittings.
2. Material: PP pipe and fittings.
3. Material: Yellow, PVC pipe and fittings.
4. Material: Clear, PVC pipe and fittings.
5. Material: Clear, PVC pipe and fittings with adhesive channels, instead of gaskets and clamps, for use with drainage-pattern carrier piping.
6. Material: Clear, PVC split pipe with adhesive channels and split fittings with clips and adhesive channels, instead of gaskets and clamps, for use with drainage-pattern carrier pipe fittings.

2.7 NEUTRALIZATION TANKS

- A. Neutralization Tanks: Corrosion-resistant, cast-ceramic shell. Include removable, reinforced-plastic, gastight cover; inlet; interior, sidewall, dip-tube outlet; vent; and bell, sidewall pipe connections.

1. Extension: Ceramic, of size and length indicated, and with cast-iron manhole frame and cover.
2. Extension: Steel with protective coating, 28-inch diameter, and cast-iron manhole frame and cover.
3. Limestone: Chips or lumps, with calcium-carbonate content more than 90 percent, and 1- to 3-inch diameter.
4. Dolomitic Limestone: Chips or lumps, with combined magnesium- and calcium-carbonate content more than 90 percent, and 1- to 3-inch diameter.

- B. Collection Tanks: Corrosion-resistant, cast-ceramic shell. Include removable, reinforced-plastic, gastight cover; inlet; vent; and bell, sidewall pipe connections.

1. Extension: Ceramic, of size and length indicated, and with cast-iron manhole frame and cover.
2. Extension: Steel with protective coating, 28-inch diameter, and cast-iron manhole frame and cover.

2.8 MANHOLES

- A. General: Fabricate manholes from PE components. Include bottom, sidewalls, top section, manhole frame and cover, fusion or other watertight joints, and the following:
1. Construction: Single wall.
 2. Construction: Double wall with interstitial space.
 3. Bottom: Channeled.
 4. Connections: Inlets and outlet matching or suitable for piping.
 5. Steps: Manufacturer's standard, fusion welded to sidewall. Omit steps for manholes less than 60 inches deep.
 6. Top: Include 24-inch nominal diameter frame and cover.

2.9 LEAK-DETECTION SYSTEMS

- A. Description: Leak-detection and monitoring system, with controls, wiring, probes, and sensors, and piping capable of detecting and annunciating fluid leaks.
- B. Annunciator Panel: Enclosure with visual and audible alarms.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 IDENTIFICATION

- A. Materials and their installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground structures.
1. Use warning tape or detectable warning tape over ferrous piping.
 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.3 PIPING APPLICATIONS

- A. Refer to Part 2 of this Section for detailed specifications for pipe and fitting products listed below. Use pipe, fittings, and joining methods according to applications indicated.
- B. Gravity-Flow Piping: Use the following:
1. NPS 2 to NPS 4: High-silicon-iron piping with bell-and-spigot ends and calked joints.
 2. NPS 2 to NPS 4: Stainless-steel drainage pipe and fittings, gaskets, and

- gasketed joints.
 - 3. NPS 1-1/2 to NPS 4: Glass piping, couplings, and coupled joints.
 - 4. NPS 1-1/2 to NPS 4: PE drainage piping and heat-fusion joints.
 - 5. NPS 1-1/2 to NPS 4: PP drainage piping and electrofusion joints.
 - 6. NPS 1-1/2 to NPS 4: PVDF drainage piping and electrofusion joints.
 - 7. NPS 1-1/2 to NPS 4: RTRP pressure pipe and RTRP pressure fittings, and bonded joints.
 - 8. NPS 6: High-silicon-iron piping with bell-and- spigot ends and calked joints.
 - 9. NPS 6: Stainless-steel drainage pipe and fittings, gaskets, and gasketed joints.
 - 10. NPS 6: Glass piping, couplings, and coupled joints.
 - 11. NPS 6: PE drainage piping and heat-fusion joints.
 - 12. NPS 6: PP drainage piping and electrofusion joints.
 - 13. NPS 6: PVDF drainage piping and electrofusion joints.
 - 14. NPS 6: RTRP pressure pipe and RTRP pressure fittings, and bonded joints.
 - 15. NPS 8 to NPS 15: High-silicon-iron piping with bell-and-spigot ends and calked joints.
 - 16. NPS 8 to NPS 15: RTRP sewer pipe and RTRP nonpressure fittings, and bonded joints.
- C. Force-Main, Double-Contained Piping: Drainage pipe and fittings are prohibited for this application. Use the following:
- 1. NPS 2 to NPS 8: PE/PE double-contained piping.
 - 2. NPS 2 to NPS 8: PP/PP double-contained piping.
 - 3. NPS 2 to NPS 8: PP/PVC double-contained piping.
 - 4. NPS 2 to NPS 8: PVDF/PVDF double-contained piping.
 - 5. NPS 2 to NPS 8: PVDF/PVC double-contained piping.
 - 6. NPS 2 to NPS 8: RTRP/RTRP double-contained piping.
- D. Gravity-Flow, Double-Contained Piping: Use the following:
- 1. NPS 2 to NPS 12: PE/PE double-contained piping.
 - 2. NPS 2 to NPS 12: PP/PP double-contained piping.
 - 3. NPS 2 to NPS 12: PP/PVC double-contained piping.
 - 4. NPS 2 to NPS 12: PVDF/PVDF double-contained piping.
 - 5. NPS 2 to NPS 12: PVDF/PVC double-contained piping.
 - 6. NPS 2 to NPS 12: RTRP/RTRP double-contained piping.
- ### 3.4 INSTALLATION, GENERAL
- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground process material sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.

- C. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.
- D. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. Install gravity-flow piping and connect to building's chemical-waste drains, of sizes and in locations indicated. Terminate piping as indicated.
 - 1. Install piping pitched down in direction of flow, at minimum slope of 2 percent, unless otherwise indicated.
 - 2. Install piping with 36-inch minimum cover.
- F. Install force-main piping between and connect to building's chemical-waste force main and termination point indicated.
 - 1. Install piping with restrained joints at horizontal and vertical changes in direction. Use cast-in-place concrete supports and anchors or corrosion-resistant rods and clamps.
 - 2. Install piping with 36-inch minimum cover.
- G. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

3.5 PIPE JOINT CONSTRUCTION AND INSTALLATION

- A. General: Join and install pipe and fittings according to installations indicated.
- B. Where specific joint construction or method of installation is not indicated, follow piping manufacturer's written instructions.
- C. Plastic-Piping, Electrofusion Joints: Make polyolefin drainage-piping joints according to ASTM F 1290.
- D. Install RTRP sewer piping according to ASTM D 2321.
- E. Install RTRP pressure piping according to ASTM D 3839.
- F. Joint Material for Dissimilar Pipe: Adapters compatible with pipe materials being joined.

3.6 SPECIALTY FITTINGS INSTALLATION

- A. Install floor drains in locations indicated.
 - 1. Embed drains in 4-inch minimum depth of concrete around bottom and sides.
 - 2. Fasten grates to drains if indicated.
 - 3. Set drains with tops flush with pavement surface.
- B. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use iron

pipe fittings in sewer pipes at branches for cleanouts and iron pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in pipe.

1. Set cleanout bodies in earth in cast-in-place concrete block, 18 inches by 18 inches by 12 inches deep. Set with tops 1 inch above surrounding grade. Set cleanout plugs in concrete pavement with tops flush with pavement surface.
- C. Install backwater valves in horizontal position where indicated.

3.7 TANK INSTALLATION

- A. Install holding tanks according to manufacturer's written instructions.
- B. Install neutralization tanks according to manufacturer's written instructions. Include initial fill of limestone.

3.8 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.

3.9 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318 and ACI 350R, and Section 033000 "Cast-In-Place Concrete".

3.10 CONNECTIONS

- A. Make connections to existing piping so finished Work complies as nearly as practical with requirements specified for new Work.
- B. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
- C. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye with not less than 6 inches of concrete with 28- day compressive strength of 3000 psi.
- D. Protect existing piping to prevent concrete or debris from entering while making connections. Remove debris or other extraneous material that may accumulate.
- E. Ground leak-detection system components.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
2. Arrange for electric-power connections to components and devices that require power. Electric power, wiring, and disconnect switches are specified in Division 26 Sections.

3.11 LEAK-DETECTION SYSTEM INSTALLATION

- A. General: Install according to manufacturer's written instructions.
- B. Gravity-Flow Piping: Install monitoring system below piping.
- C. Double-Contained Piping: Install monitoring system in piping interstitial space.
- D. Double-Contained Piping: Install monitoring system below piping.
- E. Manholes: Install monitoring system in interstitial space.
- F. Manholes: Around bottom of exterior.
- G. Panel: Install monitoring system in location indicated.

3.12 FIELD QUALITY CONTROL

- A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.
 1. Place plug in end of incomplete piping at end of day and when work stops.
 2. Flush piping to remove collected debris, if required by authorities having jurisdiction.
- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 1. Submit separate reports for each system inspection.
 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between inspection points.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.

4. Reinspect and repeat procedure until results are satisfactory.
- C. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
1. Do not enclose, cover, or put into service before inspection and approval.
 2. Test completed piping systems according to authorities having jurisdiction.
 3. Schedule tests, and their inspections by authorities having jurisdiction, with at least seven (7) days advance notice.
 4. Submit separate reports for each test.
 5. If authorities having jurisdiction do not have published procedures, perform tests as follows:
 - a. Gravity-Flow Piping: Perform hydrostatic test.
 - 1) Allowable leakage is maximum of 50 gal. per inch of nominal pipe size per mile of pipe, during 24-hour period.
 - 2) Close openings in system and fill with water.
 - 3) Purge air and refill with water.
 - 4) Disconnect water supply.
 - 5) Test and inspect joints for leaks.
 - b. Gravity-Flow Piping: Perform air test according to UNI-B-6.
 - c. Force Main: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than one and one-half times maximum system operating pressure, but not less than 100 psig.
 6. Leaks and loss in test pressure constitute defects that must be repaired.
 7. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.13 DEMONSTRATION

- A. Engage a factory-authorized service representative to assist Contractor and train Owner's maintenance personnel to adjust, operate, and maintain the process material sewerage systems. Refer to Section 017900 "Demonstration and Training."

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this section. The cost of the work described in this section shall be included in the lump sum contract price.

END OF SECTION 221314

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.
 - 3. Encasement for underground metal piping.
- B. Related Sections:
 - 1. Section 221313 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.
 - 2. Section 221329 "Sanitary Sewerage Pumps" for effluent and sewage pumps.
 - 3. Section 226600 "Chemical-Waste Systems for Laboratory and Healthcare Facilities" for chemical-waste and vent piping systems.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: [10-foot head of water (30 kPa)] <Insert pressure>.
 - 2. Waste, Force-Main Piping: [50 psig (345 kPa)] [100 psig (690 kPa)] [150 psig (1035 kPa)] <Insert pressure>.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7] <Insert requirement>.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1. Indicate valve data and ratings.
2. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: For solvent drainage system. Include plans, elevations, sections, and details.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

C. Welders Certificate: Include welder's certification of compliance with **[ASME SEC 9]** **[AWS D1.1.]** **[Insert standard]** and Section 059990 "Welding".

D. Contractor shall submit fully dimensioned spool drawings for all welded piping work. Drawings shall indicate all weld types, sizes, and materials to be used. Provide drawings in electronic format in compliance with Division 01 requirements and currently accepted by DEN.

1.6 CLOSEOUT SUBMITTALS

A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.7 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.
- C. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- D. Welders Certification: In accordance with ASME Sec 9.
- E. Unless specified otherwise, all materials and equipment shall be of domestic (USA) manufacture and shall be of the best quality used for the purpose in commercial practice.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify DEN Project Manager no fewer than seven (7) days in advance of proposed interruption of sanitary waste service.
 - 2. Do not proceed with interruption of sanitary waste service without DEN Project Manager's written permission.

1.9 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with City and County of Denver plumbing code.
- B. Conform to code for installation of backflow prevention devices.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products under provisions of Section 220400 "Basic Plumbing Requirements" and Division 01 requirements.
- B. Inspect materials for damage after delivery.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.12 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, [**Service**] [**and**] [**Extra Heavy**] class(es).
- B. Gaskets: ASTM C 564, [**neoprene**] rubber.
- C. Caulking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
- C. CISPI, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Dallas Specialty & Mfg. Co.
 - c. Fernco Inc.
 - d. Matco-Norca, Inc.
 - e. MIFAB, Inc.
 - f. Mission Rubber Company; a division of MCP Industries, Inc.
 - g. Stant.
 - h. Tyler Pipe.
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
 - 2. Standards: ASTM C 1277 and CISPI 310.

3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Clamp-All Corp.
 - c. Dallas Specialty & Mfg. Co.
 - d. MIFAB, Inc.
 - e. Mission Rubber Company; a division of MCP Industries, Inc.
 - f. Stant.
 - g. Tyler Pipe.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.
2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

E. Cast-Iron, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MG Piping Products Company.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.
2. Standard: ASTM C 1277.
3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

- A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight class. Include square-cut-grooved or threaded ends matching joining method.
- B. **[Galvanized-]**Cast-Iron Drainage Fittings:
 1. ASME B16.12, threaded.
 2. ASME B16.1
 3. ASME B16.4, screwed.
- C. Steel Pipe Pressure Fittings:

1. **[Galvanized-]**Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Schedule 40, seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
3. **[Galvanized-]**Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.

D. Cast-Iron Flanges: ASME B16.1, Class 125.

1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, **1/8-inch** (3.2-mm) maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

E. Grooved-Joint, Galvanized-Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International; a subsidiary of Mueller Water Products, Inc.
 - b. Grinnell Mechanical Products.
 - c. Shurjoint Piping Products.
 - d. Victaulic Company.
 - e. **<Insert manufacturer's name>**.
 - f. or approved equal.
2. Galvanized, Grooved-End Fittings for Galvanized-Steel Piping: ASTM A 536 ductile-iron castings, ASTM A 47/A 47M malleable-iron castings, ASTM A 234/A 234M forged steel fittings, or ASTM A 106/A 106M steel pipes with dimensions matching ASTM A 53/A 53M steel pipe, and complying with AWWA C606 for grooved ends.
3. Grooved Mechanical Couplings for Galvanized-Steel Piping: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber gasket suitable for hot and cold water; and bolts and nuts.

2.5 DUCTILE-IRON PIPE AND FITTINGS

A. Ductile-Iron, Mechanical-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, mechanical-joint, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Ductile-Iron, Push-on-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, push-on-joint ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Gaskets: AWWA C111/A21.11, rubber.

C. Ductile-Iron, Grooved-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51 with round-cut-grooved ends according to AWWA C606.
2. Ductile-Iron-Pipe Appurtenances:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Anvil International.
 - 2) Shurjoint Piping Products.
 - 3) Star Pipe Products.
 - 4) Victaulic Company.
 - 5) **<Insert manufacturer's name>**.
 - 6) or approved equal.
 - b. Grooved-End, Ductile-Iron Fittings: ASTM A 536 ductile-iron castings with dimensions matching AWWA C110/A 21.10 ductile-iron pipe or AWWA C153/A 21.53 ductile-iron fittings and complying with AWWA C606 for grooved ends.
 - c. Grooved Mechanical Couplings for Ductile-Iron Pipe: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber center-leg gasket suitable for hot and cold water; and bolts and nuts.

2.6 ABS PIPE AND FITTINGS

- A. Solid-Wall ABS Pipe: ASTM D2661, Schedule 40.
- B. Cellular-Core, ABS Pipe: ASTM F628, Schedule 40.
- C. ABS Socket Fittings: ASTM D2661, made to ASTM D3311, drain, waste, and vent patterns.
- D. ABS Special Fittings: ASTM F409, drainage-pattern tube and tubular fittings with ends as required for application.
- E. Solvent Cement: ASTM D 2235.
 1. ABS solvent cement shall have a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of

Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.7 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D2665, **[plenum-rated,]** drain, waste, and vent.
- B. Cellular-Core, PVC Pipe: ASTM F891, Schedule 40, **[plenum-rated]**.
- C. Cellular-Core, Sewer and Drain Series, PVC Pipe: ASTM F891, Series PS 100, plenum-rated.
- D. PVC Socket Fittings: ASTM D2665, made to ASTM D3311, **[plenum-rated,]** drain, waste, and vent patterns and to fit Series PS 100 sewer and drain pipe.
- E. PVC Special Fittings: ASTM F409, **[plenum-rated,]** drainage-pattern tube and tubular fittings with ends as required for application.
- F. PVC Pipe: ASTM D 3033 or D 3034, SDR 35.
 - 1. Fittings: PVC.
 - 2. Joints: ASTM F 477, elastomeric gaskets.
- G. PVC Pipe: Cellular-core, Schedule 40
 - 1. Fittings: PVC socket fittings
 - 2. Joints: solvent-cemented joints.
- H. Adhesive Primer: ASTM F 656.
 - 1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- I. Solvent Cement: ASTM D 2564.
 - 1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.8 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Mission Rubber Company; a division of MCP Industries, Inc.
 - 4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - 5) **<Insert manufacturer's name>**.
 - 6) or approved equal.
 - b. Standard: ASTM C 1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company; a division of MCP Industries, Inc.
 - 3) **<Insert manufacturer's name>**.
 - 4) or approved equal.
 - b. Standard: ASTM C 1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
5. Pressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cascade Waterworks Mfg. Co.

- 2) Dresser, Inc.
- 3) EBAA Iron, Inc.
- 4) JCM Industries, Inc.
- 5) Romac Industries, Inc.
- 6) Smith-Blair, Inc.; a Sensus company.
- 7) The Ford Meter Box Company, Inc.
- 8) Viking Johnson.
- 9) **<Insert manufacturer's name>**.
- 10) or approved equal.

- b. Standard: AWWA C219.
- c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
- d. Center-Sleeve Material: **[Manufacturer's standard] [Carbon steel] [Stainless steel] [Ductile iron] [Malleable iron]**.
- e. Gasket Material: Natural or synthetic rubber.
- f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Capitol Manufacturing Company.
 - 2) Central Plastics Company.
 - 3) Hart Industries International, Inc.
 - 4) Jomar International Ltd.
 - 5) Matco-Norca, Inc.
 - 6) McDonald, A. Y. Mfg. Co.
 - 7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 8) Wilkins; a Zurn company.
 - 9) **<Insert manufacturer's name>**.
 - 10) or approved equal.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: **[125 psig (860 kPa) minimum at 180 deg F (82 deg C)] [150 psig (1035 kPa)] [250 psig (1725 kPa)]**.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
3. Dielectric Flanges:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Capitol Manufacturing Company.
- 2) Central Plastics Company.
- 3) Matco-Norca, Inc.
- 4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 5) Wilkins; a Zurn company.
- 6) **<Insert manufacturer's name>**.
- 7) or approved equal.

b. Description:

- 1) Standard: ASSE 1079.
- 2) Factory-fabricated, bolted, companion-flange assembly.
- 3) Pressure Rating: [125 psig (860 kPa) **minimum at 180 deg F** (82 deg C)] [150 psig (1035 kPa)] [175 psig (1200 kPa)] [300 psig (2070 kPa)].
- 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Advance Products & Systems, Inc.
- 2) Calpico, Inc.
- 3) Central Plastics Company.
- 4) Pipeline Seal and Insulator, Inc.
- 5) **<Insert manufacturer's name>**.
- 6) or approved equal.

b. Description:

- 1) Nonconducting materials for field assembly of companion flanges.
- 2) Pressure Rating: [150 psig (1035 kPa)] **<Insert pressure>**.
- 3) Gasket: Neoprene or phenolic.
- 4) Bolt Sleeves: Phenolic or polyethylene.
- 5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Elster Perfection.
- 2) Grinnell Mechanical Products.
- 3) Matco-Norca, Inc.
- 4) Precision Plumbing Products, Inc.
- 5) Victaulic Company.
- 6) **<Insert manufacturer's name>**.
- 7) or approved equal.

b. Description:

- 1) Standard: IAPMO PS 66
- 2) Electroplated steel nipple.
- 3) Pressure Rating: [300 psig (2070 kPa) at 225 deg F (107 deg C)]
<Insert pressure and temperature>.
- 4) End Connections: Male threaded or grooved.
- 5) Lining: Inert and noncorrosive, propylene.

2.9 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A 674 or AWWA C105/A 21.5.
- B. Material: [Linear low-density polyethylene film of 0.008-inch (0.20-mm)] [or] [high-density, cross-laminated polyethylene film of 0.004-inch (0.10-mm)] minimum thickness.
- C. Form: [Sheet] [or] [tube].
- D. Color: [Black] [or] [natural] <Insert color>.

2.10 INSULATING JOINTS

- A. Except as otherwise specifically indicated, insulating joint assemblies shall be provided at all riser locations where buried metallic piping transitions to aboveground extensions. Assemblies shall consist of dielectric fittings or insulating flange assemblies as appropriate for the application.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. LineBacker Type "E", Pipeline Seal and Insulator, Inc.
 - b. <Insert manufacturer's name>.
 - c. or approved equal.
- B. Insulating flange assemblies shall conform to the following requirements:
 1. Flanged joints shall include full face insulating gaskets, insulating bolt sleeves and double quantity of insulating washers and stainless steel washers.
 2. Insulating materials shall be as follows:
 - a. Gasket: NEMA Grade G10 retainer conforming to ASTM D 229 with Teflon ring seal on each side of the retainer. Minimum dielectric strength shall be 500 volts per mil (VPM). Compressive strength shall be 50,000 psi. Water absorption shall be 0.05 percent (max.)
 - b. Sleeves: Shall be 1/32-inch wall thickness, length to suit two class 150 lb. weld neck flanges, insulating gaskets and valve body thickness. Sleeve shall provide "full" insulation of studs; minimum dielectric strength shall be 500 VPM. Material shall be NEMA Grade G10.

- c. Insulating washers: NEMA Grade G10, 1/8-inch thick (minimum).
- C. Install insulating joints at the locations indicated on the drawings. Where not shown on the drawings, they shall be installed within 24 inches of the location at which underground piping transitions to aboveground or within-structure extension.
- D. Insulating assemblies shall provide a minimum resistance of 500,000 ohms when tested in

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.3 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.4 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Provide dielectric fittings wherever jointing dissimilar metals.
- C. Install piping to conserve building space and not interfere with use of space. Refer to Section 220400 "Basic Plumbing Requirements" for coordination requirements.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Provide clearance for installation of insulation and access to valves and fittings.

- G. Establish elevations of buried water piping outside the building at depth of not less than 12 inches below average local frost depth or as required under applicable codes.
- H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- I. Install a cleanout in the vertical riser (vent to drain transition) above the connection to each urinal to allow for individual cleaning of each fixture drain.
- J. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- K. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- M. Install piping to permit valve servicing.
- N. Install piping at indicated slopes.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install piping to allow application of insulation.
- R. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- S. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- T. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- U. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping **NPS 3** (DN 80) and smaller; **[1 percent] [2 percent] <Insert slope>** downward in direction of flow for piping **NPS 4** (DN 100) and larger.
 2. Horizontal Sanitary Drainage Piping: **[2 percent] <Insert slope>** downward in direction of flow.
 3. Vent Piping: **[1 percent] <Insert slope>** down toward vertical fixture vent or toward vent stack.
- V. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
- W. Install steel piping according to applicable plumbing code.
- X. Install aboveground ABS piping according to ASTM D 2661.
- Y. Install aboveground PVC piping according to ASTM D 2665.
- Z. Install underground **[ABS] [and] [PVC]** piping according to ASTM D 2321.
- AA. Install engineered soil and waste drainage and vent piping systems as follows:
1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 2. Solvent Drainage System: Comply with ASSE 1043 and solvent fitting manufacturer's written installation instructions.
 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- BB. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.
 2. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.
- CC. Install force mains at elevations indicated.
- DD. Plumbing Specialties:
1. Install backwater valves in sanitary waster gravity-flow piping. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."

3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

EE. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

FF. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

GG. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

HH. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.5 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hub-and-spigot, cast-iron soil piping with caulked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum caulked joints.

C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

F. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

G. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.6 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Drainage Piping: [**Unshielded**] [**Shielded**], nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:
 - a. **NPS 1-1/2** (DN 40) and Smaller: Fitting-type transition couplings.
 - b. **NPS 2** (DN 50) and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for [**NPS 2** (DN 50)] <Insert pipe size> and Smaller: Use dielectric [**nipples**] [**unions**].
3. Dielectric Fittings for [**NPS 2-1/2 to NPS 4** (DN 65 to DN 100)] <Insert pipe size range>: Use dielectric [**flanges**] [**flange kits**] [**nipples**].
4. Dielectric Fittings for [**NPS 5** (DN 125)] <Insert pipe size> and Larger: Use dielectric flange kits.

3.7 VALVE INSTALLATION

A. General valve installation requirements are specified in Section 220523 "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.
2. Install gate or full-port ball valve for piping **NPS 2** (DN 50) and smaller.
3. Install gate valve for piping **NPS 2-1/2** (DN 65) and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. [**Use normally closed type unless otherwise indicated.**]
2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.

4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.8 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 1. Install [**carbon-steel**] <Insert material> pipe hangers for horizontal piping in noncorrosive environments.
 2. Install [**stainless-steel**] [**fiberglass**] pipe hangers for horizontal piping in corrosive environments.
 3. Install [**carbon-steel**] <Insert material> pipe support clamps for vertical piping in noncorrosive environments.
 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
 6. Install individual, straight, horizontal piping runs:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
 7. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting[, valve,] and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
 3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.

4. NPS 6 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
 5. NPS 10 and NPS 12 (DN 250 and DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
 6. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).
- G. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 5. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 7. NPS 6 and NPS 8 (DN 150 and DN 200): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
 8. NPS 10 and NPS 12 (DN 250 and DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
- I. Install supports for vertical steel piping every 15 feet (4.5 m).
- J. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 2 (DN 50): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 2. NPS 3 (DN 80): 96 inches (2400 mm) with 1/2-inch (13-mm) rod.
 3. NPS 4 (DN 100): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
 4. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
- K. Install supports for vertical stainless-steel piping every 10 feet (3 m).
- L. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
 4. NPS 3 and NPS 5 (DN 80 and DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
 5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
 6. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
- M. Install supports for vertical copper tubing every 10 feet (3 m).
- N. Install hangers for [ABS] [and] [PVC] piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 4. NPS 6 and NPS 8 (DN 150 and DN 200): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 5. NPS 10 and NPS 12 (DN 250 and DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
- O. Install supports for vertical [**ABS**] [**and**] [**PVC**] piping every 48 inches (1200 mm).
- P. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.9 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Provide new services to the extent indicated on the drawings. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- C. Provide new water service complete with [reduced pressure backflow preventer and] water meter with by-pass valves [and sand strainer]. [Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Caulk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.]
- D. Provide 18 gage galvanized sheet metal sleeve around service main to 6 inch above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.
- E. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- F. Connect drainage and vent piping to the following:
1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 5. Install horizontal backwater valves [**with cleanout cover flush with floor**] [**in pit with pit cover flush with floor**] <Insert description>.

6. Comply with requirements for **[backwater valves] [cleanouts] [and] [drains]** specified in Section 221319 "Sanitary Waste Piping Specialties."
 7. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections **NPS 2-1/2 (DN 65)** and larger.
- G. Connect force-main piping to the following:
1. Sanitary Sewer: To exterior force main.
 2. Sewage Pump: To sewage pump discharge.
- H. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- I. Make connections according to the following unless otherwise indicated:
1. Install unions, in piping **NPS 2 (DN 50)** and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping **NPS 2-1/2 (DN 65)** and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.10 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.11 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

3.12 TESTING

- A. Perform all tests in the presence of the authorized City representative when required. Contractor shall provide inspector minimum 48-hour prior notice of test; also notify

DEN Project Manager.

- B. Test soil, waste, and vent and roof drainage and drain systems with a minimum of 10 foot hydrostatic head or in accordance with local and state codes governing plumbing and drainage work.
- C. No piping or joint shall be left untested. All leaks shall be repaired and the piping system shall be re-tested until satisfactory results are obtained.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 6. Prepare reports for tests and required corrective action.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 2. Cap and subject piping to static-water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 4. Prepare reports for tests and required corrective action.
- F. Pneumatic Leak Test:

1. General: Pneumatic leak tests shall only be used on piping with restricted access, piping exposed to freezing conditions, or where water leakage would damage critical DEN operational equipment. Contractor shall submit a written request for test in accordance with the Submittals paragraph of this specification Section.
2. Pneumatic Test Procedure:
 - a. Contractor shall submit safety plan for pneumatic testing prior to test.
 - b. General: Compressed gas poses the risk of sudden release of stored energy. For that reason, pneumatic testing shall be used only within the following limitations.
 - 1) The piping system does not contain cast iron pipe or plastic pipe subject to brittle failure.
 - 2) The system does not contain soldered or solvent cement joints over NPS 2.
 - 3) The test pressure does not exceed 150 psig.
 - c. Test Medium: The gas shall be nonflammable and nontoxic.
 - d. Preliminary Test: Prior to application of full pneumatic test pressure, a preliminary test of not more than 10 psig shall be applied to reveal possible major leaks.
 - e. Pneumatic Test Pressure:
 - 1) Except as limited in subparagraph 2 below, the test pressure shall not exceed 1.25 times the design pressure. Pressure shall be applied in several stages, allowing time for the system to reach equilibrium at each stage.
 - 2) The test pressure shall not exceed the maximum allowable pneumatic test pressure for any vessel, pump, valve, or other component in the system under test.
 - f. Examination for Leakage: After the preliminary test, pressure shall be raised in stages of not more than 25% up to full pneumatic test pressure, allowing time for equalization of strains and detection of major leaks at each stage. Following the application of test pressure for at least 10 minutes, the pressure may be reduced to design pressure and examination shall be made for leakage of the piping. Leaks may be detected by soap bubble, halogen gas, scented gas, test gage monitoring, ultrasonic, or other suitable means. If leaks are found, pressure shall be vented, appropriate repair or replacement shall be made, and the pneumatic test repeated until no leakage is found.
 - g. Contractor shall measure the surface temperature of the pipe for the duration of testing. The pneumatic test will be deemed successful only when the test pressure can be held at a constant pipe surface temperature for a period of no less than 10 continuous minutes. Record of the pipe temperatures and pressures during the duration of the test shall be submitted to the DEN Project Manager following completion of the test.

G. Repair piping systems which fail required piping test, by disassembly and

reinstallation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

- H. Drain test water from piping systems after testing and repair work that has been completed.
- I. Prepare written report of testing procedures and result and submit to DEN Project Manager.

3.13 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed **[ABS] [and] [PVC]** Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.14 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping **[NPS 4 (DN 100) and smaller]** <Insert pipe size range> shall be **[any of]** the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings **[and solvent stack fittings]; [CISPI] [heavy-duty]** hubless-piping couplings; and coupled joints.
 - 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
 - 4. **[Solid-wall] [Cellular-core]** PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 5. Dissimilar Pipe-Material Couplings: **[Unshielded] [Shielded]**, nonpressure transition couplings.
- C. Aboveground, soil and waste piping **[NPS 5 (DN 125) and larger]** <Insert pipe size range> shall be **[any of]** the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings **[and solvent stack fittings]; [CISPI] [heavy-duty]** hubless-piping couplings; and coupled joints.
 - 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
 - 4. Stainless-steel pipe and fittings, sealing rings, and gasketed joints.
 - 5. **[Solid-wall] [Cellular-core]** PVC pipe, PVC socket fittings, and solvent-cemented joints.

6. Dissimilar Pipe-Material Couplings: **[Unshielded]** **[Shielded]**, nonpressure transition couplings.
- D. Aboveground, vent piping **[NPS 4 (DN 100) and smaller]** **<Insert pipe size range>** shall be **[any of]** the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; **[CISPI]** **[heavy-duty]** hubless-piping couplings; and coupled joints.
 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
 - a. Option for Vent Piping, **NPS 2-1/2 and NPS 3-1/2** (DN 65 and DN 90): Hard copper tube, **Type M** (Type C); copper pressure fittings; and soldered joints.
 4. **[Solid-wall]** **[Cellular-core]** ABS pipe, ABS socket fittings, and solvent-cemented joints.
 5. **[Solid-wall]** **[Cellular-core]** PVC pipe, PVC socket fittings, and solvent-cemented joints.
 6. Dissimilar Pipe-Material Couplings: **[Unshielded]** **[Shielded]**, nonpressure transition couplings.
- E. Aboveground, vent piping **[NPS 5 (DN 125) and larger]** **<Insert pipe size range>** shall be **[any of]** the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; **[CISPI]** **[heavy-duty]** hubless-piping couplings; and coupled joints.
 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
 4. **[Solid-wall]** **[Cellular-core]** PVC pipe, PVC socket fittings, and solvent-cemented joints.
 5. Dissimilar Pipe-Material Couplings: **[Unshielded]** **[Shielded]**, nonpressure transition couplings.
- F. Underground, soil, waste, and vent piping **[NPS 4 (DN 100) and smaller]** **<Insert pipe size range>** shall be **[any of]** the following:
1. **[Solid wall]** **[Cellular-core]** ABS pipe, ABS socket fittings, and solvent-cemented joints.
 2. **[Solid wall]** **[Cellular-core]** PVC pipe, PVC socket fittings, and solvent-cemented joints.
 3. Dissimilar Pipe-Material Couplings: **[Unshielded]** **[Shielded]**, nonpressure transition couplings.
- G. Underground, soil and waste piping **[NPS 5 (DN 125) and larger]** **<Insert pipe size range>** shall be **[any of]** the following:
1. **[Solid-wall]** **[Cellular-core]** PVC pipe; PVC socket fittings; and solvent-cemented joints.
 2. Dissimilar Pipe-Material Couplings: **[Unshielded]** **[Shielded]**, nonpressure transition couplings.

- H. Aboveground sanitary-sewage force mains [NPS 1-1/2 and NPS 2 (DN 40 and DN 50)] <Insert pipe size range> shall be[**any of**] the following:
1. Galvanized-steel pipe, pressure fittings, and threaded joints.
- I. Aboveground sanitary-sewage force mains [NPS 2-1/2 to NPS 6 (DN 65 to DN 150)] <Insert pipe size range> shall be[**any of**] the following:
1. Galvanized-steel pipe, pressure fittings, and threaded joints.
 2. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
- J. Underground sanitary-sewage force mains [NPS 4 (DN 100) and smaller] <Insert pipe size range> shall be[**any of**] the following:
1. [Hard] [Soft] copper tube, Type L (Type B); [wrought-]copper pressure fittings; and soldered joints.
 2. Ductile-iron, mechanical-joint piping and mechanical joints.
 3. Ductile-iron, push-on-joint piping and push-on joints.
 4. Ductile-iron, grooved-joint piping and grooved joints.
 5. Fitting-type transition coupling for piping smaller than NPS 1-1/2 (DN 40) and pressure transition coupling for NPS 1-1/2 (DN 40) and larger if dissimilar pipe materials.
- K. Underground sanitary-sewage force mains [NPS 5 (DN 125) and larger] <Insert pipe size range> shall be[**any of**] the following:
1. Hard copper tube, Type L (Type B); [wrought-]copper pressure fittings; and soldered joints.
 2. Ductile-iron, mechanical-joint piping and mechanical joints.
 3. Ductile-iron, push-on-joint piping and push-on joints.
 4. Ductile-iron, grooved-joint piping and grooved joints.
 5. Pressure transition couplings if dissimilar pipe materials.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Backwater valves.
2. Cleanouts.
3. Floor drains.
4. Trench drains.
5. Channel drainage systems.
6. Air-admittance valves.
7. Roof flashing assemblies.
8. Through-penetration firestop assemblies.
9. Miscellaneous sanitary drainage piping specialties.
10. Flashing materials.
11. FOG disposal systems.
12. Grease interceptors.
13. Grease removal devices.
14. Oil interceptors.
15. Solids interceptors.

- B. Related Requirements:

1. Section 221423 "Storm Drainage Piping Specialties" for storm drainage piping inside the building, drainage piping specialties, and drains.
2. Section 224300 "Medical Plumbing Fixtures" for plaster sink interceptors.
3. Section 334100 "Storm Utility Drainage Piping" for storm draining piping and piping specialties outside the building.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FOG: Fats, oils, and greases.

- C. FRP: Fiberglass-reinforced plastic.
- D. HDPE: High-density polyethylene plastic.
- E. PE: Polyethylene plastic.
- F. PP: Polypropylene plastic.
- G. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Provide component sizes, rough-in requirements, service sizes, and finishes (not required for drains and cleanouts). Include rated capacities, operating characteristics, and accessories for the following:
 - 1. FOG disposal systems.
 - 2. Grease interceptors.
 - 3. Grease removal devices.
 - 4. Oil interceptors.
 - 5. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For fabricated items, indicate dimensions, weights, and placement of openings and holes.
 - 1. Show fabrication and installation details for frost-resistant vent terminals.
 - 2. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer Seismic Qualification Certification: Submit certification that **[FOG disposal systems,] [grease interceptors,] [grease removal devices,] [oil interceptors,]** accessories, and components will withstand seismic forces defined in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Record actual locations of equipment, cleanouts, backflow preventers.
- B. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.
 1. Include installation instructions, spare parts lists, exploded assembly views.
 2. Indicate frequency of treatment required for interceptors.
- C. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.
- D. Manufacturers: For each product specified, provide components by same manufacturer throughout.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in [**Section 033000 "Cast-in-Place Concrete."**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete."**]
- B. Coordinate size and location of roof penetrations.

1.9 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Cultures: Provide 1-gal. (3.8-L) bottles of bacteria culture recommended by manufacturer of FOG disposal systems equal to [200] <Insert number> percent of amount installed, but no fewer than [2] <Insert number> 1-gal. (3.8-L) bottles.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES

- A. Horizontal, Cast-Iron Backwater Valves <Insert drawing designation if any>:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. <Insert manufacturer's name>.
 - h. or approved equal.
 2. Standard: ASME A112.14.1.
 3. Size: Same as connected piping.
 4. Body: Cast iron.
 5. Cover: Cast iron with [bolted] [or] [threaded] access check valve.
 6. End Connections: [Hub and spigot] [Hub and spigot or hubless] [Hubless].
 7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang [closed] [open for airflow unless subject to backflow condition].
 8. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.
- B. Drain-Outlet Backwater Valves <Insert drawing designation if any>:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
 - e. **<Insert manufacturer's name>**.
 - f. or approved equal.
2. Size: Same as floor drain outlet.
3. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
4. Check Valve: Removable ball float.
5. Inlet: Threaded.
6. Outlet: Threaded or spigot.

2.2 BACKFLOW PREVENTERS

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Febco.
 - b. Watts Regulator Company.
 - c. **<Insert manufacturer's name>**
 - d. or approved equal.
- B. General: ASSE standard, backflow preventers.
 1. NPS 2 and Smaller: Bronze body with threaded ends.
 2. NPS 2-1/2 and Larger: Bronze, cast-iron, steel, or stainless-steel body with flanged ends.
 - a. Interior Lining: AWWA C550 or FDA-approved, epoxy coating for backflow preventers having cast-iron or steel body.
 3. Interior Components: Corrosion-resistant materials.
 4. Exterior Finish: Polished chrome plate if used in chrome-plated piping system.
 5. Strainer: On inlet.
- C. Reduced Pressure Backflow Preventers: ASSE 1013 suitable for continuous pressure application. Construction shall be bronze body with bronze and plastic internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve which opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two outside screw and yoke non-rising stem gate valves on inlet and outlet, strainer on inlet, and four test cocks and pressure-differential relief valve with ASME A112.1.2 air-gap fitting located between two positive-seating check valves.

1. Pressure Loss: 12 psig (83 kPa) maximum, through middle 1/3 of flow range.

D. Double Check Valve Assemblies: ASSE 1012 suitable for continuous pressure application; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent. Include shutoff valves on inlet and outlet, and strainer on inlet; test cocks; and two positive-seating check valves.

1. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.

2.3 CLEANOUTS

A. Exposed Metal Cleanouts <Insert drawing designation if any>:

1. ASME A112.36.2M, Cast-Iron Cleanouts:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) [Josam Company.](#)
- 2) [MIFAB, Inc.](#)
- 3) [Smith, Jay R. Mfg. Co.](#)
- 4) [Tyler Pipe.](#)
- 5) [Watts Drainage Products.](#)
- 6) [Zurn Plumbing Products Group.](#)
- 7) <Insert manufacturer's name>.
- 8) or approved equal.

2. Standard: [ASME A112.36.2M for cast iron] <Insert standard> for cleanout test tee.

B. Metal Floor Cleanouts <Insert drawing designation if any>:

1. ASME A112.36.2M, Cast-Iron Cleanouts:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) [Josam Company.](#)
- 2) [Oatey.](#)
- 3) [Sioux Chief Manufacturing Co., Inc.](#)
- 4) [Smith, Jay R. Mfg. Co.](#)
- 5) [Tyler Pipe.](#)
- 6) [Watts Drainage Products.](#)
- 7) [Zurn Plumbing Products Group.](#)
- 8) <Insert manufacturer's name>.
- 9) or approved equal.

2. Exterior Surfaced Areas (CO-1): [Round] [Square] enameled cast iron access frame and nickel bronze non-skid cover.

3. Exterior Unsurfaced Areas (CO-2): Line type with lacquered cast iron body and round heavy-duty epoxy coated gasketed cover and bronze clean-out plug.
4. Interior Finished Floor Areas (CO-3): Lacquered cast iron, two-piece body with double drainage flange, weep holes, [**reversible clamping collar,**] and adjustable nickel-bronze strainer, round with scoriated cover in service areas and [**round**] [**square**] with depressed cover to accept floor finish in finished floor areas.
5. Interior Finished Wall Areas (CO-4): Line type with lacquered cast iron body and round epoxy coated gasketed cover, bronze clean-out plug, and round stainless steel access cover secured with machine screw.
6. Interior Unfinished Accessible Areas (CO-5): Calked or threaded type with bronze clean-out plug. Provide bolted stack cleanouts on vertical rainwater leaders.

2.4 FLOOR DRAINS

A. Cast-Iron Floor Drains <Insert drawing designation if any>:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. [Commercial Enameling Co.](#)
- b. [Josam Company](#); Josam Div.
- c. [MIFAB, Inc.](#)
- d. [Prier Products, Inc.](#)
- e. [Smith, Jay R. Mfg. Co.](#)
- f. [Tyler Pipe](#); Wade Div.
- g. [Watts Drainage Products](#).
- h. [Zurn Plumbing Products Group](#); [**Light Commercial Operation**] [**Specification Drainage Operation**].
- i. <Insert manufacturer's name>.
- j. or approved equal.

2. Standard: ASME A112.6.3[**with backwater valve**].

- B. FD-1: Lacquered cast iron two-piece body with double drainage flange, weep holes, [**reversible clamping collar,**] and round, adjustable nickel-bronze strainer.
- C. FD-2: Same as FD-1 except with removable perforated sediment bucket and square strainer.
- D. FD-3: Same as FD-1 except with polished bronze funnel [**or anti-splash rim**] type strainer.
- E. FD-4: Same as FD-1 except with extra heavy-duty strainers.
- F. FD-5: Same as FD-1 except with extra heavy-duty strainers with hinged grate and sediment bucket.

- G. FD-6: Lacquered cast iron two-piece body with drainage flange, heavy duty grate [6] [12] inches wide, [12] [24] inches long, dome strainer, end plates with gaskets.

2.5 TRENCH DRAINS

- A. Trench Drains <Insert drawing designation if any>:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. [Josam Company; Josam Div.](#)
- b. [MIFAB, Inc.](#)
- c. [Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.](#)
- d. [Tyler Pipe; Wade Div.](#)
- e. [Watts Drainage Products Inc.](#)
- f. [Zurn Plumbing Products Group; Specification Drainage Operation.](#)
- g. <Insert manufacturer's name>.
- h. or approved equal.

2. Standard: ASME A112.6.3 for trench drains.
3. Material: Ductile or gray iron.
4. Flange: [Anchor] [Seepage] [Not required].
5. Clamping Device: [Not required] [Required].
6. Outlet: [Bottom] [End] [Side] <Insert location>.
7. Grate Material: [Ductile iron] [Ductile iron or gray iron] [Gray iron] [Stainless steel] <Insert material>.
8. Grate Finish: [Painted] [Not required] <Insert finish>.
9. Dimensions of Frame and Grate: <Insert dimensions and describe body, sump, and grate if required.>
10. Top Loading Classification: [Extra Heavy-Duty] [Heavy Duty] [Light Duty] [Medium Duty] <Delete if not applicable>.
11. Trap Material: [Cast iron] [Stainless steel] [Not required] <Insert material>.
12. Trap Pattern: [Standard P-trap] [Not required] <Insert pattern>.

2.6 CHANNEL DRAINAGE SYSTEMS

- A. Stainless-Steel Channel Drainage Systems <Insert drawing designation if any>:

1. ASME A112.3.1, Stainless-Steel Channel Drainage Systems:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) [Josam Company.](#)
- 2) <Insert manufacturer's name>.
- 3) or approved equal.

2. Non-ASME A112.3.1, Stainless-Steel Channel Drainage Systems:

- a. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1) [MultiDrain Systems](#).
 - 2) [Zurn Plumbing Products Group](#).
 - 3) **<Insert manufacturer's name>**.
 - 4) or approved equal.

3. Type: Modular system of stainless-steel channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 - a. Standard: ASME A112.3.1, for trench drains.
 - b. Channel Sections: Interlocking-joint, stainless-steel with level invert.
 - 1) Dimensions: **[5.8 inches (147 mm)] [11.7 inches (297mm)]** wide. Include number of units required to form total lengths indicated.
 - c. Grates: Manufacturer's designation "**[heavy] [medium]** duty," with slots or perforations, and of width and thickness that fit recesses in channels.
 - 1) Material: **[Ductile iron] [Fiberglass] [Galvanized steel] [Gray iron] [Stainless steel] <Insert material>**.
 - 2) Locking Mechanism: **[Manufacturer's standard device for securing grates to channel sections] [Not required]**.
 - d. Covers: Solid **[ductile or gray iron] [stainless steel] <Insert material>**, of width and thickness that fit recesses in channels, and of lengths indicated.
 - e. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
 - f. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

4. Type: Modular system of stainless-steel channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 - a. Channel Sections: Interlocking-joint, stainless steel with level invert.
 - 1) Dimensions: **[6 inches (152 mm)] [12 inches (305 mm)]** wide. Include number of units required to form total lengths indicated.
 - b. Grates: Manufacturer's designation "**[heavy] [medium]** duty," with slots or perforations, and of width and thickness that fit recesses in channels.
 - 1) Material: **[Ductile iron] [Fiberglass] [Galvanized steel] [Gray iron] [Stainless steel] <Insert material>**.
 - 2) Locking Mechanism: **[Manufacturer's standard device for securing grates to channel sections] [Not required]**.

- c. Covers: Solid **[ductile or gray iron] [stainless steel] <Insert material>**, of width and thickness that fit recesses in channels, and of lengths indicated.
 - d. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
 - e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
- B. Polymer-Concrete Channel Drainage Systems **<Insert drawing designation if any>**:
1. Narrow, Sloped-Invert, Polymer-Concrete Channel Drainage Systems:
 - a. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1) ABT, Inc.
 - 2) ACO Polymer Products, Inc.
 - 3) Forte Composites, Inc.
 - 4) Josam Company.
 - 5) Smith, Jay R. Mfg. Co.
 - 6) Strongwell Corporation.
 - 7) **<Insert manufacturer's name>**.
 - 8) or approved equal.
 2. Narrow, Level-Invert, Polymer-Concrete Channel Drainage Systems:
 - a. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1) ABT, Inc.
 - 2) ACO Polymer Products, Inc.
 - 3) Forte Composites, Inc.
 - 4) Josam Company.
 - 5) **<Insert manufacturer's name>**.
 - 6) or approved equal.
 3. Wide, Level-Invert, Polymer-Concrete Channel Drainage Systems:
 - a. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1) ABT, Inc.
 - 2) ACO Polymer Products, Inc.
 - 3) Josam Company.
 - 4) Strongwell Corporation.
 - 5) **<Insert manufacturer's name>**.
 - 6) or approved equal.
 4. Type: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.

- a. Channel Sections: Narrow, interlocking-joint, sloped-invert, polymer-concrete modular units with end caps. Include rounded bottom, with built-in invert slope of 0.6 percent and with outlets in number, sizes, and locations indicated. Include extension sections necessary for required depth.
 - 1) Dimensions: **4-inch (102-mm)** inside width. Include number of units required to form total lengths indicated.
 - 2) Frame: **[Gray-iron or galvanized steel for grates] [Not required]**.
- b. Grates: Manufacturer's designation "**[heavy] [medium]** duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.
 - 1) Material: **[Ductile iron] [Fiberglass] [Galvanized steel] [Gray iron] [Stainless steel] <Insert material>**.
 - 2) Locking Mechanism: **[Manufacturer's standard device for securing grates to channel sections] [Not required]**.
- c. Covers: Solid **[ductile or gray iron] <Insert material>**, of width and thickness that fit recesses in channel sections, and of lengths indicated.
- d. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
- e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
- f. Channel Sections: Narrow, interlocking-joint, precast, polymer-concrete modular units with end caps. Include rounded bottom, with level invert and with **NPS 4 (DN 100)** outlets in number and locations indicated.
 - 1) Dimensions: **[5-inch (127-mm)] <Insert dimension>** inside width and **[9-3/4 inches (248 mm)] <Insert dimension>** deep. Include number of units required to form total lengths indicated.
 - 2) Frame: **[Gray-iron or galvanized steel for grates] [Not required]**.
- g. Grates: Manufacturer's designation "**[heavy] [medium]** duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.
 - 1) Material: **[Ductile iron] [Fiberglass] [Galvanized steel] [Gray iron] [Stainless steel] <Insert material>**.
 - 2) Locking Mechanism: **[Manufacturer's standard device for securing grates to channel sections] [Not required]**.
- h. Covers: Solid **[ductile or gray iron] <Insert material>**, of width and thickness that fit recesses in channel sections, and of lengths indicated.
- i. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
- j. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

- k. Channel Sections: Wide, interlocking-joint, precast, polymer-concrete modular units with end caps. Include flat or rounded bottom, with level invert and with outlets in number, sizes, and locations indicated.
 - 1) Dimensions: **[8-inch (203-mm)] <Insert dimension>** inside width and **[13-3/4 inches (350 mm)] <Insert dimension>** deep. Include number of units required to form total lengths indicated.
 - 2) Frame: **[Gray-iron or galvanized steel for grates] [Not required]**.
 - l. Grates: Manufacturer's designation "**[heavy] [medium]** duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.
 - 1) Material: **[Ductile iron] [Fiberglass] [Galvanized steel] [Gray iron] [Stainless steel] <Insert material>**.
 - 2) Locking Mechanism: **[Manufacturer's standard device for securing grates to channel sections] [Not required]**.
 - m. Covers: Solid **[ductile or gray iron] <Insert material>**, of width and thickness that fit recesses in channel sections, and of lengths indicated.
 - n. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
 - o. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
- C. Polymer-Concrete Sediment Interceptor **<Insert drawing designation if any>**:
- 1. Description: **[27-inch- (686-mm-)] <Insert dimension>** square, precast, polymer-concrete body, with outlets in number and sizes indicated. Include **24-inch- (610-mm-)** square, gray-iron slotted grate.
 - 2. Frame: **[Gray-iron or galvanized steel for grate] [Not required]**.
- D. FRP Channel Drainage Systems **<Insert drawing designation if any>**:
- 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. ACO Polymer Products, Inc.
 - b. Aquaduct, Inc.; an ACO Polymer Products, Inc. Company.
 - c. Josam Company; Mea-Josam Div.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Zurn Plumbing Products Group; Flo-Thru Operation.
 - f. **<Insert manufacturer's name.>**
 - g. or approved equal.
 - 2. Description: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.

- a. Channel Sections: Interlocking-joint, sloped-invert, FRP modular units, with end caps. Include flat, rounded, or inclined inside bottom, with outlets in number, sizes, and locations indicated.
 - 1) Dimensions: [**4 inches (102 mm)**] [**4 or 6 inches (102 or 152 mm)**] [**6 inches (152 mm)**] [**6 or 8 inches (152 or 203 mm)**] [**8 inches (203 mm)**] wide. Include number of units required to form total lengths indicated.
 - 2) Frame: [**Galvanized steel**] [**Stainless steel**] [**Manufacturer's standard metal**] <Insert material> for grates.
 - b. Grates: With slots or perforations and widths and thickness that fit recesses in channel sections.
 - 1) Material: [**Fiberglass**] [**Galvanized steel**] [**Gray iron**] [**Stainless steel**] <Insert material>.
 - 2) Locking Mechanism: [**Manufacturer's standard device for securing grates to channel sections**] [**Not required**].
 - c. Covers: Solid [**ductile or gray iron**] <Insert material>, of width and thickness that fit recesses in channel sections, and of lengths indicated.
 - d. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
 - e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
- E. Plastic Channel Drainage Systems <Insert drawing designation if any>:
1. HDPE or PE Channel Drainage Systems:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) [Smith, Jay R. Mfg. Co.](#)
 - 2) [Tuf-Tite Corporation.](#)
 - 3) [Zurn Plumbing Products Group.](#)
 - 4) <Insert manufacturer's name>.
 - 5) or approved equal.
 2. PP Channel Drainage Systems:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) [Infinity Plastics, Inc.](#)
 - 2) [Smith, Jay R. Mfg. Co.](#)
 - 3) <Insert manufacturer's name>.
 - 4) or approved equal.
 3. PVC Channel Drainage Systems:

- a. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1) MultiDrain Systems.
 - 2) NDS Inc.
 - 3) **<Insert manufacturer's name>.**
 - 4) or approved equal.
4. **HDPE, PE, PP, or PVC Channel Drainage Systems:**
 - a. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1) Infinity Plastics, Inc.
 - 2) MultiDrain Systems.
 - 3) NDS Inc.
 - 4) Smith, Jay R. Mfg. Co.
 - 5) Tuf-Tite Corporation.
 - 6) Zurn Plumbing Products Group.
 - 7) **<Insert manufacturer's name>.**
 - 8) or approved equal.
5. **Type: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.**
 - a. **Channel Sections: Interlocking-joint, [HDPE or PE] [PP] [or] [PVC] modular units, with end caps. Include flat, rounded, or inclined bottom, with level invert and with outlets in number, sizes, and locations indicated.**
 - 1) **Dimensions: 4 inches (102 mm) wide. Include number of units required to form total lengths indicated.**
 - b. **Grates: With slots or perforations and widths and thickness that fit recesses in channel sections.**
 - 1) **Material: [Fiberglass] [Galvanized steel] [Gray iron] [Stainless steel] <Insert material>.**
 - 2) **Color: <Insert color or delete subparagraph.>**
 - c. **Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.**
 - d. **Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.**

2.7 FLOOR SINKS

- A. **FS-1: Nickel bronze grate and cast iron body with dome strainer and cast iron seepage flange; acid-resisting porcelain enamel coated.**
- B. **Provide floor sinks to accept indirect waste lines. FS-2: [Round] [Square] cast iron**

body with integral cast iron seepage pan, epoxy coated interior, nickel bronze grate and dome strainer, cast iron clamp collar, [**sediment bucket,**] [**epoxy coated,**] [**nickel bronze frame and**] [**full**] [**half**] grate.

2.8 AREA DRAINS

- A. Area Drains: As shown on drawings.

2.9 PLANTER DRAINS

- A. PD-1: Galvanized cast iron body with sump.
1. Strainer: Removable cast bronze dome with stainless steel screen.
 2. Accessories: Cast iron membrane flange and membrane clamp with integral gravel stop.

2.10 AIR-ADMITTANCE VALVES

- A. Fixture Air-Admittance Valves **<Insert drawing designation if any>**:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. [Ayrlett, LLC.](#)
 - b. [Durgo, Inc.](#)
 - c. [Oatey.](#)
 - d. [ProSet Systems Inc.](#)
 - e. [RectorSeal.](#)
 - f. [Studor, Inc.](#)
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected fixture or branch vent piping.

- B. Stack Air-Admittance Valves **<Insert drawing designation if any>**:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. [Durgo, Inc.](#)
 - b. [Oatey.](#)
 - c. [Studor, Inc.](#)
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.

2. Standard: ASSE 1050 for vent stacks.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected stack vent or vent stack.

C. Wall Box **<Insert drawing designation if any>**:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. [Durgo, Inc.](#)
 - b. [Oatey.](#)
 - c. [RectorSeal.](#)
 - d. [Studor, Inc.](#)
 - e. **<Insert manufacturer's name>**.
 - f. or approved equal.
2. Description: White plastic housing with white plastic grille, made for recessed installation. Include bottom pipe connection and space to contain one air-admittance valve.
3. Size: About **9 inches wide by 8 inches high by 4 inches deep** (230 mm wide by 200 mm high by 100 mm deep).

2.11 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies **<Insert drawing designation if any>**:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. [Acorn Engineering Company; Elmdor/Stoneman Div.](#)
 - b. [Thaler Metal Industries Ltd.](#)
 - c. **<Insert manufacturer's name>**.
 - d. or approved equal.
2. Description: Manufactured assembly made of [**4.0-lb/sq. ft. (20-kg/sq. m)**, **0.0625-inch- (1.6-mm-)**] [**6.0-lb/sq. ft. (30-kg/sq. m)**, **0.0938-inch- (2.4-mm-)**] thick, lead flashing collar and skirt extending at least [**6 inches (150 mm)**] [**8 inches (200 mm)**] [**10 inches (250 mm)**] from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 - a. Open-Top Vent Cap: Without cap.
 - b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 - c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.12 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies **<Insert drawing designation if any>**:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. ProSet Systems Inc.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.
2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

2.13 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains **<Insert drawing designation if any>**:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping[**with increaser fitting of size indicated**].

B. Deep-Seal Traps **<Insert drawing designation if any>**:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
 - a. **NPS 2 (DN 50): 4-inch- (100-mm-)** minimum water seal.
 - b. **NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-)** minimum water seal.

C. Floor-Drain, Trap-Seal Primer Fittings **<Insert drawing designation if any>**:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with **NPS 1/2 (DN 15)** side inlet.

D. Air-Gap Fittings **<Insert drawing designation if any>**:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.

5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

E. Sleeve Flashing Device **<Insert drawing designation if any>**:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend [**1 inch (25 mm)**] [**2 inches (51 mm)**] **<Insert dimension>** above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

F. Stack Flashing Fittings **<Insert drawing designation if any>**:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Vent Caps **<Insert drawing designation if any>**:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

H. Frost-Resistant Vent Terminals **<Insert drawing designation if any>**:

1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
2. Design: To provide **1-inch (25-mm)** enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

I. Expansion Joints **<Insert drawing designation if any>**:

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

2.14 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: **4.0-lb/sq. ft. (20-kg/sq. m)**, **0.0625-inch (1.6-mm)** thickness.
2. Vent Pipe Flashing: **3.0-lb/sq. ft. (15-kg/sq. m)**, **0.0469-inch (1.2-mm)** thickness.
3. Burning: **6-lb/sq. ft. (30-kg/sq. m)**, **0.0938-inch (2.4-mm)** thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: **12 oz./sq. ft.** (3.7 kg/sq. m or 0.41-mm thickness).
2. Vent Pipe Flashing: **8 oz./sq. ft.** (2.5 kg/sq. m or 0.27-mm thickness).

- C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and **0.04-inch** (1.01-mm) minimum thickness, unless otherwise indicated. Include **G90 (Z275)** hot-dip galvanized, mill-phosphatized finish for painting if indicated.

- D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, **40-mil** (1.01-mm) minimum thickness.

- E. Fasteners: Metal compatible with material and substrate being fastened.

- F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

- G. Solder: ASTM B 32, lead-free alloy.

- H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.15 FOG DISPOSAL SYSTEMS

- A. FOG Disposal Systems **<Insert drawing designation if any>**:
 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. **Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.**
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.

 2. Standard: IAPMO PS 118, for removing solids from and breaking down and digesting suspended fats, oils, and greases from food[**-preparation**] [**or**] [**-processing**] wastewater.

 3. Flow-Control Fitting: Matching unit size.

 4. Strainer Unit: Stainless-steel housing with aluminum cover and removable-basket-type, stainless-steel, wire-mesh strainer. [**Include pressure plug instead of cover.**] [**Include extra basket.**] [**Include stainless-steel extension.**]

 5. Media Chamber: Stainless-steel housing and aluminum cover, with internal baffles, piping, plastic coalescing surfaces, and clarifier section with test ports. [**Include stainless-steel extension.**]

 6. Shelf: Stainless steel, **19.5 inches wide by 13 inches high by 8.75 inches deep** (495 mm wide by 330 mm high by 222 mm deep), for metering pump, control devices, and culture bottle.

 7. Culture Metering Pump, Timer, Control, and Tubing: Proprietary.

 8. Culture: Include **1-gal.** (3.8-L) bottle, as recommended by unit manufacturer.

 9. Strainer and Media-Chamber, Unit Size: [**20 gpm (1.26 L/s)**] [**35 gpm (2.21 L/s)**].

 10. Inlet and Outlet: **NPS 2 (DN 50)**.

11. Strainer and Media-Chamber, Unit Size: **[50 gpm (3.15 L/s)] [75 gpm (4.73 L/s)]**.
12. Inlet and Outlet: **NPS 3 (DN 80)**.
13. Piping: Waste and vent piping is specified in Section 221316 "Sanitary Waste and Vent Piping."
14. Power Requirement: **[120-V ac] <Insert power>**.
15. Full-Load Amperes: **<Insert value> A**.
16. Minimum Circuit Ampacity: **<Insert value> A**.
17. Maximum Overcurrent Protection: **<Insert value> A**.

2.16 TRAP SEAL PRIMER VALVES

- A. Supply-Type Trap Seal Primer Valves: ASSE 1018, water-supply-fed type, with the following characteristics:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. E & S Valves.
- b. Josam Co.
- c. MIFAB Manufacturing, Inc.
- d. Precision Plumbing Products, Inc.
- e. Smith, Jay R. Mfg. Co.
- f. Tyler Pipe; Wade Div.
- g. Watts Industries, Inc
- h. Zurn Industries, Inc.
- i. **<Insert manufacturer's name>**
- j. or approved equal.

2. 150-psig (860-kPa) maximum working pressure.
3. Bronze body with atmospheric-vented drain chamber.
4. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
5. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

- B. Drainage-Type Trap Seal Primer Valves: ASSE 1044, fixture-trap, waste-drainage-fed type, with the following characteristics:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Smith, Jay R. Mfg. Co.
- b. **<Insert manufacturer's name>**
- c. or approved equal.

2. Chrome-plated, cast-brass, NPS 1-1/4 (DN 32) minimum, lavatory P-trap with

NPS 3/8 (DN 10) minimum, trap makeup connection.

C. Trap Seal Primer System: Factory-fabricated, automatic-operation assembly for wall mounting with the following:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Precision Plumbing Products, Inc.
- b. **<Insert manufacturer's name>**
- c. or approved equal.

2. Piping: NPS 3/4, ASTM B 88, Type L (DN 20, ASTM B 88M, Type B); copper, water tubing inlet and manifold with number of NPS 1/2 (DN 15) outlets as indicated.

3. Cabinet: Steel box with stainless-steel cover.

4. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.

5. Water Hammer Arrester: ASSE 1010.

6. Vacuum Breaker: ASSE 1001.

2.17 SUMPS

A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

1. Pump Manufacturer.
2. Harrison Plastic Systems.
3. Lifetime Fiberglass Tank Company.
4. **<Insert manufacturer's name>**
5. or approved equal.

B. **[Precast concrete specified in Division 03] [Precast concrete] [Epoxy coated fabricated steel] [Glass fiber reinforced encased with 8 inches reinforced concrete]** with required openings and drainage fittings, and supports for level controls, piping, etc.

1. Cover: 3/8 inch thick checkered steel plate with gasket seal frames and anchor bolts, with gas-tight connections for controls, fluid, and vent piping. Provide cover lifting lugs or recessed threaded sleeves for lifting eye-bolts.

2.18 GREASE INTERCEPTORS

A. Grease Interceptors **<Insert drawing designation if any>**:

1. Cast-Iron or Steel Grease Interceptors:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) [Applied Chemical Technology, Incorporated.](#)
 - 2) [Josam Company.](#)
 - 3) [MIFAB, Inc.](#)
 - 4) [Rockford Sanitary Systems, Inc.](#)
 - 5) [Schier Products Company.](#)
 - 6) [Smith, Jay R. Mfg. Co.](#)
 - 7) [Tyler Pipe.](#)
 - 8) [Watts Drainage Products.](#)
 - 9) [Zurn Plumbing Products Group.](#)
 - 10) **<Insert manufacturer's name>.**
 - 11) or approved equal.

2. Plastic Grease Interceptors:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) [Ashland Trap Distribution Co.](#)
 - 2) [Bio-Microbics, Inc.](#)
 - 3) [Canplas LLC.](#)
 - 4) [Schier Products Company.](#)
 - 5) [Zurn Plumbing Products Group.](#)
 - 6) **<Insert manufacturer's name>.**
 - 7) or approved equal.

3. Standard: ASME A112.14.3[**and PDI-G101**], for intercepting and retaining fats, oils, and greases from food[**-preparation**] [or] [**-processing**] wastewater.
4. Plumbing and Drainage Institute Seal: [**Not required**] [**Required**].
5. Body Material: [**Cast iron**] [**Cast iron or steel**] [**Plastic**] **<Insert material>.**
6. Interior Lining: [**Corrosion-resistant enamel**] [**Not required**] **<Insert lining>.**
7. Exterior Coating: [**Corrosion-resistant enamel**] [**Not required**] **<Insert coating>.**
8. Body Dimensions: **<Insert dimensions.>**
9. Body Extension: [**Not required**] [**Required**].
10. Flow Rate: **<Insert interceptor design rate.>**
11. Grease Retention Capacity: **<Insert capacity.>**
12. Inlet and Outlet Size: **<Insert size.>**
13. End Connections: [**Flanged**] [**Hub**] [**Threaded**].
14. Cleanout: Integral[**or field installed on outlet**].
15. Mounting: [**Above floor**] [**Recessed in acid-resistant, coated steel frame and cradle**] [**Recessed, flush with floor**] **<Insert mounting>.**
16. Flow-Control Fitting: [**Not required**] [**Required**].
17. Operation: [**Automatic recovery**] [**Manual cleaning**] [**Semiautomatic, manual drawoff**] **<Insert operation>.**

2.19 GREASE REMOVAL DEVICES

A. Grease Removal Devices <Insert drawing designation if any>:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Applied Chemical Technology, Incorporated.
 - b. G K & L, Inc.
 - c. International Grease Recovery Device.
 - d. Josam Company; Blucher-Josam Div.
 - e. Low Engineering; a division of Highland Tank & Manufacturing Co., Inc.
 - f. Thermaco, Inc.
 - g. <Insert manufacturer's name>.
 - h. or approved equal.
2. Standard: ASME A112.14.4[**and with PDI-G101 for flow tests**], for automatic intercepting and removal of fats, oils, and greases from food[-preparation] [or] [-processing] <Insert application> wastewater.
3. Body Material: [**Stainless steel**] [**Steel**] <Insert material>.
4. Interior Separation Device: [**Baffles**] [**Screens**] <Insert device>.
5. Heater: [**Not required**] [**Required**].
6. Interior Lining: [**Not required**] <Insert description if required>.
7. Exterior Coating: [**Not required**] <Insert description if required>.
8. Unit Dimensions: <Insert dimensions.>
9. Flow Rate: <Insert recovery unit design rate.>
10. Basket Material: [**Stainless steel**] <Insert material>.
11. Inlet and Outlet Size: <Insert size.>
12. End Connections: [**Flanged**] [**Hub**] [**Threaded**].
13. Cleanout: Integral[**or field installed on outlet**].
14. Mounting: [**Above floor**] <Insert mounting>.
15. Flow-Control Fitting: [**Not required**] [**Required**].
16. Operation: [**Automatic recovery**] <Insert operation>.
17. Power Requirement: [**120-V ac**] <Insert power>.
18. Full-Load Amperes: <Insert value> A.
19. Minimum Circuit Ampacity: <Insert value> A.
20. Maximum Overcurrent Protection: <Insert value> A.
21. Waste Grease Receptacle: [**Furnished by Owner**] <Insert description>.

2.20 OIL INTERCEPTORS

A. Oil Interceptors <Insert drawing designation if any>:

1. Cast-Iron or Steel Oil Interceptors:
 - a. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1) Applied Chemical Technology, Incorporated.

- 2) [Josam Company.](#)
- 3) [MIFAB, Inc.](#)
- 4) [Rockford Sanitary Systems, Inc.](#)
- 5) [Schier Products Company.](#)
- 6) [Smith, Jay R. Mfg. Co.](#)
- 7) [Tyler Pipe.](#)
- 8) [Watts Drainage Products.](#)
- 9) [Zurn Plumbing Products Group.](#)
- 10) **<Insert manufacturer's name>.**
- 11) or approved equal.

2. Plastic Oil Interceptors:

- a. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- 1) [Ashland Trap Distribution Co.](#)
- 2) [Schier Products Company.](#)
- 3) [Town & Country Plastics, Inc.](#)
- 4) **<Insert manufacturer's name>.**
- 5) or approved equal.

3. Type: Factory-fabricated interceptor for separating and removing [**light oil**] **<Insert type of oil>** from wastewater.
4. Body Material: [**Cast iron or steel**] [**Plastic**] **<Insert material>.**
5. Interior Lining: [**Corrosion-resistant enamel**] [**Not required**] **<Insert lining>.**
6. Exterior Coating: [**Corrosion-resistant enamel**] [**Not required**] **<Insert coating>.**
7. Body Dimensions: **<Insert dimensions.>**
8. Flow Rate: **<Insert interceptor design rate.>**
9. Inlet and Outlet Size: **<Insert size.>**
10. End Connections: [**Flanged**] [**Hub**] [**Threaded**].
11. Cleanout: Integral[**or field installed on outlet**].
12. Mounting: [**Above floor**] [**Recessed in acid-resistant, coated steel frame and cradle**] [**Recessed, flush with floor**] **<Insert mounting>.**
13. Flow-Control Fitting: [**Not required**] [**Required**].
14. Descriptive Type or Function: **<Describe type or function or delete subparagraph.>**
15. Oil Storage Tank: [**Coordinate with Section 231113 "Facility Fuel-Oil Piping."**] **<Insert tank description.>**

2.21 SOLIDS INTERCEPTORS

- A. Solids Interceptors **<Insert drawing designation if any>:**

1. Cast-Iron or Steel Solids Interceptors:

- a. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- 1) Josam Company.
- 2) MIFAB, Inc.
- 3) Rockford Sanitary Systems, Inc.
- 4) Schier Products Company.
- 5) Smith, Jay R. Mfg. Co.
- 6) Tyler Pipe.
- 7) Watts Drainage Products.
- 8) Zurn Plumbing Products Group.
- 9) **<Insert manufacturer's name>.**
- 10) or approved equal.

2. Plastic Solids Interceptors:

a. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- 1) Ashland Trap Distribution Co.
- 2) Schier Products Company.
- 3) Town & Country Plastics, Inc.
- 4) **<Insert manufacturer's name>.**
- 5) or approved equal.

3. Type: Factory-fabricated interceptor made for removing and retaining **[lint]** **[sediment]** **<Insert solid>** from wastewater.
4. Body Material: **[Cast iron or steel]** **[Stainless steel]** **[Plastic]** **<Insert material>.**
5. Interior Separation Device: **[Baffles]** **[Screens]** **<Insert device>.**
6. Interior Lining: **[Corrosion-resistant enamel]** **[Not required]** **<Insert lining>.**
7. Exterior Coating: **[Corrosion-resistant enamel]** **[Not required]** **<Insert coating>.**
8. Body Dimensions: **<Insert dimensions.>**
9. Flow Rate: **[Not required]** **<Insert description if required>.**
10. Inlet and Outlet Size: **<Insert size.>**
11. End Connections: **[Threaded]** **<Insert connections>.**
12. Mounting: **[Above floor]** **[Inline]** **<Insert mounting>.**

2.22 MOTORS

A. General requirements for motors are specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Mounting:

1. Install [**FOG disposal systems**] [**grease interceptors**] [**grease removal devices**] [**and**] [**solids interceptors**] on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in [**Section 033000 "Cast-in-Place Concrete."**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete."**]
 2. Comply with requirements for vibration isolation and seismic control devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment"
 3. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
- B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- C. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- D. Install expansion joints on vertical risers, stacks, and conductors if indicated.
- E. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to **NPS 4 (DN 100)**. Use **NPS 4 (DN 100)** for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 135 degrees.
 3. Locate at minimum intervals of **50 feet (15 m)** for piping **NPS 4 (DN 100)** and smaller and **100 feet (30 m)** for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- F. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- G. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- H. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- I. Encase exterior cleanouts in concrete flush with grade.

- J. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, **30 Inches** (750 mm) or Less: Equivalent to 1 percent slope, but not less than **1/4-inch** (6.35-mm) total depression.
 - b. Radius, **30 to 60 Inches** (750 to 1500 mm): Equivalent to 1 percent slope.
 - c. Radius, **60 Inches** (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than **1-inch** (25-mm) total depression.
 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- K. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.
- L. Assemble and install ASME A112.3.1, stainless-steel channel drainage systems according to ASME A112.3.1. Install on support devices so that top will be flush with surface.
- M. Assemble non-ASME A112.3.1, stainless-steel channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- N. Assemble FRP channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- O. Assemble plastic channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- P. Install fixture air-admittance valves on fixture drain piping.
- Q. Install stack air-admittance valves at top of stack vent and vent stack piping.
- R. Install air-admittance-valve wall boxes recessed in wall.
- S. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- T. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

- U. Install through-penetration firestop assemblies in plastic [**conductors**] [**and**] [**stacks**] at floor penetrations.
- V. Assemble open drain fittings and install with top of hub [**1 inch (25 mm)**] [**2 inches (51 mm)**] <Insert dimension> above floor.
- W. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- X. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- Y. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- Z. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- AA. Install vent caps on each vent pipe passing through roof.
- BB. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain **1-inch (25-mm)** clearance between vent pipe and roof substrate.
- CC. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- DD. Install frost-proof vent caps on each vent pipe passing through roof. Maintain **1-inch (25-mm)** clearance between vent pipe and roof substrate.
- EE. Assemble components of FOG disposal systems and install on floor. Install trap, vent, fresh-air inlet, and flow-control fitting according to authorities having jurisdiction. Install shelf fastened to reinforcement in wall construction and adjacent to unit, unless otherwise indicated. Install culture bottle, culture metering pump, timer, and control on shelf. Install tubing between culture bottle, metering pump, and chamber.
- FF. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
 - 1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
 - 2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
 - 3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
 - 4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.

- GG. Install grease removal devices on floor. Install trap, vent, and flow-control fitting according to authorities having jurisdiction. Install control panel adjacent to unit, unless otherwise indicated.
- HH. Install oil interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing. Coordinate oil-interceptor storage tank and gravity drain with Section 231113 "Facility Fuel-Oil Piping."
- II. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.
- JJ. Install wood-blocking reinforcement for wall-mounting-type specialties.
- KK. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. FOG Disposal Systems: Connect inlet and outlet to unit, connect flow-control fitting and fresh-air inlet piping to unit inlet piping, and connect vent piping between trap and media chamber. Connect electrical power.
- D. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.
- E. Grease Removal Devices: Connect controls, electrical power, factory-furnished accessories, and inlet, outlet, and vent piping to unit.
- F. Oil Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; flow-control fitting and vent to unit inlet piping; and gravity drawoff and suction piping to oil storage tank.
- G. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- H. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
1. Lead Sheets: Burn joints of lead sheets **6.0-lb/sq. ft.** (30-kg/sq. m), **0.0938-inch** (2.4-mm) thickness or thicker. Solder joints of lead sheets **4.0-lb/sq. ft.** (20-kg/sq. m), **0.0625-inch** (1.6-mm) thickness or thinner.
 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of **10 inches** (250 mm), and skirt or flange extending at least **8 inches** (200 mm) around pipe.
 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least **8 inches** (200 mm) around sleeve.
 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least **8 inches** (200 mm) around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
1. FOG disposal systems.
 2. Grease interceptors.
 3. Grease removal devices.
 4. Oil interceptors.
 5. Solids interceptors.
 6. Backflow preventers.
 7. Trap seal primer system.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to assist Contractor and inspect field-assembled [**FOG disposal systems**] [**trap seal primer systems**] [**and**] [**grease removal devices**] and their installation, including piping and electrical connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to assist Contractor and train Owner's maintenance personnel to adjust, operate, and maintain [**FOG disposal systems**] [**trap seal primer systems**] [**interceptors**] [**and**] [**grease removal devices**]. Refer to Section 017900 "Demonstration and Training."

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 221319

SECTION 221323 - SANITARY WASTE INTERCEPTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Grease interceptors.
 - 2. Oil interceptors.
 - 3. Sediment interceptors.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of [metal] interceptor indicated. Include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size, and location of each pipe connection, furnished specialties, and accessories.
 - 1. Metal oil interceptors. Include rated liquid flow and retention capacities.
 - 2. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For each type and size of precast-concrete interceptor indicated.
 - 1. Include materials of construction, dimensions, rated capacities, retention capacities, location, and size of each pipe connection, furnished specialties, and accessories.
 - 2. Include materials of construction, dimensions, liquid retention capacity, piping connections, and appurtenances for cast-in-place concrete interceptors.
 - 3. Reports and Calculations: For design mixes for each class of cast-in-place concrete.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Interceptors, drawn to scale, on which the following items are shown and coordinated with each other, based on input from Installers of the items

involved:

1. Interceptors.
2. Piping connections. Include size, location, and elevation of each.
3. Include details of underground structures and connections.
4. Interface and spatial relationship with underground structures, piping and utility services.

1.5 CLOSEOUT SUBMITTALS

- A. Record actual locations of equipment, cleanouts, backflow preventers.
- B. Operation Data: Indicate frequency of treatment required for interceptors.
- C. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.6 PROJECT CONDITIONS

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.
- B. Interruption of Existing Sewer Services: Do not interrupt services to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sewer services according to requirements indicated:
 1. Notify DEN Project Manager no fewer than seven (7) days in advance of proposed interruption of service.
 2. Do not proceed with interruption of sewer services without DEN Project Manager's written permission.

1.7 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of interceptors and are based on the specific system indicated. Other manufacturers' systems with equal performance characteristics may be considered. Refer to Section 012510 "Substitutions."
- B. Manufacturer: For each product specified, provide components by same manufacturer throughout.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products under provisions of Division 01
- B. Accept specialties on site in original factory packaging. Inspect for damage.

- C. Handle precast concrete interceptors according to manufacturer's written rigging instructions. Check all products for damage after delivery.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GREASE INTERCEPTORS

- A. Grease Interceptors: Precast concrete complying with **[ASTM C 913]** <Insert authority title>.
 - 1. Include rubber-gasketed joints, **[vent connections]**, manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.
 - 2. Structural Design Loads:
 - a. Medium-Traffic Load: Comply with ASTM C 890, A-12 (ASSHTO HS15-44).
 - b. Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).
 - c. Walkway Load: Comply with ASTM C 890, A-03.
 - 3. Resilient Pipe Connectors: **ASTM C 923** (ASTM C 923M), cast or fitted into interceptor walls, for each pipe connection.
 - 4. Steps: **[Individual FRP steps or FRP ladder]** **[Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP]** **[ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP]** <Insert material>, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at **12- to 16-inch** (300- to 400-mm) intervals. Omit steps if total depth from floor of interceptor to finished grade is less than **[60 inches (1500 mm)]** <Insert dimension>.
 - 5. Grade Rings: Reinforced-concrete rings, **6- to 9-inch** (150- to 225-mm) total thickness, to match diameter of manhole frame and cover.
 - 6. Manhole Frames and Covers: Ferrous; **24-inch** (610-mm) ID by **7- to 9-inch** (175- to 225-mm) riser with **4-inch-** (100-mm-) minimum width flange and **26-inch-** (660-mm-) diameter cover.
 - a. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
 - b. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.
 - c. Include indented top design with lettering cast into cover, using wording equivalent to "**[INTERCEPTOR]** **[GREASE INTERCEPTOR]** **[SANITARY SEWER]** <Insert lettering>."

B. Capacities and Characteristics:

1. Length by Width by Depth: <Insert inches (mm)>.
2. Number of Compartments: [One] [Two] <Insert number>.
3. Retention Capacity: <Insert gal. or lb (L or kg)>.
4. Inlet and Outlet Pipe Size: <Insert NPS (DN)>
 - a. Centerline of Inlet to Floor: <Insert inches (mm)>.
 - b. Centerline of Outlet to Floor: <Insert inches (mm)>.
5. Trapped Outlet Required: [Integral] [No] [Yes].
6. Vent Pipe Size: [Not required] <Insert NPS (DN)>.
7. Installation Position: [Top flush with grade] [Underground with manhole riser to grade] <Insert position>.

2.2 OIL INTERCEPTORS

A. Oil Interceptors: Precast concrete comply with [ASTM C 913] <Insert authority title> and authorities having jurisdiction.

1. Include rubber-gasketed joints, vent connections, manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.
2. Structural Design Loads:
 - a. Medium-Traffic Load: Comply with ASTM C 890, A-12 (ASSHTO HS15-44).
 - b. Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).
 - c. Walkway Load: Comply with ASTM C 890, A-03.
3. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into interceptor walls, for each pipe connection.
4. Steps: [Individual FRP steps or FRP ladder] [Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP] [ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP] <Insert material>, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of interceptor to finished grade is less than [60 inches (1500 mm)] <Insert dimension>.
5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover.
6. Manhole Frames and Covers: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (100-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover.
 - a. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
 - b. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.
 - c. Include indented top design with lettering cast into cover, using wording equivalent to "[INTERCEPTOR] [OIL INTERCEPTOR] [SANITARY

SEWER] <Insert lettering>."

7. Waste-oil storage tank and piping are specified in Section 231113 "Facility Fuel-Oil Piping."
 8. Protective Coating: Coal-tar epoxy, 15-mil minimum thickness covering interior and exterior surfaces. Omit coating on corrosion-resistant surfaces.
- B. Oil Interceptors: Factory-fabricated, cast-iron or steel body; with removable sediment bucket or strainer, baffles, vents, and flow-control fitting on inlet.
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Parkson Corporation.
 - d. Rockford Sanitary Systems, Inc.
 - e. Schier Products Company.
 - f. Smith, Jay R. Mfg. Co.
 - g. Tyler Pipe, Inc.
 - h. Watts Water Technologies, Inc.
 - i. Zurn Plumbing Products Group; Zurn Specification Drainage Products.
 - j. **<Insert manufacturer's name>.**
 - k. or approved equal.
 2. Inlet, Outlet, Vent, and Waste-Oil Outlet Piping Connections: Hub, hubless, or threaded, unless otherwise indicated.
 3. Extension: Cast-iron or steel shroud, full size of interceptor, extending from top of interceptor to grade.
 4. Cover: Cast iron or steel, with steel reinforcement to provide ASTM C 890, [**A-03, walkway**] **<Insert type loading>** load.
 5. Comply with requirements in Section 231113 "Facility Fuel-Oil Piping" for waste-oil storage tank and piping
 6. Protective Coating: Coal-tar epoxy, 15-mil minimum thickness covering interior and exterior surfaces. Omit coating on corrosion-resistant surfaces.
 7. Waste-Oil Storage Tank and Piping: Refer to Section 231113 "Facility Fuel-Oil Piping".
- C. Capacities and Characteristics:
1. Capacity: [**Not applicable**] **<Insert gal. (L)>.**
 2. Overall Dimensions: **<Insert inches (mm)>.**
 3. Inlet and Outlet Pipe Size: **<Insert NPS (DN)>.**
 - a. Centerline of Inlet to Floor: **<Insert inches (mm)>.**
 - b. Centerline of Outlet to Floor: **<Insert inches (mm)>.**
 4. Waste-Oil-Outlet Pipe Size: **<Insert NPS (DN)>.**
 - a. Centerline of Outlet to Floor: **<Insert inches (mm)>.**

5. Trapped Outlet Required: **[Integral] [No] [Yes]**.
6. Vent Pipe Size: **<Insert NPS (DN)>**.
7. Installation Position: **[Top flush with grade] [Underground with extension to grade] [Underground with manhole riser to grade] <Insert position>**.

2.3 SEDIMENT INTERCEPTORS

- A. Steel Sediment Interceptors: Factory-fabricated steel body and cover; with settlement chambers; baffles; and removable basket, strainer, or screens.
 1. Piping Connections: Threaded or hub type.
 2. Extension: Steel, extending from top of interceptor to grade.
 3. Protective Coating: Coal-tar epoxy, 15-mil minimum thickness covering interior and exterior surfaces. Omit coating on corrosion-resistant surfaces.
- B. Concrete Sediment Interceptors: Precast or cast-in-place concrete structure complying with authorities having jurisdiction.
- C. Precast Concrete Sediment Interceptors: ASTM C 913, designed according to ASTM C 890 for A-16, heavy-traffic, structural loading. Include sump for collection and retention of sediment; manholes or grates; compartments or baffles with piping or openings to permit wastewater flow; and rubber gasket joints.
- D. Cast-in-Place Concrete Sediment Interceptors: Construct of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16, heavy-traffic, structural loading. Include sump for collection and retention of sediment; manholes or grates; and compartments or baffles with piping or openings to permit wastewater flow.
 1. Resilient Pipe Connectors: ASTM C 923, cast or fitted into interceptor walls, for each pipe connection.
 2. Steps: Fiberglass, individual steps, or ladder wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of interceptor to finished grade is less than 60 inches.
 3. Steps: Manufactured from deformed, 1/2-inch steel reinforcing rod complying with ASTM A 615/A 615M and encased in polypropylene complying with ASTM D 4101; in pattern designed to prevent lateral slippage off step. Cast or anchor steps into side-walls at 12- to 16-inch intervals. Omit steps if total depth from floor of interceptor to finished grade is less than 60 inches.
 4. Protective Coating: One- or two-coat, coal-tar epoxy; 15-mil minimum thickness.
 - a. Coverage: Applied to interior sidewall surface.
 - b. Coverage: Applied to exterior sidewall surface.
 - c. Coverage: Applied to interior and exterior sidewall surfaces.
5. Installation Position: **[Top flush with grade] <Insert position>**.

2.4 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:
1. Cement: ASTM C 150, Type II.
 2. Fine Aggregate: ASTM C 33, sand.
 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio.
1. Reinforcing Fabric: ASTM A 185, steel, welded wire fabric, plain.
 2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

2.5 PRECAST-CONCRETE MANHOLE RISERS

- A. Precast-Concrete Manhole Risers: **[ASTM C 478 (ASTM C 478M)] [ASTM C 913]**, with rubber-gasket joints.
1. Structural Design Loads:
 - a. Medium-Traffic Load: Comply with ASTM C 890, A-12 (ASSHTO HS15-44).
 - b. Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).
 - c. Walkway Load: Comply with ASTM C 890, A-03.
 2. Length: From top of underground concrete structure to grade.
 3. Riser Sections: **3-inch (75-mm)** minimum thickness and **[36-inch (915-mm)] <Insert dimension>** diameter.
 4. Top Section: Eccentric cone, unless otherwise indicated. Include top of cone to match grade ring size.
 5. Gaskets: **ASTM C 443 (ASTM C 443M)**, rubber.
 6. Steps: **[Individual FRP steps or FRP ladder] [Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP] [ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP] <Insert material>**, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at **12- to 16-inch (300- to 400-mm)** intervals.
- B. Grade Rings: Reinforced-concrete rings, **6- to 9-inch (150- to 225-mm)** total thickness, diameter matching manhole frame and cover, and height as required to adjust the manhole frame and cover to indicated elevation and slope.
- C. Manhole Frames and Covers: Ferrous; **24-inch (610-mm)** ID by **7- to 9-inch (175- to 225-mm)** riser with **4-inch- (100-mm-)** minimum width flange and **26-inch- (660-mm-)** diameter cover.
1. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.

2. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.
3. Include indented top design with lettering cast into cover, using wording equivalent to the following:
 - a. Grease Interceptors in Sanitary Sewerage System: "[INTERCEPTOR] [GREASE INTERCEPTOR] [SANITARY SEWER] <Insert lettering>."
 - b. Oil Interceptors in Sanitary Sewerage System: "[INTERCEPTOR] [OIL INTERCEPTOR] [SANITARY SEWER] <Insert lettering>."

2.6 GRATING FRAMES AND GRATES

- A. Description: ASTM A 536, Grade 60-40-18, ductile-iron frame and grate, designed for heavy-duty service. Include flat grate with small square or short slotted drainage openings.
 1. Minimum Size: 24 inches by 24 inches, unless otherwise indicated.
 2. Grate-Free Area: Approximately 50 percent, unless otherwise indicated.
- B. Protective Coating: One- or two-coat, coal-tar epoxy; 15-mil minimum thickness applied to all frame and grate surfaces.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 IDENTIFICATION

- A. Identification materials and installation are specified in Section 312000 "Earth Moving." Ar-range for installation of green warning tapes directly over piping and at outside edges of underground interceptors.
 1. Use warning tapes or detectable warning tape over ferrous piping.
 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.3 INSTALLATION

- A. Install precast-concrete interceptors according to ASTM C 891. Set level and plumb.
- B. Install interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
- C. Install metal sediment interceptors according to manufacturer's written instructions.

- D. Install metal oil interceptors according to manufacturer's written instructions. Install piping and oil storage tanks according to Section 231113 "Facility Fuel-Oil Piping."
- E. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.
- F. Set tops of manhole frames and covers flush with finished surface in pavements. Set tops [3 inches (75 mm)] <Insert position> above finish surface elsewhere, unless otherwise indicated.
- G. Set tops of grating frames and grates flush with finished surface.
- H. Set [metal] [and] [plastic] interceptors level and plumb.
- I. Set tops of metal interceptor covers flush with finished surface in pavements. Set tops [3 inches (75 mm)] <Insert position> above finish surface elsewhere, unless otherwise indicated.
- J. Install piping and oil storage tanks according to Section 231113 "Facility Fuel-Oil Piping."
- K. Refer to Section 030000 "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.
- L. Place concrete for cast-in-place interceptors according to ACI 318, ACI 350R, and as indicated.
- M. Repair and restore protective coatings to original condition.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Make piping connections between interceptors and piping systems.

3.5 IDENTIFICATION

- A. Identification materials and installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground interceptors.
 - 1. Use warning tapes or detectable warning tape over ferrous piping.
 - 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to assist Contractor and inspect field-assembled [trap seal primer systems] [and] [grease recovery units] and their installation, including piping and electrical

connections. Report results in writing.

- C. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 CLEANING

- A. Clear interior of interceptors as work progresses.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to assist Contractor and train DEN Project Manager's maintenance personnel to adjust, operate, and maintain **[interceptors] [and] [grease recovery units]**. Refer to Division 01 requirements.
 - 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 221323

SECTION 221329 - SANITARY SEWERAGE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Submersible effluent pumps.
2. Submersible sewage pumps.
3. Wet-pit-volute sewage pumps.
4. Sewage-pump, reverse-flow assemblies.
5. Sewage-pump basins and basin covers.
6. Progressing-cavity sewage pumps.
7. Packaged, submersible sewage-pump units.
8. Packaged wastewater-pump units.

- B. Related Sections include the following:

1. Section 221343 "Facility Packaged Sewage Pumping Stations" for applications in site-construction sewage pumping.
2. Section 221429 "Sump Pumps" for applications in storm-drainage systems.

- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles.

1. Include dimension drawings indicating components and connections to other equipment and piping.
2. Indicate pump type, capacity, impeller size, power requirements, and affected adjacent construction.
3. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
4. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
5. Include data substantiating that materials comply with requirements.

- C. Wiring Diagrams: For power, signal, and control wiring.
- D. Shop Drawings:
 - 1. For each pump system and/or basin, include construction details, material descriptions, dimensions of components and profiles, rated capacities, furnished specialties, and accessories.
 - 2. Include dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tapplings, and drains.
 - 3. Detail equipment assemblies and weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.
- B. Field quality-control test reports.
- C. Warranties: Special warranties specified in this Section.
- D. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with current Denver codes and standards.
- B. Installer Qualifications: An authorized representative of packaged pumping station manufacturer for installation and maintenance of units required for this Project.
- C. Manufacturer Qualifications: A qualified manufacturer.
- D. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7.
- E. Provide pumps with manufacturer's name, model number, and rating/capacity identified.
- F. Product Options: Drawings indicate size, profiles, and dimensional requirements of packaged pumping stations and are based on the specific system indicated. Refer to Section 016000 "Product Requirements."
- G. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.
- H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency acceptable to authorities having jurisdiction,

and marked for intended location and application.

- I. UL Compliance: Comply with UL 778 for motor-operated water pumps.
- J. HI Compliance: Comply with HI 1.1-1.5 for sewage [**and sump**] pumps.
- K. NEMA Compliance: Comply with NEMA MG 1 for electric motors.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products under provisions of Division 01
- B. Provide temporary inlet and outlet caps. Maintain caps in place until installation.
- C. Retain shipping flange protective covers and protective coatings during storage.
- E. Protect bearings and couplings against damage.
- F. Comply with pump manufacturer's written rigging instructions for handling.

1.7 COORDINATION

- A. Coordinate sizes and locations of concrete [**bases**] [**bases and pits**] [**pits**] with actual equipment provided.
- B. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify DEN Project Manager not less than seven (7) days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without DEN Project Manager's written permission.

1.9 WARRANTY

- A. Provide minimum five (5) year warranty for [**submersible sump pumps**] [**sump pumps**] [**sewage ejectors**] <Insert product>.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419

"Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE EFFLUENT PUMPS

A. Submersible, Fixed-Position, Single-Seal Effluent Pumps:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Barnes; Crane Pumps & Systems.
- b. Bell & Gossett Domestic Pump; ITT Corporation.
- c. Flo Fab inc.
- d. Goulds Pumps; ITT Corporation.
- e. Grundfos Pumps Corp.
- f. Liberty Pumps.
- g. Little Giant Pump Co.
- h. McDonald, A. Y. Mfg. Co.
- i. Pentair Pump Group; Hydromatic Pumps.
- j. Pentair Pump Group; Myers;
- k. Stancor, Inc.
- l. Sta-Rite Industries, Inc.
- m. WILO-EMU USA LLC.
- n. Zoeller Company.
- o. **<Insert manufacturer's name>.**
- p. or approved equal.

2. Description: Factory-assembled and -tested effluent-pump unit.
3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal effluent pump as defined in HI 1.1-1.2 and HI 1.3.
4. Pump Casing: Cast iron, with open inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
5. Impeller: Statically and dynamically balanced, [**ASTM A 48/A 48M, Class No. 25 A cast iron**] [**ASTM A 532/A 532M, abrasion-resistant cast iron**] [**ASTM B 584, cast bronze**] [**and**] [**stainless steel**], closed or semiopen design for clear wastewater, and keyed and secured to shaft.
6. Pump and Motor Shaft: Stainless steel[**or steel**], with factory-sealed, grease-lubricated ball bearings.
7. Seal: Mechanical.
8. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - a. Motor Housing Fluid: [**Air**] [**Oil**].
9. Controls:

- a. Enclosure: NEMA 250, [**Type 1**] [**Type 4X**] <Insert type>.
- b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
- c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
- d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches** (1500 mm).
- e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

10. Controls:

- a. Enclosure: NEMA 250, [**Type 1**] [**Type 4X**] <Insert type>; [**pedestal**] [**wall**]-mounted.
- b. Switch Type: [**Mechanical-float**] [**Mercury-float**] [**Pressure**] <Insert type> type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
- c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
- d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with [**mechanical-float, mercury-float, or pressure**] <Insert type> switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

11. Control-Interface Features:

- a. Remote Alarm Contacts: For remote alarm interface.
- b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.

G. Submersible, Fixed-Position, Double-Seal Effluent Pumps:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. [ABS Pumps Inc.](#)
- b. [BJM Pumps, LLC.](#)
- c. [Federal Pump Corp.](#)
- d. [HOMA Pump Technology Inc.](#)
- e. [KSB Inc.](#)
- f. [Pentair Pump Group; Hydromatic Pumps;](#)
- g. [PX Pumps USA.](#)
- h. [Stancor, Inc.](#)
- i. [Tsurumi America, Inc.](#)
- j. [WILO-EMU USA LLC.](#)
- k. [Zoeller Company.](#)
- l. <Insert manufacturer's name>.

- m. or approved equal.
- 2. Description: Factory-assembled and -tested effluent-pump unit.
- 3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal effluent pump as defined in HI 1.1-1.2 and HI 1.3.
- 4. Pump Casing: Cast iron, with open inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
- 5. Impeller: Statically and dynamically balanced, [**ASTM A 48/A 48M, Class No. 25 A cast iron**] [**ASTM A 532/A 532M, abrasion-resistant cast iron**] [**ASTM B 584, cast bronze**] [**and**] [**stainless steel**], closed or semiopen design for clear wastewater, and keyed and secured to shaft.
- 6. Pump and Motor Shaft: Stainless steel[**or steel**], with factory-sealed, grease-lubricated ball bearings.
- 7. Seals: Mechanical.
- 8. Moisture-Sensing Probe: Internal moisture sensor and moisture alarm.
- 9. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - a. Motor Housing Fluid: [**Air**] [**Oil**].
- 10. Controls:
 - a. Enclosure: NEMA 250, [**Type 1**] [**Type 4X**] **<Insert type>**.
 - b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches** (1500 mm).
 - e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
- 11. Controls:
 - a. Enclosure: NEMA 250, [**Type 1**] [**Type 4X**] **<Insert type>**; [**pedestal**] [**wall**]-mounted.
 - b. Switch Type: [**Mechanical-float**] [**Mercury-float**] [**Pressure**] **<Insert type>** type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with [**mechanical-float, mercury-float, or pressure**] **<Insert type>** switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
- 12. Control-Interface Features:
 - a. Remote Alarm Contacts: For remote alarm interface.

- b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.

H. Submersible, Quick-Disconnect, Single-Seal Effluent Pumps:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Pentair Pump Group; Hydromatic Pumps.
 - b. Pentair Pump Group; Myers.
 - c. Stancor, Inc.
 - d. WILO-EMU USA LLC.
 - e. Zoeller Company.
 - f. **<Insert manufacturer's name>.**
 - g. or approved equal.
2. Description: Factory-assembled and -tested effluent-pump unit with guide-rail supports.
3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal effluent pump as defined in HI 1.1-1.2 and HI 1.3.
4. Pump Casing: Cast iron, with open inlet, and discharge fittings for connection to guide-rail support.
5. Impeller: Statically and dynamically balanced, [**ASTM A 48/A 48M, Class No. 25 A cast iron**] [**ASTM A 532/A 532M, abrasion-resistant cast iron**] [**ASTM B 584, cast bronze**] [**and**] [**stainless steel**], closed or semiopen design for clear wastewater, and keyed and secured to shaft.
6. Pump and Motor Shaft: Stainless steel[**or steel**], with factory-sealed, grease-lubricated ball bearings.
7. Seal: Mechanical.
8. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - a. Motor Housing Fluid: [**Air**] [**Oil**].
9. Controls:
 - a. Enclosure: NEMA 250, [**Type 1**] [**Type 4X**] **<Insert type>.**
 - b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches** (1500 mm).
 - e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

10. Controls:

- a. Enclosure: NEMA 250, [Type 1] [Type 4X] <Insert type>; [pedestal] [wall]-mounted.
- b. Switch Type: [Mechanical-float] [Mercury-float] [Pressure] <Insert type> type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
- c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
- d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with [mechanical-float, mercury-float, or pressure] <Insert type> switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

11. Control-Interface Features:

- a. Remote Alarm Contacts: For remote alarm interface.
- b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.

12. Guide-Rail Supports:

- a. Standard: SWPA's "Submersible Sewage Pumping Systems (SWPA) Handbook."
- b. Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.
- c. Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.
- d. Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.
- e. Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.
- f. Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.
- g. Lifting Cable: Stainless steel; attached to pump and cover at manhole.

I. Submersible, Quick-Disconnect, Double-Seal Effluent Pumps:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. [ABS Pumps Inc.](#)
 - b. [Chicago Pump Company; a division of Yeomans Chicago Corporation.](#)
 - c. [Federal Pump Corp.](#)
 - d. [HOMA Pump Technology Inc.](#)

- e. [ITT Flygt Corporation.](#)
 - f. [Pentair Pump Group; Hydromatic Pumps.](#)
 - g. [PX Pumps USA.](#)
 - h. [Stancor, Inc.](#)
 - i. [Tsurumi America, Inc.](#)
 - j. [WILO-EMU USA LLC.](#)
 - k. [Zoeller Company.](#)
 - l. **<Insert manufacturer's name>.**
 - m. or approved equal.
2. Description: Factory-assembled and -tested effluent-pump unit with guide-rail supports.
 3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal effluent pump as defined in HI 1.1-1.2 and HI 1.3.
 4. Pump Casing: Cast iron, with open inlet, and discharge fittings for connection to guide-rail support.
 5. Impeller: Statically and dynamically balanced, **[ASTM A 48/A 48M, Class No. 25 A cast iron] [ASTM A 532/A 532M, abrasion-resistant cast iron] [ASTM B 584, cast bronze] [and] [stainless steel]**, closed or semiopen design for clear wastewater, and keyed and secured to shaft.
 6. Pump and Motor Shaft: Stainless steel **[or steel]**, with factory-sealed, grease-lubricated ball bearings.
 7. Seals: Mechanical.
 8. Moisture-Sensing Probe: Internal moisture sensor and moisture alarm.
 9. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - a. Motor Housing Fluid: **[Air] [Oil]**.
10. Controls:
 - a. Enclosure: NEMA 250, **[Type 1] [Type 4X] <Insert type>**.
 - b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches (1500 mm)**.
 - e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 11. Controls:
 - a. Enclosure: NEMA 250, **[Type 1] [Type 4X] <Insert type>**; **[pedestal] [wall]**-mounted.
 - b. Switch Type: **[Mechanical-float] [Mercury-float] [Pressure] <Insert type>** type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.

- d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with **[mechanical-float, mercury-float, or pressure]** <Insert type> switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

12. Control-Interface Features:

- a. Remote Alarm Contacts: For remote alarm interface.
- b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.

13. Guide-Rail Supports:

- a. Standard: SWPA's "Submersible Sewage Pumping Systems (SWPA) Handbook."
- b. Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.
- c. Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.
- d. Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.
- e. Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.
- f. Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.
- g. Lifting Cable: Stainless steel; attached to pump and cover at manhole.

J. Capacities and Characteristics:

1. Unit Capacity: <Insert gpm (L/minute)>.
2. Number of Pumps: **[One]** **[Two]** <Insert value>.
3. Each Pump:
 - a. Capacity: <Insert gpm (L/minute)>.
 - b. Solids Handling Capability: **[Not applicable]** **[2 inches (50 mm)]** **[2-1/2 inches (65 mm)]** **[3 inches (75 mm)]** <Insert inches (mm)> minimum.
 - c. Total Dynamic Head: <Insert feet (kPa)>.
 - d. Speed: <Insert rpm>.
 - e. Discharge Pipe Size: <Insert NPS (DN)>.
 - f. Motor Horsepower: <Insert value>.
 - g. Electrical Characteristics:
 - 1) Volts: **[120]** **[240]** **[277]** **[480]** <Insert value>.
 - 2) Phases: **[Single]** **[Three]**.
 - 3) Hertz: 60.

4. Unit Electrical Characteristics:
 - a. Full-Load Amperes: **<Insert value>**.
 - b. Minimum Circuit Ampacity: **<Insert value>**.
 - c. Maximum Overcurrent Protection: **<Insert value>** A.

1.2 SUBMERSIBLE SEWAGE PUMPS

A. Submersible, Fixed-Position, Single-Seal Sewage Pumps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Barnes; Crane Pumps & Systems.
- b. Bell & Gossett Domestic Pump; ITT Corporation.
- c. EBARA Fluid Handling.
- d. Flo Fab inc.
- e. Goulds Pumps; ITT Corporation.
- f. Grundfos Pumps Corp.
- g. ITT Flygt Corporation.
- h. Liberty Pumps.
- i. Little Giant Pump Co.
- j. McDonald, A. Y. Mfg. Co.
- k. PACO Pumps; Grundfos Pumps Corporation, U.S.A.
- l. Peerless Pump, Inc.
- m. Pentair Pump Group; Hydromatic Pumps.
- n. Pentair Pump Group; Myers.
- o. Swaby Manufacturing Company.
- p. Weil Pump Company, Inc.
- q. Weinman Division; Crane Pumps & Systems.
- r. WILO-EMU USA LLC.
- s. Zoeller Company.
- t. **<Insert manufacturer's name>**.
- u. or approved equal.

2. Description: Factory-assembled and -tested sewage-pump unit.
3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sewage pump as defined in HI 1.1-1.2 and HI 1.3.
4. Pump Casing: Cast iron, with open inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
5. Impeller: Statically and dynamically balanced, [**ASTM A 48/A 48M, Class No. 25 A cast iron**] [**ASTM A 532/A 532M, abrasion-resistant cast iron**] [**ASTM B 584, cast bronze**] [**and**] [**stainless steel**], nonclog, open, or semiopen design for solids handling, and keyed and secured to shaft.
6. Pump and Motor Shaft: Stainless steel[**or steel**], with factory-sealed, grease-lubricated ball bearings.
7. Seal: Mechanical.

8. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - a. Motor Housing Fluid: **[Air] [Oil]**.
 9. Controls:
 - a. Enclosure: NEMA 250, **[Type 1] [Type 4X] <Insert type>**.
 - b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches** (1500 mm).
 - e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 10. Controls:
 - a. Enclosure: NEMA 250, **[Type 1] [Type 4X] <Insert type>**; **[pedestal] [wall]**-mounted.
 - b. Switch Type: **[Mechanical-float] [Mercury-float] [Pressure] <Insert type>** type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with **[mechanical-float, mercury-float, or pressure] <Insert type>** switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 11. Control-Interface Features:
 - a. Remote Alarm Contacts: For remote alarm interface.
 - b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.
- B. Submersible, Fixed-Position, Double-Seal Sewage Pumps:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. [ABS Pumps Inc.](#)
 - b. [Barnes; Crane Pumps & Systems.](#)
 - c. [Bell & Gossett Domestic Pump; ITT Corporation.](#)
 - d. [BJM Pumps, LLC.](#)

- e. [Chicago Pump Company; a division of Yeomans Chicago Corporation.](#)
 - f. [EBARA Fluid Handling.](#)
 - g. [E.I.M. Electric Co., Ltd.](#)
 - h. [Federal Pump Corp.](#)
 - i. [Goulds Pumps; ITT Corporation.](#)
 - j. [HOMA Pump Technology Inc.](#)
 - k. [ITT Flygt Corporation.](#)
 - l. [KSB Inc.](#)
 - m. [PACO Pumps; Grundfos Pumps Corporation, U.S.A..](#)
 - n. [Pentair Pump Group; Fairbanks Morse.](#)
 - o. [Pentair Pump Group; Hydromatic Pumps.](#)
 - p. [Pentair Pump Group; Myers.](#)
 - q. [PX Pumps USA.](#)
 - r. [Stancor, Inc.](#)
 - s. [Sta-Rite Industries, Inc.](#)
 - t. [Swaby Manufacturing Company.](#)
 - u. [Weil Pump Company, Inc.](#)
 - v. [Weinman Division; Crane Pumps & Systems.](#)
 - w. [WILO-EMU USA LLC.](#)
 - x. [Zoeller Company.](#)
 - y. **<Insert manufacturer's name>.**
 - z. or approved equal.
2. Description: Factory-assembled and -tested sewage-pump unit.
3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sewage pump as defined in HI 1.1-1.2 and HI 1.3.
4. Pump Casing: Cast iron, with open inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
5. Impeller: Statically and dynamically balanced, [**ASTM A 48/A 48M, Class No. 25 A cast iron**] [**ASTM A 532/A 532M, abrasion-resistant cast iron**] [**ASTM B 584, cast bronze**] [**and**] [**stainless steel**], nonclog, open, or semiopen design for solids handling, and keyed and secured to shaft.
6. Pump and Motor Shaft: Stainless steel[**or steel**], with factory-sealed, grease-lubricated ball bearings.
7. Seals: Mechanical.
8. Moisture-Sensing Probe: Internal moisture sensor and moisture alarm.
9. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
- a. Motor Housing Fluid: [**Air**] [**Oil**].
10. Controls:
- a. Enclosure: NEMA 250, [**Type 1**] [**Type 4X**] **<Insert type>**.
 - b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches** (1500 mm).

- e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

11. Controls:

- a. Enclosure: NEMA 250, [Type 1] [Type 4X] <Insert type>; [pedestal] [wall]-mounted.
- b. Switch Type: [Mechanical-float] [Mercury-float] [Pressure] <Insert type> type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
- c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
- d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with [mechanical-float, mercury-float, or pressure] <Insert type> switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

12. Control-Interface Features:

- a. Remote Alarm Contacts: For remote alarm interface.
- b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.

C. Submersible, Quick-Disconnect, Single-Seal Sewage Pumps:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. [EBARA Fluid Handling.](#)
- b. [Gorman-Rupp Company \(The\).](#)
- c. [Goulds Pumps; ITT Corporation.ITT Flygt Corporation.](#)
- d. [PACO Pumps; Grundfos Pumps Corporation, U.S.A.](#)
- e. [Pentair Pump Group; Hydromatic Pumps.](#)
- f. [Pentair Pump Group; Myers.](#)
- g. [Swaby Manufacturing Company.](#)
- h. [Weil Pump Company, Inc.](#)
- i. [WILO-EMU USA LLC.](#)
- j. [Zoeller Company.](#)
- k. <Insert manufacturer's name>.
- l. or approved equal.

2. Description: Factory-assembled and -tested sewage-pump unit with guide-rail supports.

3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sewage pump as defined in HI 1.1-1.2 and HI 1.3.

4. Pump Casing: Cast iron, with open inlet, and discharge fittings for connection to guide-rail support.
5. Impeller: Statically and dynamically balanced, [**ASTM A 48/A 48M, Class No. 25 A cast iron**] [**ASTM A 532/A 532M, abrasion-resistant cast iron**] [**ASTM B 584, cast bronze**] [**and**] [**stainless steel**], nonclog, open, or semiopen design for solids handling, and keyed and secured to shaft.
6. Pump and Motor Shaft: Stainless steel[**or steel**], with factory-sealed, grease-lubricated ball bearings.
7. Seal: Mechanical.
8. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - a. Motor Housing Fluid: [**Air**] [**Oil**].
9. Controls:
 - a. Enclosure: NEMA 250, [**Type 1**] [**Type 4X**] <Insert type>.
 - b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches** (1500 mm).
 - e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
10. Controls:
 - a. Enclosure: NEMA 250, [**Type 1**] [**Type 4X**] <Insert type>; [**pedestal**] [**wall**]-mounted.
 - b. Switch Type: [**Mechanical-float**] [**Mercury-float**] [**Pressure**] <Insert type> type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with [**mechanical-float, mercury-float, or pressure**] <Insert type> switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
11. Control-Interface Features:
 - a. Remote Alarm Contacts: For remote alarm interface.
 - b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.

12. Guide-Rail Supports:

- a. Standard: SWPA's "Submersible Sewage Pumping Systems (SWPA) Handbook."
- b. Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.
- c. Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.
- d. Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.
- e. Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.
- f. Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.
- g. Lifting Cable: Stainless steel; attached to pump and cover at manhole.

D. Submersible, Quick-Disconnect, Double-Seal Sewage Pumps:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. [ABS Pumps Inc.](#)
- b. [Barnes; Crane Pumps & Systems.](#)
- c. [Bell & Gossett Domestic Pump; ITT Corporation.](#)
- d. [BJM Pumps, LLC.](#)
- e. [Chicago Pump Company; a division of Yeomans Chicago Corporation.](#)
- f. [EBARA Fluid Handling.](#)
- g. [E.I.M. Electric Co., Ltd.](#)
- h. [Federal Pump Corp.](#)
- i. [Gorman-Rupp Company \(The\).](#)
- j. [Goulds Pumps; ITT Corporation.](#)
- k. [HOMA Pump Technology Inc.](#)
- l. [ITT Flygt Corporation.](#)
- m. [KSB Inc.](#)
- n. [PACO Pumps; Grundfos Pumps Corporation, U.S.A.](#)
- o. [Pentair Pump Group; Fairbanks Morse.](#)
- p. [Pentair Pump Group; Hydromatic Pumps.](#)
- q. [Pentair Pump Group; Myers.](#)
- r. [PX Pumps USA.](#)
- s. [Stancor, Inc.](#)
- t. [Sta-Rite Industries, Inc.](#)
- u. [Swaby Manufacturing Company.](#)
- v. [Tsurumi America, Inc.](#)
- w. [Weil Pump Company, Inc.](#)
- x. [Weinman Division; Crane Pumps & Systems.](#)
- y. [WILO-EMU USA LLC.](#)
- z. [Zoeller Company.](#)
- aa. **<Insert manufacturer's name>.**
- bb. or approved equal.

2. Description: Factory-assembled and -tested sewage-pump unit with guide-rail supports.
3. Pump type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sewage pump as defined in HI 1.1-1.2 and HI 1.3.
4. Pump Casing: Cast iron, with open inlet, and discharge fittings for connection to guide-rail support.
5. Impeller: Statically and dynamically balanced, [**ASTM A 48/A 48M, Class No. 25 A cast iron**] [**ASTM A 532/A 532M, abrasion-resistant cast iron**] [**ASTM B 584, cast bronze**] [**and**] [**stainless steel**], nonclog, open, or semiopen design for solids handling, and keyed and secured to shaft.
6. Pump and Motor Shaft: Stainless steel[**or steel**], with factory-sealed, grease-lubricated ball bearings.
7. Seals: Mechanical.
8. Moisture-Sensing Probe: Internal moisture sensor and moisture alarm.
9. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - a. Motor Housing Fluid: [**Air**] [**Oil**].
10. Controls:
 - a. Enclosure: NEMA 250, [**Type 1**] [**Type 4X**] <Insert type>.
 - b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches** (1500 mm).
 - e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
11. Controls:
 - a. Enclosure: NEMA 250, [**Type 1**] [**Type 4X**] <Insert type>; [**pedestal**] [**wall**]-mounted.
 - b. Switch Type: [**Mechanical-float**] [**Mercury-float**] [**Pressure**] <Insert type> type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with [**mechanical-float, mercury-float, or pressure**] <Insert type> switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
12. Control-Interface Features:
 - a. Remote Alarm Contacts: For remote alarm interface.

- b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.
13. Guide-Rail Supports:
 - a. Standard: SWPA's "Submersible Sewage Pumping Systems (SWPA) Handbook."
 - b. Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.
 - c. Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.
 - d. Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.
 - e. Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.
 - f. Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.
 - g. Lifting Cable: Stainless steel; attached to pump and cover at manhole.

E. Submersible, Quick-Disconnect, Grinder Sewage Pumps:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. [ABS Pumps Inc.](#)
 - b. [Alyan Pump Company.](#)
 - c. [Barnes; Crane Pumps & Systems.](#)
 - d. [BJM Pumps, LLC.](#)
 - e. [EBARA Fluid Handling.](#)
 - f. [HOMA Pump Technology Inc.](#)
 - g. [Liberty Pumps.](#)
 - h. [Pentair Pump Group; Hydromatic Pumps.](#)
 - i. [Stancor, Inc.](#)
 - j. [Tsurumi America, Inc.](#)
 - k. [Vaughan Co., Inc.](#)
 - l. [Weil Pump Company, Inc.](#)
 - m. [WILO-EMU USA LLC.](#)
 - n. [Zoeller Company.](#)
 - o. **<Insert manufacturer's name>.**
 - p. or approved equal.
2. Description: Factory-assembled and -tested, grinder sewage-pump unit with guide-rail supports.
3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sewage pump as defined in HI 1.1-1.2 and HI 1.3.

4. Pump Casing: Cast iron, with open inlet, and discharge fittings for connection to guide-rail supports.
5. Impeller: Bronze or stainless steel; statically and dynamically balanced, with stainless-steel cutter, grinder, or slicer assembly; capable of handling solids; and keyed and secured to shaft.
6. Pump and Motor Shaft: Stainless steel[**or steel**], with factory-sealed, grease-lubricated ball bearings.
7. Seal: Mechanical.
8. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - a. Motor Housing Fluid: [**Air**] [**Oil**].
9. Controls:
 - a. Enclosure: NEMA 250, [**Type 1**] [**Type 4X**] <Insert type>.
 - b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches** (1500 mm).
 - e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
10. Controls:
 - a. Enclosure: NEMA 250, [**Type 1**] [**Type 4X**] <Insert type>; [**pedestal**] [**wall**]-mounted.
 - b. Switch Type: [**Mechanical-float**] [**Mercury-float**] [**Pressure**] <Insert type> type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with [**mechanical-float, mercury-float, or pressure**] <Insert type> switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
11. Control-Interface Features:
 - a. Remote Alarm Contacts: For remote alarm interface.
 - b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.
12. Guide-Rail Supports:

- a. Standard: SWPA's "Submersible Sewage Pumping Systems (SWPA) Handbook."
- b. Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.
- c. Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.
- d. Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.
- e. Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.
- f. Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.
- g. Lifting Cable: Stainless steel; attached to pump and cover at manhole.

F. Submersible, Quick-Disconnect, Progressing-Cavity, Grinder Sewage Pumps:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. [Barnes; Crane Pumps & Systems.](#)
- b. [Environment One Corporation.](#)
- c. [Pentair Pump Group; Hydromatic Pumps.](#)
- d. **<Insert manufacturer's name>.**
- e. or approved equal.

2. Description: Factory-assembled and -tested progressing-cavity, grinder sewage-pump unit with guide-rail supports.
3. Pump Type: Submersible, progressing-cavity, single-screw rotary, grinder sewage pump as defined in HI 3.1-3.5.
4. Pump Body: [**Cast iron**] **<Insert material>.**
5. Pump Bearings: Radial and thrust types.
6. Pump Shaft: Steel.
7. Rotor: Stainless steel.
8. Stator: [**Buna-N**] [**or**] [**natural rubber**] **<Insert material>.**
9. Seal: Packing gland and mechanical types.
10. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
11. Controls:
 - a. Enclosure: NEMA 250, [**Type 1**] [**Type 4X**] **<Insert type>.**
 - b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches** (1500 mm).
 - e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

12. Controls:

- a. Enclosure: NEMA 250, [Type 1] [Type 4X] <Insert type>; [pedestal] [wall]-mounted.
- b. Switch Type: [Mechanical-float] [Mercury-float] [Pressure] <Insert type> type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
- c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
- d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with [mechanical-float, mercury-float, or pressure] <Insert type> switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

13. Control-Interface Features:

- a. Remote Alarm Contacts: For remote alarm interface.
- b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.

14. Guide-Rail Supports:

- a. Standard: SWPA's "Submersible Sewage Pumping Systems (SWPA) Handbook."
- b. Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.
- c. Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.
- d. Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.
- e. Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.
- f. Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.
- g. Lifting Cable: Stainless steel; attached to pump and cover at manhole.

G. Capacities and Characteristics:

1. Unit Capacity: <Insert gpm (L/minute)>.
2. Number of Pumps: [One] [Two] <Insert value>.
3. Each Pump:
 - a. Capacity: <Insert gpm (L/minute)>.
 - b. Solids Handling Capability: [Not applicable] [2 inches (50 mm)] [2-1/2 inches (65 mm)] [3 inches (75 mm)] <Insert inches (mm)> minimum.

- c. Total Dynamic Head: <Insert feet (kPa)>.
- d. Speed: <Insert rpm>.
- e. Discharge Pipe Size: <Insert NPS (DN)>.
- f. Motor Horsepower: <Insert value>.
- g. Electrical Characteristics:
 - 1) Volts: [120] [240] [277] [480] <Insert value>.
 - 2) Phases: [Single] [Three].
 - 3) Hertz: 60.
4. Unit Electrical Characteristics:
 - a. Full-Load Amperes: <Insert value>.
 - b. Minimum Circuit Ampacity: <Insert value>.
 - c. Maximum Overcurrent Protection: <Insert value> A.

2.2 WET-PIT-VOLUTE SEWAGE PUMPS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

1. [Alyan Pump Company.](#)
2. [Armstrong Pumps Inc.](#)
3. [Chicago Pump Company; a division of Yeomans Chicago Corporation.](#)
4. [Federal Pump Corp.](#)
5. [Flo Fab inc.](#)
6. [PACO Pumps; Grundfos Pumps Corporation, U.S.A.](#)
7. [Peerless Pump, Inc..](#)
8. [Pentair Pump Group; Aurora Pump.](#)
9. [Swaby Manufacturing Company.](#)
10. [Tramco Pump Company.](#)
11. [Vertiflo Pump Company.](#)
12. [Weil Pump Company, Inc.](#)
13. [Weinman Division; Crane Pumps & Systems.](#)
14. [Yeomans Chicago Corporation.](#)
15. <Insert manufacturer's name>.
16. or approved equal.

- B. Description: Factory-assembled and -tested sewage-pump unit.
- C. Pump Type: Wet-pit-volute, single-stage, separately-coupled, overhung-impeller, centrifugal sewage pump as defined in HI 1.1-1.2 and HI 1.3.
- D. Pump Casing: Cast iron, with open inlet and threaded or flanged connection for discharge piping.
- E. Pump Shaft: [Stainless-steel] [and] [steel].
- F. Impeller: Statically and dynamically balanced, [ASTM A 48/A 48M, Class No. 25 A

- cast iron] [ASTM A 532/A 532M, abrasion-resistant cast iron] [and] [ASTM B 584, cast bronze]**, nonclog, open, or semiopen design for solids handling, and keyed and secured to shaft.
- G. Sleeve Bearings: Bronze. Include oil-lubricated, intermediate sleeve bearings at **48-inch (1200-mm)** maximum intervals if basin depth is more than **48 inches (1200 mm)**, and grease-lubricated, ball-type thrust bearings.
- H. Pump and Motor Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
- I. Pump Discharge Piping: Factory or field fabricated, [**galvanized, ASTM A 53/A 53M, Schedule 40, steel pipe with ASME B16.1, Class 125, cast-iron flanges and flanged fittings or ASME B16.4, Class 125, gray iron threaded fittings**] <Insert pipe material>.
1. Modify piping configuration to accommodate reverse-flow assembly.
- J. Support Plate: Cast iron or coated steel and strong enough to support pumps, motors, and controls. Refer to Part 2 "Sewage-Pump Basins and Basin Covers" Article for requirements.
- K. Shaft Seal: Stuffing box, with graphite-impregnated braided-yarn rings and bronze packing gland.
- L. Motor: Single-speed; grease-lubricated ball bearings and mounted on vertical, cast-iron pedestal.
- M. Controls:
1. Enclosure: NEMA 250, [**Type 1**] [**Type 4X**] <Insert type>.
 2. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 3. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 4. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches (1500 mm)**.
 5. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
- N. Controls:
1. Enclosure: NEMA 250, [**Type 1**] [**Type 4X**] <Insert type>; [**pedestal**] [**wall**]-mounted.
 2. Switch Type: [**Mechanical-float**] [**Mercury-float**] [**Pressure**] <Insert type> type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 3. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 4. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with [**mechanical-float, mercury-float, or pressure**] <Insert type> switch matching

control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

O. Control-Interface Features:

1. Remote Alarm Contacts: For remote alarm interface.
2. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - a. On-off status of pump.
 - b. Alarm status.

P. Capacities and Characteristics:

1. Unit Capacity: <Insert gpm (L/minute).>
2. Number of Pumps: [One] [Two] <Insert value>.
3. Each Pump:
 - a. Capacity: <Insert gpm (L/minute).>
 - b. Solids Handling Capability: [2 inches (50 mm)] [2-1/2 inches (65 mm)] [3 inches (75 mm)] <Insert inches (mm)> minimum.
 - c. Total Dynamic Head: <Insert feet (kPa)>.
 - d. Speed: <Insert rpm>.
 - e. Discharge Pipe Size: <Insert NPS (DN)>.
 - f. Motor Horsepower: <Insert value>.
 - g. Electrical Characteristics:
 - 1) Volts: [120] [240] [277] [480] <Insert value>.
 - 2) Phases: [Single] [Three].
 - 3) Hertz: 60.
4. Unit Electrical Characteristics:
 - a. Full-Load Amperes: <Insert value>.
 - b. Minimum Circuit Ampacity: <Insert value>.
 - c. Maximum Overcurrent Protection: <Insert value> A.

2.3 SEWAGE-PUMP, REVERSE-FLOW ASSEMBLIES

A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

1. [Chicago Pump Company; a division of Yeomans Chicago Corporation.](#)
2. [Federal Pump Corp.](#)
3. [PACO Pumps; Grundfos Pumps Corporation, U.S.A.](#)
4. [Peerless Pump, Inc.](#)
5. [Weil Pump Company, Inc.](#)
6. [Yeomans Chicago Corporation.](#)
7. <Insert manufacturer's name>.
8. or approved equal.

- B. Description: Factory-fabricated, sewage pump reverse-flow assembly for factory or field assembly and installation in sewage pump basin. Include the following corrosion-resistant-metal components:
1. Inlet Fitting: One combination inlet-overflow strainer fitting.
 2. Valves: Two shutoff valves and two check valves.
 3. Strainers: Two strainer housings with reverse-flow, self-flushing strainers.
 4. Pipe and Fittings: Size and configuration required to connect to sewage pumps and piping.

2.4 SEWAGE-PUMP BASINS AND BASIN COVERS

- A. Basins: Factory-fabricated, watertight, cylindrical, basin sump with top flange and sidewall openings for pipe connections.
1. Material: [**Cast iron**] [**Fiberglass**] [**Polyethylene**] <Insert material>.
 2. Reinforcement: Mounting plates for pumps, fittings[, **guide-rail supports if used,**] and accessories.
 3. Anchor Flange: Same material as or compatible with basin sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.
- B. Basin Covers: Fabricate metal cover with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
1. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.
- C. Capacities and Characteristics:
1. Capacity: <Insert gal (L)>.
 2. Diameter: <Insert inches (mm)>.
 3. Depth: <Insert inches (mm)>.
 4. Inlet No. 1:
 - a. Drainage Pipe Size: <Insert NPS (DN)>.
 - b. Bottom of Sump to Centerline: <Insert inches (mm)>.
 - c. Type: [**Flanged**] [**Hubbed**] [**Threaded**] outside.
 5. Inlet No. 2:
 - a. Drainage Pipe Size: <Insert NPS (DN)>.
 - b. Bottom of Sump to Centerline: <Insert inches (mm)>.
 - c. Type: [**Flanged**] [**Hubbed**] [**Threaded**] outside.
 6. Inlet No. 3:
 - a. Drainage Pipe Size: <Insert NPS (DN)>.
 - b. Bottom of Sump to Centerline: <Insert inches (mm)>.

- c. Type: **[Flanged]** **[Hubbed]** **[Threaded]** outside.
7. Sidewall Outlet:
 - a. Discharge Pipe Size: **<Insert NPS (DN)>**.
 - b. Bottom of Sump to Centerline: **<Insert inches (mm)>**.
 - c. Type: **[Hubbed inside]** **[Hubbed outside]** **<Insert type>**.
 8. Cover Material: **[Cast iron]** **[Steel with bituminous coating]** **[Cast iron or steel with bituminous coating]** **<Insert material>**.
 9. Cover Diameter: **<Insert inches (mm)>**, but not less than outside diameter of basin top flange.
 10. Manhole Required in Cover: **[Yes]** **[No]**.
 11. Vent Size: **<Insert NPS (DN)>**.

2.5 SEWAGE PUMP PITS

- A. Description: Concrete pit with sump, pipe connections, curb frame, and separate cover.
- B. Sump: Construct of watertight, cast-in-place, reinforced concrete with sidewall openings for pipe connections. Cast-in-place concrete, formwork, and reinforcement are specified in Division 03.
 1. Pipe Connections: Sleeved openings large enough for mechanical sleeve seals for drainage piping. Sleeves and mechanical sleeve seals are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping".
- C. Curb Frame and Cover:
 1. Curb Frame Material: Galvanized steel or steel with bituminous coating.
 - a. Pattern: **[Angle-cross-section shape with flat top surface]** **[Z-cross-section shape with raised outer rim of height matching cover, for recessed mounting with installed cover flush with top of floor slab]**.
 2. Cover: Fabricate with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
 - a. Material: **[Cast iron]** **[Cast iron or steel with bituminous coating]** **[Steel with bituminous coating]**.
 - b. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.
- D. Capacities and Characteristics:
 1. Capacity: **<Insert gallons >**
 2. Diameter: **<Insert inches>**

3. Depth: **<Insert inches>**
4. Inlet No. 1:
 - a. Drainage Pipe Size: **<Insert NPS>**.
 - b. Bottom of Pit to Centerline: **<Insert inches>**.
5. Inlet No. 2:
 - a. Drainage Pipe Size: **<Insert NPS>**.
 - b. Bottom of Pit to Centerline: **<Insert inches>**.
6. Inlet No. 3:
 - a. Drainage Pipe Size: **<Insert NPS>**.
 - b. Bottom of Pit to Centerline: **<Insert inches>**.
7. Sidewall Outlet:
 - a. Discharge Pipe Size: **<Insert NPS>**.
 - b. Bottom of Pit to Centerline: **<Insert inches>**.
8. Curb Frame:
 - a. Material: **[Galvanized steel] [Steel with bituminous coating]**.
 - b. Pattern: **<Insert pattern>**.
9. Cover:
 - a. Material: **[Cast iron] [Cast iron or steel with bituminous coating] [Steel with bituminous coating]**.
 - b. Diameter: **<Insert inches>**.
 - c. Manhole Required: **[Yes] [No]**.
 - d. Vent Size: **<Insert NPS>**

2.6 PROGRESSING-CAVITY SEWAGE PUMPS

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 1. **Continental Pump Co.**
 2. **Moyno, Inc.; a unit of Robbins & Myers, Inc.Roper Pump Co.**
 3. **<Insert manufacturer's name>**.
 4. **or approved equal.**
- B. **Description: Factory-assembled and -tested progressing-cavity, single-screw rotary pump as defined in HI 3.1-3.5.**
- C. **Pump Body: [Cast iron] <Insert material> with feet for base or floor installation.**
- D. **Pump Bearings: Radial and thrust types.**

- E. Pump Shaft: Steel.
- F. Rotor: [**Chrome-plated steel**] <Insert material>.
- G. Stator: [**Buna-N**] [or] [natural rubber] <Insert material>.
- H. Seals: Packing gland and mechanical types.
- I. Coupling: Flexible.
- J. Motor: Single-speed; grease-lubricated ball bearings.
- K. Capacities and Characteristics:
 - 1. Capacity: <Insert gpm (L/minute)>.
 - 2. Solids Handling Capability: [**Not applicable**] [2 inches (50 mm)] [2-1/2 inches (65 mm)] [3 inches (75 mm)] <Insert inches (mm)> minimum.
 - 3. Total Dynamic Head: <Insert feet (kPa)>.
 - 4. Speed: <Insert rpm>.
 - 5. Discharge Pipe Size: <Insert NPS (DN)>.
 - 6. Motor Horsepower: <Insert value>.
 - 7. Electrical Characteristics:
 - a. Volts: [**120**] [**240**] [**277**] [**480**] <Insert value>.
 - b. Phases: [**Single**] [**Three**].
 - c. Hertz: 60.
 - 8. Unit Electrical Characteristics:
 - a. Full-Load Amperes: <Insert value>.
 - b. Minimum Circuit Ampacity: <Insert value>.
 - c. Maximum Overcurrent Protection: <Insert value> A.

2.7 PACKAGED, SUBMERSIBLE SEWAGE-PUMP UNITS

- A. Packaged, Submersible, Grinder, Sewage-Pump Units:
 - 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Barnes; Crane Pumps & Systems.
 - b. Environment One Corporation.
 - c. Goulds Pumps; ITT Corporation.
 - d. Liberty Pumps.
 - e. McDonald, A. Y. Mfg. Co.
 - f. Pentair Pump Group; Myers.
 - g. Zoeller Company.
 - h. <Insert manufacturer's name>.
 - i. or approved equal.

2. Description: Factory-assembled and -tested, automatic-operation, basin-mounted, grinder, sewage-pump unit.
3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller centrifugal pump as defined in HI 1.1-1.2 and HI 1.3.
4. Pump Casing: Cast iron.
5. Impeller: Stainless-steel grinder[, **cutter, or slicer**] type with shredding ring.
6. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
7. Control: Manufacturer's standard panel for one pump.
8. Controls: Automatic, with mechanical- or mercury-float switches and alternator.
9. Pump Discharge Piping: Factory or field fabricated, [**galvanized, ASTM A 53/A 53M, Schedule 40, steel pipe with ASME B16.4, Class 125, gray iron threaded fittings**] <Insert pipe material>.
10. Basin: Watertight[**plastic**] and of size required for pumps, with inlet pipe connection and gastight cover with pump discharge and vent connections.

B. Packaged, Submersible, Nonclog, Sewage-Pump Units:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. [Barnes; Crane Pumps & Systems.](#)
- b. [Bell & Gossett Domestic Pump; ITT Corporation.](#)
- c. [Glentronics, Inc.](#)
- d. [Goulds Pumps; ITT Corporation.](#)
- e. [Grundfos Pumps Corp.](#)
- f. [Liberty Pumps.](#)
- g. [Little Giant Pump Co.](#)
- h. [McDonald, A. Y. Mfg. Co.](#)
- i. [PACO Pumps; Grundfos Pumps Corporation, U.S.A.](#)
- j. [Pentair Pump Group; Hydromatic Pumps.](#)
- k. [Pentair Pump Group; Myers.](#)
- l. [Sta-Rite Industries, Inc.](#)
- m. [Zoeller Company.](#)
- n. **<Insert manufacturer's name>.**
- o. or approved equal.

2. Description: Factory-assembled and -tested, automatic-operation, basin-mounted, sewage-pump unit.
3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller centrifugal pump as defined in HI 1.1-1.2 and HI 1.3.
4. Pump Casing: Cast iron.
5. Impeller: Brass or cast iron; statically and dynamically balanced, non-clog design, and capable of handling **2-inch (50-mm)** diameter solids.
6. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
7. Control: Manufacturer's standard panel for one pump.
8. Controls: Automatic, with mechanical- or mercury-float switches and alternator.

9. Pump Discharge Piping: Factory or field fabricated, **[galvanized, ASTM A 53/A 53M, Schedule 40, steel pipe with ASME B16.4, Class 125, gray iron threaded fittings]** <Insert pipe material>.
10. Basin: Watertight[**plastic**] and of size required for pumps, with inlet pipe connection and gastight cover with pump discharge and vent connections.

C. Capacities and Characteristics:

1. System Capacity: <Insert gpm (L/minute)>.
2. Number of Pumps: [**One**] [**Two**].
3. Each Pump:
 - a. Capacity: <Insert gpm (L/minute)>.
 - b. Total Dynamic Head: <Insert feet (kPa)>.
 - c. Speed: <Insert rpm>.
 - d. Discharge Pipe Size: <Insert NPS (DN)>.
 - e. Motor Horsepower: <Insert value>.
 - f. Electrical Characteristics:
 - 1) Volts: [**120**] [**240**] [**277**] [**480**] <Insert value>.
 - 2) Phases: [**Single**] [**Three**].
 - 3) Hertz: 60.
4. Unit Electrical Characteristics:
 - a. Full-Load Amperes: <Insert value>.
 - b. Minimum Circuit Ampacity: <Insert value>.
 - c. Maximum Overcurrent Protection: <Insert value> A.
5. Alternator Control Required: [**Yes**] [**No**].
6. Basin:
 - a. Dimensions: <Insert values>.
 - b. Inlet Size: <Insert NPS (DN)>.
 - c. Bottom to Inlet Centerline: <Insert inches (mm)>.
 - d. Vent Size: <Insert NPS (DN)>.

2.8 PACKAGED WASTEWATER-PUMP UNITS

A. Packaged, Wet-Pit-Volute, Wastewater-Pump Units:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. [Alyan Pump Company](#).
 - b. [Federal Pump Corp.](#)
 - c. [Hartell Pumps; a div. of Milton Roy Company](#).
 - d. <Insert manufacturer's name>.
 - e. or approved equal.

2. Description: Factory-assembled and -tested, automatic-operation, basin-mounted, effluent-pump unit.
3. Pump Type: Wet-pit-volute, single-stage, separately-coupled, overhung-impeller centrifugal pump as defined in HI 1.1-1.2 and HI 1.3.
4. Pump Body and Impeller: Corrosion-resistant materials.
5. Motor: With built-in overload protection and mounted vertically on basin cover.
6. Power Cord: Three-conductor, waterproof cable of length required but not less than **72 inches** (1830 mm) and with grounding plug and cable-sealing assembly for connection at pump.
7. Control: Float switch.
8. Pump Discharge Piping: Factory or field fabricated, **[galvanized, ASTM A 53/A 53M, Schedule 40, steel pipe with ASME B16.4, Class 125, gray iron threaded fittings]** <Insert pipe material>.
9. Basin: Watertight, aluminum, plastic, or coated steel with inlet pipe connection and gastight cover with vent and pump discharge connections.

B. Packaged, Submersible Wastewater-Pump Units:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. [ABS Pumps Inc.](#)
- b. [Bell & Gossett Domestic Pump; ITT Corporation.](#)
- c. [Goulds Pumps; ITT Corporation.](#)
- d. [Grundfos Pumps Corp.](#)
- e. [Liberty Pumps.](#)
- f. [Little Giant Pump Co.](#)
- g. [McDonald, A. Y. Mfg. Co.](#)
- h. [Pentair Pump Group; Myers.](#)
- i. [Sta-Rite Industries, Inc.](#)
- j. [Zoeller Company.](#)
- k. **<Insert manufacturer's name>.**
- l. or approved equal.

2. Description: Factory-assembled and -tested, automatic-operation, effluent-pump unit with basin.
3. Pump Type: Submersible, end-suction, single-stage, overhung-impeller, centrifugal pump as defined in HI 1.1-1.2 and HI 1.3.
4. Pump Body and Impeller: Corrosion-resistant materials.
5. Pump Seals: Mechanical.
6. Motor: Hermetically sealed, capacitor-start type, with built-in overload protection.
7. Power Cord: Three-conductor, waterproof cable of length required but not less than **72 inches** (1830 mm) and with grounding plug and cable-sealing assembly for connection at pump.
8. Control: Float switch.
9. Pump Discharge Piping: Factory or field fabricated, **[galvanized, ASTM A 53/A 53M, Schedule 40, steel pipe with ASME B16.4, Class 125, gray iron threaded fittings]** <Insert pipe material>.
10. Basin: Watertight plastic with inlet pipe connection and gastight cover with vent and pump discharge connections.

11. Capacities and Characteristics:

- a. Pump Capacity: <Insert gpm (L/minute)>.
- b. Total Dynamic Head: <Insert feet (kPa)>.
- c. Speed: <Insert rpm>.
- d. Discharge Pipe Size: <Insert NPS (DN)>.
- e. Motor Horsepower: <Insert value>.
- f. Electrical Characteristics:
 - 1) Volts: [120] [240] <Insert value>.
 - 2) Phases: [Single] [Three].
 - 3) Hertz: 60.
- g. Unit Electrical Characteristics:
 - 1) Full-Load Amperes: <Insert value>.
 - 2) Minimum Circuit Ampacity: <Insert value>.
 - 3) Maximum Overcurrent Protection: <Insert value> A.
- h. Basin:
 - 1) Capacity: [2 gal (7.6 L)] [4 gal (15.1 L)] <Insert capacity> minimum.
 - 2) Inlet Connection: [NPS 1-1/2 (DN 40)] <Insert size> minimum.
 - 3) Vent Connection: [NPS 1-1/2 (DN 40)] <Insert size> minimum.

2.9 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation and filling are specified in Section 312000 "Earth Moving."

3.2 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

- B. Examine roughing-in for plumbing piping to verify actual locations of sanitary drainage and vent piping connections before sewage pump installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 CONCRETE

- A. Install concrete bases of dimensions indicated for pumps and controllers. Refer to Section 220500 Common Work Results for Plumbing".
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.4 IDENTIFICATION

- A. Install identifying labels permanently attached to equipment.
- B. Install operating instruction signs permanently attached to equipment or on pumping station wall near equipment.
- C. Arrange for installing green [**warning tape or**] detectable warning tape over outside edges of underground packaged pumping stations. Tape materials and their installation are specified in Section 220553 "Identification for Plumbing Piping and Equipment".

3.5 INSTALLATION

- A. Pump Installation Standards:
 - 1. Comply with HI 1.4 for installation of centrifugal pumps.
 - 2. Comply with HI 3.1-3.5 for installation of progressing-cavity sewage pumps.
- B. Equipment Mounting:
 - 1. Install progressing-cavity sewage pumps on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in [**Section 033000 "Cast-in-Place Concrete."**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete."**]
 - 2. Comply with requirements for vibration isolation and seismic control devices

specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment"

3. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

- C. Wiring Method: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.6 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Connect sanitary drainage and vent piping to pumps. Install discharge piping equal to or greater than size of pump discharge piping. Install vent piping equal to or greater than size of pump basin vent connection. Refer to Section 221316 "Sanitary Waste and Vent Piping".
 1. Install flexible connectors adjacent to pumps in discharge piping.
 2. Install check and shutoff valves on discharge piping from each pump. Install unions on pumps having threaded pipe connections. Install valves same size as connected piping. Refer to Section 221316 "Sanitary Waste and Vent Piping" for general-duty valves for sanitary waste piping.
- D. Make connections with dielectric fittings where piping is made of dissimilar metal.
- E. Electrical Connections: Power wiring and disconnect switches are specified in Division 26 Sections. Arrange wiring to allow unit service.
- F. Ground Equipment:
 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 1. Manufacturer's Field Service: Engage a factory-authorized service representative to assist Contractor and inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. After installing packaged pumping stations and after electrical circuitry has been energized, test for compliance with requirements. Furnish water required for pump tests.
2. Perform each visual and mechanical inspection.
3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Pumps and controls will be considered defective if they do not pass tests and inspections.

D. Remove malfunctioning units, replace with new units, and retest as specified above.

E. Prepare test and inspection reports.

3.8 STARTUP SERVICE

A. **[Engage a factory-authorized service representative to perform] [Perform]** startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify bearing lubrication.
3. Disconnect couplings and check motors for proper direction of rotation.
4. Verify that each pump is free to rotate by hand. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
5. Verify that pump controls are correct for required application.
6. **<Insert additional startup steps if any.>**

B. Start pumps without exceeding safe motor power:

1. Start motors.
2. Open discharge valves slowly.
3. Check general mechanical operation of pumps and motors.

C. Test and adjust controls and safeties.

D. Remove and replace damaged and malfunctioning components.

1. Pump Controls: Set pump controls for automatic start, stop, and alarm operation as required for system application.
2. Set field-adjustable switches and circuit-breaker trip ranges as indicated, or if not indicated, for normal operation.

E. Occupancy Adjustments: When requested by DEN Project Manager within twelve (12)

months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions.

1. Provide up to two (2) visits to Project outside normal occupancy hours for this purpose.

3.9 ADJUSTING

- A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust control set points.

3.10 CLEANING

- A. Clean dirt and debris from wet wells, pumps, and piping.
- B. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finishes to match original finishes.
- C. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove dirt and construction debris and repair damaged finishes.

3.11 DEMONSTRATION

- A. Engage a factory-authorized service representative to assist Contractor and train Owner's maintenance personnel to adjust, operate, and maintain[**controls and**] pumps.
 1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days' advance notice.
- B. Review data in maintenance manuals. Refer to Section 017825 "Operation and Maintenance Data".

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 221329

SECTION 221343 - FACILITY PACKAGED SEWAGE PUMPING STATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes dry-well, packaged pumping stations with [**dry-well**] [**vacuum-primed**] sewage pumps.
- B. This Section includes wet-well, packaged pumping stations with [**submersible**] [**submersible grinder**] [**wet-well-mounting**] sewage pumps.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 PERFORMANCE REQUIREMENTS

- A. Pressure Rating of Sewage Pumps and Discharge Piping Components: At least equal to sewage pump discharge pressure, but not less than **125 psig** (860 kPa).
- B. Pressure Rating of Other Piping Components: At least equal to system operating pressure.

1.4 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.
 - 1. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: Show fabrication and installation details for each packaged sewage pumping station. Detail equipment assemblies and indicate dimensions; shipping, installed, and operating weights; loads; required clearances; method of field assembly; components; electrical characteristics; and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of sewage pump, signed by product manufacturer.
- B. Manufacturer Seismic Qualification Certification: Submit certification that packaged sewage pumping station, accessories, and components will withstand seismic forces defined in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means, "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means, "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Qualification Data: For **[Installer]** **[testing agency]**.
- D. Source quality-control test reports.
- E. Field quality-control test reports.
- F. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For equipment to include in emergency, operation, and maintenance manuals.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer.

- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of pack-aged pumping stations and are based on the specific system indicated.
- D. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Comply with HI 1.1-1.2, "Centrifugal Pumps for Nomenclature and Definitions"; HI 1.3, "Centrifugal Pumps for Design and Application"; and HI 1.4, "Centrifugal Pumps for Installation, Operation and Maintenance," for sewage[**and sump**] pumps.
- G. NEMA Compliance: Comply with NEMA MG 1 for electric motors.
- H. Comply with UL 778, "Motor-Operated Water Pumps," for sewage[**and sump**] pumps.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Sewer Service: Do not interrupt sanitary sewer service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sanitary sewer service according to requirements indicated:
 - 1. Notify DEN Project Manager no fewer than seven (7) days in advance of proposed interruption of sanitary sewer service.
 - 2. Do not proceed with interruption of sanitary sewer service without DEN Project Manager's written permission.

1.9 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in [**Section 033000 "Cast-in-Place Concrete."**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete."**]

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged sewage pumping stations that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including shell.
 - b. Faulty operation of sewage pumps, controls, or accessories.

- c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Period for Shells: Minimum **<Insert number>** years from date of Substantial Completion.
3. Warranty Period for Sewage Pumps and Controls: Minimum**<Insert number>** years from date of Substantial Completion.
4. Warranty Period for Accessories: Minimum**<Insert number>** years from date of Substantial Completion.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 DRY-WELL, PACKAGED SEWAGE PUMPING STATIONS

- A. Dry-Well, Packaged Sewage Pumping Stations with Dry-Well Sewage Pumps:
 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Dakota Pump Incorporated.
 - b. Gorman-Rupp Company (The).
 - c. PumpTech, Inc.
 - d. Smith & Loveless.
 - e. USEMCO.
 - f. **<Insert manufacturer's name.>**
 - g. or approved equal.
 2. Description: Factory fabricated, assembled, and tested with wet well for **[comminutor and]**collection of sanitary sewage and with dry equipment chamber for sewage pumps, controls, and accessories.
 - a. Orientation: Shell underground with dry equipment chamber **[underground with top flush with grade] [partially recessed underground] [above grade] [underground with entrance tube to grade] <Insert orientation>**.
 - b. Shell: Factory fabricated from **[structural-steel plate] [fiberglass]**.
 - c. Entrance Tube: From dry compartment to entrance at grade, and of size required to replace largest piece of equipment, but not smaller than **[36 inches (914 mm)] <Insert dimension>** in diameter.
 - d. Cathodic Protection: **<Insert number>** exterior magnesium anode(s).
 - e. Comminutor: Full size of sewage inlet pipe.
 - f. Sewage Pumps: **[Two] [Three] <Insert number>** dry-well-type, nonclog sewage pumps with controls and piping. Include ASTM A 48/A 48M, Class

25, nonclog, cast-iron impeller capable of passing solids of 3-inch (76-mm) minimum diameter; mechanical or stuffing-box seals; and pedestal-mounted motor.

3. Capacities and Characteristics:

- a. Diameter or Dimensions of Shell: **<Insert inches (mm) or other dimensions.>**
- b. Height of Shell Base Section: **<Insert inches (mm).>**
- c. Pumping Station, Inlet Pipe Size: **<Insert NPS (DN).>**
- d. Pumping Station, Discharge Pipe Size: **<Insert NPS (DN).>**
- e. Comminutor:
 - 1) Required: **[No] [Yes]**.
 - 2) Capacity: **<Insert gpm (L/s).>**
 - 3) Pipe Size: **<Insert NPS (DN).>**
 - 4) Motor Size: **<Insert value.>**
 - 5) Electrical Characteristics:
 - a) Volts: **[240] [277] [480] <Insert value> V.**
 - b) Phases: **[Single] [Three]**.
 - c) Hertz: 60.
- f. Sewage Pumps: **[Two] [Three] <Insert number>** required.
- g. Each Sewage Pump:
 - 1) Capacity: **<Insert gpm (L/s).>**
 - 2) Total Dynamic Head: **<Insert feet (kPa).>**
 - 3) Speed: **<Insert rpm.>**
 - 4) Impeller:
 - a) Type: **<Insert type.>**
 - b) Diameter: **<Insert inches (mm).>**
 - c) Solids Size Design: **<Insert inches (mm).>**
 - 5) Inlet Size: **<Insert NPS (DN).>**
 - 6) Discharge Size: **<Insert NPS (DN).>**
 - 7) Motor Size: **<Insert value> hp.**
 - 8) Electrical Characteristics:
 - a) Volts: **[240] [277] [480] <Insert value> V.**
 - b) Phases: **[Single] [Three]**.
 - c) Hertz: 60.
- h. Sump Pump:
 - 1) Capacity: **<Insert gpm (L/s).>**
 - 2) Total Dynamic Head: **<Insert feet (kPa).>**
 - 3) Speed: **<Insert rpm.>**
 - 4) Discharge Size: **<Insert NPS (DN).>**

- 5) Motor Size: **<Insert value>** hp.
 - 6) Electrical Characteristics:
 - a) Volts: **[120] [240] [277] [480] <Insert value>** V.
 - b) Phases: **[Single] [Three]**.
 - c) Hertz: 60.
 - i. Pumping Station Electrical Characteristics:
 - 1) Full-Load Amperes: **<Insert value.>**
 - 2) Minimum Circuit Ampacity: **<Insert value.>**
 - 3) Maximum Overcurrent Protection: **<Insert amperage.>**
- B. Dry-Well, Packaged Sewage Pumping Stations with Vacuum-Primed Sewage Pumps:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Dakota Pump Incorporated.
 - b. Gorman-Rupp Company (The).
 - c. PumpTech, Inc.
 - d. USEMCO.
 - e. **<Insert manufacturer's name.>**
 - f. or approved equal.
 2. Description: Factory fabricated, assembled, and tested with wet well for **[comminutor and]**collection of sanitary sewage and with dry equipment chamber for sewage pumps, vacuum pumps, controls, and accessories.
 - a. Orientation: Shell underground with dry equipment chamber **[underground with top flush with grade] [partially recessed underground] [above grade] [underground with entrance tube to grade] <Insert orientation>**.
 - b. Shell: Factory fabricated from **[structural-steel plate] [fiberglass]**.
 - c. Entrance Tube: From dry compartment to entrance at grade, and of size required to replace largest piece of equipment, but not smaller than **[36 inches (914 mm)] <Insert dimension>** in diameter.
 - d. Cathodic Protection: **<Insert number>** exterior magnesium anode(s).
 - e. Comminutor: Full size of sewage inlet pipe.
 - f. Sewage Pumps: **[Two] [Three] <Insert number>** dry-chamber-mounting, vacuum-primed, nonclog sewage pumps located in dry compartment above wet pit, with controls and piping. Include ASTM A 48/A 48M, Class 25, nonclog, cast-iron impeller capable of passing solids of **3-inch (76-mm)** minimum diameter; mechanical or stuffing-box seals; pedestal-mounted motor; and suction piping extending to bottom of wet pit.
 - g. Vacuum Pumps: Duplex arrangement with controls, vacuum piping, and vent piping of size and capacity required for system. Include automatic alternator, with manual disconnect switch, to change sequence of lead-lag vacuum pumps at completion of each cycle.
 3. Capacities and Characteristics:

- a. Diameter or Dimensions of Shell: **<Insert inches (mm) or other dimensions.>**
- b. Height of Shell Base Section: **<Insert inches (mm).>**
- c. Pumping Station, Inlet Pipe Size: **<Insert NPS (DN).>**
- d. Pumping Station, Discharge Pipe Size: **<Insert NPS (DN).>**
- e. Comminutor:
 - 1) Required: **[No] [Yes]**.
 - 2) Capacity: **<Insert gpm (L/s).>**
 - 3) Pipe Size: **<Insert NPS (DN).>**
 - 4) Motor Size: **<Insert value>** hp.
 - 5) Electrical Characteristics:
 - a) Volts: **[240] [277] [480] <Insert value>** V.
 - b) Phases: **[Single] [Three]**.
 - c) Hertz: 60.
- f. Sewage Pumps: **[Two] [Three] <Insert number>** required.
- g. Each Sewage Pump:
 - 1) Capacity: **<Insert gpm (L/s).>**
 - 2) Total Dynamic Head: **<Insert feet (kPa).>**
 - 3) Speed: **<Insert rpm.>**
 - 4) Impeller:
 - a) Type: **<Insert type.>**
 - b) Diameter: **<Insert inches (mm).>**
 - c) Solids Size Design: **<Insert inches (mm).>**
 - 5) Inlet Size: **<Insert NPS (DN).>**
 - 6) Discharge Size: **<Insert NPS (DN).>**
 - 7) Motor Size: **<Insert value>** hp.
 - 8) Electrical Characteristics:
 - a) Volts: **[240] [277] [480] <Insert value>** V.
 - b) Phases: **[Single] [Three]**.
 - c) Hertz: 60.
- h. Sump Pump:
 - 1) Capacity: **<Insert gpm (L/s).>**
 - 2) Total Dynamic Head: **<Insert feet (kPa).>**
 - 3) Speed: **<Insert rpm.>**
 - 4) Discharge Size: **<Insert NPS (DN).>**
 - 5) Motor Size: **<Insert value>** hp.
 - 6) Electrical Characteristics:
 - a) Volts: **[120] [240] [277] [480] <Insert value>** V.
 - b) Phases: **[Single] [Three]**.
 - c) Hertz: 60.

- i. Pumping Station Electrical Characteristics:
 - 1) Full-Load Amperes: **<Insert value.>**
 - 2) Minimum Circuit Ampacity: **<Insert value.>**
 - 3) Maximum Overcurrent Protection: **<Insert amperage.>**

2.2 WET-WELL, PACKAGED SEWAGE PUMPING STATIONS

A. Wet-Well, Packaged Sewage Pumping Stations with Submersible Sewage Pumps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Gorman-Rupp Company (The).
- b. Metropolitan Industries, Inc.
- c. PumpTech, Inc.
- d. USEMCO.
- e. Yeomans Chicago Corporation.
- f. **<Insert manufacturer's name.>**
- g. or approved equal.

2. Description: Factory fabricated, assembled, and tested with wet well for **[comminutor,]**sewage pumps and collection of sanitary sewage and with sewage pumps and dry equipment chamber for controls and accessories.

- a. Orientation: Shell underground with dry equipment chamber **[underground with top flush with grade] [partially recessed underground] [above grade] [underground with entrance tube to grade] <Insert orientation>**.
- b. Shell: Factory fabricated from **[structural-steel plate] [fiberglass]**.
- c. Entrance Tube: From dry compartment to entrance at grade, and of size required to replace largest piece of equipment, but not smaller than **[36 inches (914 mm)] <Insert dimension>** in diameter.
- d. Cathodic Protection: **<Insert number>** exterior magnesium anode(s).
- e. Comminutor: Full size of sewage inlet pipe.
- f. Sewage Pumps: **[Two] [Three] <Insert number>** submersible-type sewage pumps, with guide rail, quick-disconnect system, controls, and piping. Include ASTM A 48/A 48M, Class 25, nonclog, cast-iron impeller capable of passing solids of **3-inch (76-mm)** minimum diameter; and hermetically sealed motor with moisture-sensing probe, mechanical seals, and waterproof power cable.

3. Capacities and Characteristics:

- a. Diameter or Dimensions of Shell: **<Insert inches (mm) or other dimensions.>**
- b. Height of Shell Base Section: **<Insert inches (mm).>**
- c. Pumping Station, Inlet Pipe Size: **<Insert NPS (DN).>**
- d. Pumping Station, Discharge Pipe Size: **<Insert NPS (DN).>**
- e. Comminutor:

- 1) Required: **[No] [Yes]**.
 - 2) Capacity: **<Insert gpm (L/s).>**
 - 3) Pipe Size: **<Insert NPS (DN).>**
 - 4) Motor Size: **<Insert value> hp.**
 - 5) Electrical Characteristics:
 - a) Volts: **[240] [277] [480] <Insert value> V.**
 - b) Phases: **[Single] [Three]**.
 - c) Hertz: 60.
- f. Sewage Pumps: **[Two] [Three] <Insert number>** required.
- g. Each Sewage Pump:
 - 1) Capacity: **<Insert gpm (L/s).>**
 - 2) Total Dynamic Head: **<Insert feet (kPa).>**
 - 3) Speed: **<Insert rpm.>**
 - 4) Impeller:
 - a) Type: **<Insert type.>**
 - b) Diameter: **<Insert inches (mm).>**
 - c) Solids Size Design: **<Insert inches (mm).>**
 - 5) Inlet Size: **<Insert NPS (DN).>**
 - 6) Discharge Size: **<Insert NPS (DN).>**
 - 7) Motor Size: **<Insert value> hp.**
 - 8) Electrical Characteristics:
 - a) Volts: **[240] [277] [480] <Insert value> V.**
 - b) Phases: **[Single] [Three]**.
 - c) Hertz: 60.

h. Sump Pump:
 - 1) Capacity: **<Insert gpm (L/s).>**
 - 2) Total Dynamic Head: **<Insert feet (kPa).>**
 - 3) Speed: **<Insert rpm.>**
 - 4) Discharge Size: **<Insert NPS (DN).>**
 - 5) Motor Size: **<Insert value> hp.**
 - 6) Electrical Characteristics:
 - a) Volts: **[120] [240] [277] [480] <Insert value> V.**
 - b) Phases: **[Single] [Three]**.
 - c) Hertz: 60.

i. Pumping Station Electrical Characteristics:
 - 1) Full-Load Amperes: **<Insert value.>**
 - 2) Minimum Circuit Ampacity: **<Insert value.>**
 - 3) Maximum Overcurrent Protection: **<Insert amperage.>**

B. Wet-Well, Packaged Sewage Pumping Stations with Submersible Grinder Sewage Pumps:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Environment One Corporation.
- b. Gorman-Rupp Company (The).
- c. Pentair Pump Group; F. E. Myers.
- d. PumpTech, Inc.
- e. USEMCO.
- f. **<Insert manufacturer's name.>**
- g. or approved equal.

2. Description: Factory fabricated, assembled, and tested with wet well for sewage pumps and collection of sanitary sewage and with dry equipment chamber for controls and accessories.

- a. Orientation: Shell underground with dry equipment chamber [**underground with top flush with grade**] [**partially recessed underground**] [**above grade**] [**underground with entrance tube to grade**] **<Insert orientation>**.
- b. Shell: Factory fabricated from [**structural-steel plate**] [**fiberglass**].
- c. Entrance Tube: From dry compartment to entrance at grade, and of size required to replace largest piece of equipment, but not smaller than [**36 inches (914 mm)**] **<Insert dimension>** in diameter.
- d. Cathodic Protection: **<Insert number>** exterior magnesium anode(s).
- e. Sewage Pumps: [**Two**] [**Three**] **<Insert number>** submersible grinder-type sewage pumps, with guide rail, quick-disconnect system, controls, and piping. Include stainless-steel grinder impeller and hermetically sealed motor with moisture-sensing probe, mechanical seals, and waterproof power cable.

3. Capacities and Characteristics:

- a. Diameter or Dimensions of Shell: **<Insert inches (mm) or other dimensions.>**
- b. Height of Shell Base Section: **<Insert inches (mm).>**
- c. Pumping Station, Inlet Pipe Size: **<Insert NPS (DN).>**
- d. Pumping Station, Discharge Pipe Size: **<Insert NPS (DN).>**
- e. Sewage Pumps: [**Two**] [**Three**] **<Insert number>** required.
- f. Each Sewage Pump:
 - 1) Capacity: **<Insert gpm (L/s).>**
 - 2) Total Dynamic Head: **<Insert feet (kPa).>**
 - 3) Speed: **<Insert rpm.>**
 - 4) Impeller: [**Cutter**] [**Cutter or grinder**] [**Grinder**] type.
 - 5) Inlet Size: **<Insert NPS (DN).>**
 - 6) Discharge Size: **<Insert NPS (DN).>**
 - 7) Motor Size: **<Insert value>** hp.
 - 8) Electrical Characteristics:

- a) Volts: [240] [277] [480] <Insert value> V.
- b) Phases: [Single] [Three].
- c) Hertz: 60.

g. Sump Pump:

- 1) Capacity: <Insert gpm (L/s).>
- 2) Total Dynamic Head: <Insert feet (kPa).>
- 3) Speed: <Insert rpm.>
- 4) Discharge Size: <Insert NPS (DN).>
- 5) Motor Size: <Insert value> hp.
- 6) Electrical Characteristics:

- a) Volts: [120] [240] [277] [480] <Insert value> V.
- b) Phases: [Single] [Three].
- c) Hertz: 60.

h. Pumping Station Electrical Characteristics:

- 1) Full-Load Amperes: <Insert value.>
- 2) Minimum Circuit Ampacity: <Insert value.>
- 3) Maximum Overcurrent Protection: <Insert amperage.>

C. Wet-Well, Packaged Sewage Pumping Stations with Wet-Well-Mounting Sewage Pumps:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Dakota Pump Incorporated.
- b. Gorman-Rupp Company (The).
- c. PumpTech, Inc.
- d. Smith & Loveless.
- e. <Insert manufacturer's name.>
- f. or approved equal.

2. Description: Factory fabricated, assembled, and tested with wet well for [comminutor,]sewage pumps and collection of sanitary sewage and with suspended sewage pumps and dry equipment chamber for pump motors, controls, and accessories.

- a. Orientation: Shell underground with dry equipment chamber [underground with top flush with grade] [partially recessed underground] [above grade] [underground with entrance tube to grade] <Insert orientation>.
- b. Shell: Factory fabricated from [structural-steel plate] [fiberglass].
- c. Entrance Tube: From dry compartment to entrance at grade, and of size required to replace largest piece of equipment, but not smaller than [36 inches (914 mm)] <Insert dimension> in diameter.
- d. Cathodic Protection: <Insert number> exterior magnesium anode(s).
- e. Comminutor: Full size of sewage inlet pipe.

- f. Sewage Pumps: **[Two]** **[Three]** **<Insert number>** wet-well-mounting-type, nonclog sewage pumps suspended from dry-compartment floor, with controls and piping. Include ASTM A 48/A 48M, Class 25, nonclog, cast-iron impeller capable of passing solids of **3-inch** (76-mm) minimum diameter; grease-lubricated bearings and stuffing-box seal; shaft coupling; and pedestal-mounted motor.
3. Capacities and Characteristics:
- a. Diameter or Dimensions of Shell: **<Insert inches (mm) or other dimensions.>**
- b. Height of Shell Base Section: **<Insert inches (mm).>**
- c. Pumping Station, Inlet Pipe Size: **<Insert NPS (DN).>**
- d. Pumping Station, Discharge Pipe Size: **<Insert NPS (DN).>**
- e. Comminutor:
- 1) Required: **[No]** **[Yes]**.
 - 2) Capacity: **<Insert gpm (L/s).>**
 - 3) Pipe Size: **<Insert NPS (DN).>**
 - 4) Motor Size: **<Insert value>** hp.
 - 5) Electrical Characteristics:
 - a) Volts: **[240]** **[277]** **[480]** **<Insert value>** V.
 - b) Phases: **[Single]** **[Three]**.
 - c) Hertz: 60.
- f. Sewage Pumps: **[Two]** **[Three]** **<Insert number>** required.
- g. Each Sewage Pump:
- 1) Capacity: **<Insert gpm (L/s).>**
 - 2) Total Dynamic Head: **<Insert feet (kPa).>**
 - 3) Speed: **<Insert rpm.>**
 - 4) Impeller:
 - a) Type: **<Insert type.>**
 - b) Diameter: **<Insert inches (mm).>**
 - c) Solids Size Design: **<Insert inches (mm).>**
 - 5) Inlet Size: **<Insert NPS (DN).>**
 - 6) Discharge Size: **<Insert NPS (DN).>**
 - 7) Motor Size: **<Insert value>** hp.
 - 8) Electrical Characteristics:
 - a) Volts: **[240]** **[277]** **[480]** **<Insert value>** V.
 - b) Phases: **[Single]** **[Three]**.
 - c) Hertz: 60.
- h. Sump Pump:
- 1) Capacity: **<Insert gpm (L/s).>**

- 2) Total Dynamic Head: **<Insert feet (kPa).>**
- 3) Speed: **<Insert rpm.>**
- 4) Discharge Size: **<Insert NPS (DN).>**
- 5) Motor Size: **<Insert value>** hp.
- 6) Electrical Characteristics:
 - a) Volts: **[120] [240] [277] [480] <Insert value>** V.
 - b) Phases: **[Single] [Three]**.
 - c) Hertz: 60.

i. Pumping Station Electrical Characteristics:

- 1) Full-Load Amperes: **<Insert value.>**
- 2) Minimum Circuit Ampacity: **<Insert value.>**
- 3) Maximum Overcurrent Protection: **<Insert amperage.>**

2.3 COMMINUTORS

A. Comminutors:

1. Description: Motor-operated, single- or twin-shaft, cutter- or grinder-design unit with controls; for pipeline installation.
 - a. Body: Stainless steel or ductile iron with flanged ends and access plate.
 - b. Cutting Elements: Motor-driven rotor and stationary cutters or grinders of hardened stainless or heat-treated steel.
 - c. Motor: Explosion proof, directly connected to body.
 - d. Control Panel: NEMA 250, Type 12 enclosure for installation in dry equipment chamber.
 - e. **<Insert special control features.>**

2.4 CONTROLS

- A. Control Sequence of Operation: Cycle each sewage pump on and off automatically to maintain wet-well sewage level. Automatic control operates both pumps in parallel if wet-well level rises above starting point of low-level pump, until shutoff level is reached. Automatic alternator, with manual disconnect switch, changes sequence of lead-lag sewage pumps at completion of each pumping cycle.
- B. Self-Purging, Air-Bubbler System: Senses variations of sewage level in wet well. Include duplex-arrangement oilless air compressors to furnish bubbler air; filters; air-storage reservoir; piping; airflow meter with needle valve adjustment for airflow regulation; sewage depth gage; air-bubbler piping to wet well; and pressure-sensing, dustproof mercury switches.
- C. **[Electrode] [Float-Switch] [Pressure-Switch] [Ultrasonic]** System: Senses variations of sewage level in wet well. Include high and low adjustments capable of operating on **6-inch (150-mm)** minimum differential of liquid level.

- D. Motor Controllers: Magnetic, full voltage, nonreversing. Include undervoltage release, thermal-overload heaters in each phase, manual reset buttons, and hand-automatic selector switches. Include circuit breakers to provide branch-circuit protection for each controller.
- E. 120-V accessory controls with 15-A, single-phase circuit breakers or fuses for each item.
- F. Control Panel: Enclosure complying with UL 508A[**and with UL 508A, Supplement SB**] with separate compartments and covers for controllers, circuit breakers, transformers, alternators, and single-phase controls. Include 20-A duplex receptacle in NEMA WD 1, Configuration 5-20R mounted on exterior of control panel.
 - 1. Mounting: [**Inside, on dry-chamber wall**] [**Outside, on pedestal, at grade**] **<Insert building description and room number>**.
 - 2. Enclosure: NEMA 250, Type [**1**] [**4**] [**4X**] **<Insert type>**.
- G. Install labels on panel face to identify switches and controls.
- H. Wiring: Tin-copper wiring.
- I. Connection for Portable Generator: Nonautomatic (manual) transfer switch with receptacle matching generator electrical power requirements. Nonautomatic transfer switches are specified in Section 263600 "Transfer Switches" and receptacles are specified in Section 262726 "Wiring Devices."

2.5 ACCESSORIES

- A. Lighting: Minimum of 2, UL 1571, heavy-duty, cast-metal, wet-location-type fixtures with 100-W bulbs and guards in service area. Locate switches, with pilot lights, at chamber entrance.
- B. Submersible Sump Pump:
 - 1. Discharge Size: **NPS 1-1/4 (DN 32)** minimum.
 - 2. Pump End Bell and Motor Shell: Cast iron.
 - 3. Motor: 1/3 hp, 1750-rpm, hermetically sealed, capacitor-start, with built-in overload protection.
 - 4. Impeller: ASTM B 584, cast bronze or ASTM B 36/B 36M, brass.
 - 5. Shaft: Stainless steel.
 - 6. Bearings: Grease-lubricated, factory-sealed ball bearings.
 - 7. Seals: Mechanical.
 - 8. Accessories: Inlet strainer.
 - 9. Controls: Float switch.
- C. Dehumidifier: Electric refrigeration system, adjustable humidistat, reverse-acting thermostat for low-temperature cutoff controls, and condensate pump with drain piping to sump.

1. Dehumidification system capacity adequate to remove at least 15 pints (7 L) of water per day from service area air that is 80 deg F (27 deg C) with a relative humidity of 60 percent.
 - D. Ventilation: Electrically powered ventilation system. Include centrifugal blower with 4-inch- (100-mm-) round exhaust vent designed to keep out rain, insects, and other foreign matter; limit switch to start blower if entrance door or lid is opened; 0- to 15-minute timer; and separate manual switch.
 1. Ventilating system capacity to change air in dry equipment chamber every two minutes.
 - E. Heater: Electric, 1.5 kW minimum, with fan and thermostat control.
 - F. High-Water Audio Alarm: Horn for audio indication of station high-water level, energized by separate level-detecting device. Include alarm silencer switch and relay in station.
 - G. Remote Alarm Circuit: Include contacts for connection to remote alarm panel.
- 2.6 MOTORS
- A. General requirements for motors are specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
- 2.7 MISCELLANEOUS MATERIALS
- A. Structural Steel: ASTM A 6/A 6M, W or HP shapes, or ASTM A 36/A 36M, plates or beams.
 - B. Grout: ASTM C 1107, Grade B, nonshrink cement grout.
 1. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
 - C. Concrete: Concrete is specified in [**Section 033000 "Cast-in-Place Concrete."**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete."**]
- 2.8 PACKAGED SEWAGE PUMPING STATION FABRICATION
- A. Fabricate shell from structural-steel plate with continuous welds to make watertight and gastight construction.
 1. Walls: 1/4-inch (6.4-mm) minimum thickness.
 2. Top and Bottom Heads: 3/8-inch (9.5-mm) minimum thickness. Weld reinforcing steel to top and bottom heads.
 3. Entrance-Tube Walls: 1/4-inch (6.4-mm) minimum thickness.
 4. Weld steel access ladder and air vent to shell[**and entrance tube**].
 5. Apply three coats of epoxy resin to interior and exterior surfaces.

6. Include [**at least two**] [**four**] <Insert number> exterior magnesium anode(s) for cathodic protection.
- B. Fabricate shell from fiberglass with structural-steel reinforcement.
 1. Attach structural-steel reinforcement to top and bottom heads.
 2. Fabricate shell with continuous joints to make watertight and gastight construction.
 3. Attach air vent to pump chamber[**and entrance tube**].
 4. Ladder: [**Steel**] [**Fiberglass**].
- C. Install sump, **18 inches** (450 mm) in diameter by **10 inches** (254 mm) deep in dry-chamber floor. Slope floor toward sump and fasten rubber mat to floor walkway with cement.
- D. Entrance tube may be furnished separately for field installation.
- E. Entrance Cover: Waterproof and corrosion resistant, with lock. Include way to open cover from inside tube if cover is locked.
- F. Air Vent: Duct fabricated from corrosion-resistant material, extended to above grade, outlet turned down, and with insect screen in outlet.
- G. Factory fabricate piping between unit components.
 1. Use galvanized-steel pipe and cast-iron fittings or ductile-iron pipe and fittings.
 2. Use fittings for changes in direction and branch connections.
 3. Flanged and union joints may be used instead of joints specified.
 4. Use dielectric fittings for connections between ferrous- and copper-alloy piping.
- H. Piping Connections: Unless otherwise indicated, make the following piping connections:
 1. Install unions, in piping **NPS 2** (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment having **NPS 2** (DN 50) or smaller threaded pipe connection.
 2. Install flanges, in piping **NPS 2-1/2** (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
- I. Valves: Ferrous alloy.
 1. Sewage Pump Piping: Include gate valve on each pump inlet and gate and check valves on each discharge pipe.
 2. Sump Pump Piping: Include ball or gate and check valves on discharge pipe.
 3. Compressed-Air Piping: Include ball and check valves on discharge pipe from each air compressor.
 4. Vacuum Piping: Include ball and check valves on inlet pipe to each vacuum pump.
- J. Wiring: Tin-coated copper.

2.9 SOURCE QUALITY CONTROL

- A. Test and inspect sewage[**and sump**] pumps according to HI 1.6, "Centrifugal Pump Tests." Include test recordings that substantiate correct performance of pumps at design head, capacity, suction lift, speed, and horsepower.
- B. Test accessories and controls through complete cycle. Include test recordings that substantiate correct performance.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of sewerage piping systems to verify actual locations of piping connections before packaged sewage pumping station installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.3 INSTALLATION

- A. Install packaged sewage pumping station components where indicated, according to specific equipment and piping arrangement indicated.
- B. Shell Base Supports: Form from structural-steel beams, of number and lengths required to support bottom of shell and to anchor beams to concrete foundation.
 - 1. Use elevator blocks attached to bottom of shell to slope station floor **1 inch in 10 feet** (25.4 mm in 3 m) down toward sump.
- C. Grout under and around shell. Ensure that there are no voids between foundation slab and underslab of pumping station.
- D. Fill voids between shell sidewalls, sleeves, and piping and make watertight seal with grout.
- E. Connect anode conductors to grounding lugs on steel housing.
- F. Join separate sections of housing by field welding.
- G. Field weld entrance tube to housing.

3.4 CONNECTIONS

- A. Sanitary sewer piping installation requirements are specified in Section 221313 "Facility Sanitary Sewers." Drawings indicate general arrangement of piping.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.5 IDENTIFICATION

- A. Install identifying labels permanently attached to equipment.
- B. Install operating instruction signs permanently attached to equipment or on pumping station wall near equipment.
- C. Arrange for installing green[**warning tape or**] detectable warning tape over outside edges of underground packaged sewage pumping stations. Tape materials and their installation are specified in Section 312000 "Earth Moving."

3.6 PAINTING

- A. Prepare and paint ferrous piping in wet wells, structural-steel supports, and anchor devices with coal-tar epoxy-polyamide paint according to SSPC-Paint 16.
- B. Paint field-welded areas to match factory coating.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform field tests and inspections and prepare test reports.
- B. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to assist Contractor and inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. After installing packaged sewage pumping stations and after electrical circuitry has been energized, test for compliance with requirements. Furnish water required for pump tests.

2. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace packaged sewage pumping stations that do not pass tests and inspections and retest as specified above.

3.8 STARTUP SERVICE

- A. Engage a factory-authorized service representative to assist Contractor and perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Adjust pump, accessory, and control settings, and safety and alarm devices.
 3. **<Insert, in separate subparagraphs, startup steps.>**

3.9 CLEANING

- A. Clean dirt and debris from wet wells, pumps, and piping.
- B. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finishes to match original finishes.
- C. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove dirt and construction debris and repair damaged finishes.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to assist Contractor and train Owner's maintenance personnel to adjust, operate, and maintain packaged sewage pumping stations. Refer to Section 017900 "Demonstration and Training."
1. Schedule training with Owner, through DEN Project Manager, with at least seven (7) days advance notice.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 221343

SECTION 221413 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.
 - 3. Encasement for underground metal piping.
- B. Related Sections:
 - 1. Section 221429 "Sump Pumps" for storm drainage pumps.
 - 2. Section 334100 "Storm Utility Drainage Piping" for storm drainage piping outside the building.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Storm Drainage Piping: [10-foot head of water (30 kPa)] <Insert pressure>.
 - 2. Storm Drainage, Force-Main Piping: [50 psig (345 kPa)] [100 psig (690 kPa)] [150 psig (1035 kPa)] <Insert pressure>.
- B. Seismic Performance: Storm drainage piping and support and installation shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7] <Insert requirement>.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Submit manufacturer's technical product data and installation instructions for

- storm system materials and products.
2. Include data substantiating that materials comply with requirements.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: Submit shop drawings for storm sewer systems, showing piping materials, size, locations, and inverts. Include details of underground structures, connections, and manholes. Show interface and spatial relationship between piping and proximate structures.

1. For **[controlled-flow] [siphonic]** roof drainage system. Include calculations, plans, and details.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For storm drainage piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Welders Certificate: Include welder's certification of compliance with **[ASME SEC 9] [AWS D1.1.] <Insert standard>** and Section 059990 "Welding."

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

B. Contractor shall submit fully dimensioned spool drawings for all welded piping work. Drawings shall indicate all weld types, sizes, and materials to be used.

1.7 EXTRA MATERIALS

A. Provide two (2) repacking kits for each type and size valve used on Project.

1.8 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of storm system's products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.
- B. Installer's Qualifications: Firm with at least three (3) years of successful installation experience on projects with storm drainage piping work similar to that required for this project.
- C. Plumbing Code Compliance: Comply with applicable portions of Denver Plumbing Code pertaining to selection and installation of storm drainage piping materials and products.
- D. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- E. Unless specified otherwise, all materials and equipment shall be of domestic (USA) manufacture and shall be of the best quality used for the purpose in commercial practice.
- F. Comply with NSF/ANSI 14, "Plastics Piping System Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.
- G. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- H. Welders Certification: In accordance with ASME Sec 9.
- I. Valves: Manufacturer's name and pressure rating marked on valve body.

1.9 PROJECT CONDITIONS

- A. Interruption of Existing Storm-Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify DEN Project Manager no fewer than seven (7) days in advance of proposed interruption of storm-drainage service.
 - 2. Do not proceed with interruption of storm-drainage service without DEN Project Manager's written permission.

1.10 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with City and County of Denver plumbing code.
- B. Conform to code for installation of backflow prevention devices.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products under provisions of Section 220400 "Basic Plumbing Requirements and Division 01.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.12 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.13 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 IDENTIFICATION

- A. Underground Type Plastic Line Marker: Manufacturer's standard permanent, bright colored, continuous printed plastic tape, intended for direct burial service; not less than 6" wide x 4 mils thick. Provide green tape with black printing reading "CAUTION SEWER LINE BURIED BELOW".
 - 1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allen Systems Inc.
 - b. Emed Co., Inc.
 - c. Seton Name Plate Corp.
 - d. <Insert manufacturer's name>
 - e. or approved equal.

2.2 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, [**Service**] [**and**] [**Extra Heavy**] class[**es**].
- B. Gaskets: ASTM C 564, [**neoprene**] rubber.
- C. Caulking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Dallas Specialty & Mfg. Co.
 - c. Fernco Inc.
 - d. Matco-Norca, Inc.
 - e. MIFAB, Inc.
 - f. Mission Rubber Company; a division of MCP Industries, Inc.
 - g. Stant.
 - h. Tyler Pipe.
 - i. <**Insert manufacturer's name**>.
 - j. or approved equal.
 - 2. Standards: ASTM C 1277 and CISPI 310.
 - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Clamp-All Corp.
 - c. Dallas Specialty & Mfg. Co.
 - d. MIFAB, Inc.
 - e. Mission Rubber Company; a division of MCP Industries, Inc.
 - f. Stant.
 - g. Tyler Pipe.
 - h. <**Insert manufacturer's name**>.
 - i. or approved equal.
- 2. Standards: ASTM C 1277 and ASTM C 1540.

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Cast-Iron, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MG Piping Products Company.
 - b. **<Insert manufacturer's name>**.
 - c. or approved equal.
2. Standard: ASTM C 1277.
3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.5 GALVANIZED-STEEL PIPE AND FITTINGS

- A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight. Include square-cut-grooved or threaded ends matching joining method.
- B. **[Galvanized-]**Cast-Iron Drainage Fittings: ASME B16.12 threaded.
- C. Steel-Pipe Pressure Fittings:
 1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Schedule 40, seamless steel pipe. Include ends matching joining method.
 2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
 3. **[Galvanized-]**Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- D. Cast-Iron Flanges: ASME B16.1, Class 125.
 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, **1/8-inch (3.2-mm)** maximum thickness unless thickness or specific material is indicated.
 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- E. Grooved-Joint, Galvanized-Steel-Pipe Appurtenances:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International.
 - b. Grinnell Mechanical Products.
 - c. Shurjoint Piping Products.
 - d. Victaulic Company.

- e. **<Insert manufacturer's name>**.
 - f. or approved equal.
2. Galvanized, Grooved-End Fittings for Galvanized-Steel Piping: ASTM A 536 ductile-iron castings, ASTM A 47/A 47M malleable-iron castings, ASTM A 234/A 234M forged-steel fittings, or ASTM A 106/A 106M steel pipes with dimensions matching ASTM A 53/A 53M steel pipe, and complying with AWWA C606 for grooved ends.
 3. Grooved Mechanical Couplings for Galvanized-Steel Piping: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber gasket suitable for hot and cold water; and bolts and nuts.

2.6 DUCTILE-IRON PIPE AND FITTINGS

A. Ductile-Iron, Mechanical-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, mechanical-joint ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Ductile-Iron, Push-On-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, push-on-joint ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Gaskets: AWWA C111/A21.11, rubber.

C. Ductile-Iron, Grooved-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51 with round-cut-grooved ends according to AWWA C606.
2. Ductile-Iron-Pipe Appurtenances:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Anvil International.
 - 2) Shurjoint Piping Products.
 - 3) Star Pipe Products.
 - 4) Victaulic Company.
 - 5) **<Insert manufacturer's name>**.
 - 6) or approved equal.
 - b. Grooved-End, Ductile-Iron Fittings: ASTM A 536 ductile-iron castings with dimensions matching AWWA C110/A21.10 ductile-iron pipe or AWWA

C153/A21.53 ductile-iron fittings and complying with AWWA C606 for grooved ends.

- c. Grooved Mechanical Couplings for Ductile-Iron Pipe: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber center-leg gasket suitable for hot and cold water; and bolts and nuts.

2.7 ABS PIPE AND FITTINGS

- A. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.
- B. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.
- C. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.
- D. ABS Special Fittings: ASTM F 409, drainage-pattern tube and tubular fittings with ends as required for application.
- E. Solvent Cement: ASTM D 2235.
 - 1. ABS solvent cement shall have a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.8 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
- C. Cellular-Core, Sewer and Drain Series PVC Pipe: ASTM F891, Series PS 100.
- D. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- E. PVC Special Fittings: ASTM F 409, drainage-pattern tube and tubular fittings with ends as required for application.
- F. Adhesive Primer: ASTM F 656.
 - 1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of

Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

G. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.9 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
3. Unshielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Mission Rubber Company; a division of MCP Industries, Inc.
 - 4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - 5) <Insert manufacturer's name>.
 - 6) or approved equal.
 - b. Standard: ASTM C 1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company; a division of MCP Industries, Inc.
 - 3) **<Insert manufacturer's name>**.
 - 4) or approved equal.
- b. Standard: ASTM C 1460.
- c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
5. Pressure Transition Couplings:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Dresser, Inc.
 - 3) EBAA Iron, Inc.
 - 4) Ford Meter Box Company, Inc. (The)
 - 5) JCM Industries, Inc.
 - 6) Romac Industries, Inc.
 - 7) Smith-Blair, Inc.; a Sensus company.
 - 8) Viking Johnson; c/o Mueller Co.
 - 9) **<Insert manufacturer's name>**.
 - 10) or approved equal.
 - b. Standard: AWWA C219.
 - c. Description: Metal, sleeve-type couplings same size as, with pressure rating at least equal to and ends compatible with, pipes to be joined.
 - d. Center-Sleeve Material: **[Manufacturer's standard] [Carbon steel] [Stainless steel] [Ductile iron] [Malleable iron]**.
 - e. Gasket Material: Natural or synthetic rubber.
 - f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Capitol Manufacturing Company.
 - 2) Central Plastics Company.
 - 3) Hart Industries International, Inc.
 - 4) Jomar International Ltd.
 - 5) Matco-Norca, Inc.
 - 6) McDonald, A. Y. Mfg. Co.

- 7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 8) Wilkins; a Zurn company.
 - 9) **<Insert manufacturer's name>**.
 - 10) or approved equal.
- b. Description:
- 1) Standard: ASSE 1079.
 - 2) Pressure Rating: [150 psig (1035 kPa)] [250 psig (1725 kPa)] at 180 deg F (82 deg C).
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
3. Dielectric Flanges:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1) Capitol Manufacturing Company.
 - 2) Central Plastics Company.
 - 3) Matco-Norca, Inc.
 - 4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 5) Wilkins; a Zurn company.
 - 6) **<Insert manufacturer's name>**.
 - 7) or approved equal.
- b. Description:
- 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: [150 psig (1035 kPa)] [175 psig (1200 kPa) **minimum**] [300 psig (2070 kPa)].
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
4. Dielectric-Flange Insulating Kits:
- a. M Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1) Advance Products & Systems, Inc.
 - 2) Calpico, Inc.
 - 3) Central Plastics Company.
 - 4) Pipeline Seal and Insulator, Inc.
 - 5) **<Insert manufacturer's name>**.
 - 6) or approved equal.
- b. Description:
- 1) Nonconducting materials for field assembly of companion flanges.
 - 2) Pressure Rating: [150 psig (1035 kPa)] **<Insert pressure>**.

- 3) Gasket: Neoprene or phenolic.
- 4) Bolt Sleeves: Phenolic or polyethylene.
- 5) Washers: Phenolic with steel-backing washers.

5. Dielectric Nipples:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Elster Perfection.
- 2) Grinnell Mechanical Products.
- 3) Matco-Norca, Inc.
- 4) Precision Plumbing Products, Inc.
- 5) Victaulic Company.
- 6) **<Insert manufacturer's name>**.
- 7) or approved equal.

- b. Description:

- 1) Electroplated steel nipple complying with ASTM F 1545.
- 2) Pressure Rating: [300 psig (2070 kPa) at 225 deg F (107 deg C)] **<Insert pressure and temperature>**.
- 3) End Connections: Male threaded or grooved.
- 4) Lining: Inert and noncorrosive, propylene.

2.10 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Material: [**High-density, crosslaminated PE film of 0.004-inch (0.10-mm)**] [**or**] [**LLDPE film of 0.008-inch (0.20-mm)**] minimum thickness.
- C. Form: [**Sheet**] [**or**] [**tube**].
- D. Color: [**Black**] [**or**] [**natural**].

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."
- B. Flowable Backfill: All piping installed below concrete slabs, aprons or roadways shall be encased in flowable backfill. Refer to Section 033350 "Flowable Backfill Low-Strength Concrete" .

3.2 INSTALLATION OF IDENTIFICATION OF UNDERGROUND PIPING

- A. General: During back filling/top soiling of storm sewer system, install continuous underground type plastic line marker, located directly over buried line at 18" below finished grade.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.
- B. General: Install piping in accordance with the Denver Wastewater Management divisions' standards, specifications, and per the standard detail drawings.
- C. Inspect piping before installation to detect apparent defects. Mark defective materials with white paint and promptly remove from site.
- D. Route piping in orderly manner and maintain gradient.
- E. Install piping to conserve building space and not interfere with use of space. Refer to Section 220400 "Basic Plumbing Requirements" for coordination requirements.
- F. Group piping whenever practical at common elevations.
- G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- H. Provide clearance for installation of insulation and access to valves and fittings.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- J. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- K. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- M. Install piping to permit valve servicing.
- N. Install piping at indicated slopes.
- O. Install piping free of sags and bends.

- P. Install fittings for changes in direction and branch connections.
- Q. Install piping to allow application of insulation.
- R. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- S. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- T. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- U. Install storm drainage piping at the following minimum slopes unless otherwise indicated:
1. Building Storm Drain: **[1 percent] [2 percent] <Insert slope>** downward in direction of flow for piping **NPS 3 (DN 80)** and smaller; **[1 percent] [2 percent] <Insert slope>** downward in direction of flow for piping **NPS 4 (DN 100)** and larger.
 2. Horizontal Storm-Drainage Piping: **[2 percent] <Insert slope>** downward in direction of flow.
- V. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- W. Install steel piping according to applicable plumbing code.
- X. Install aboveground ABS piping according to ASTM D 2661.
- Y. Install aboveground PVC piping according to ASTM D 2665.
- Z. Install underground **[ABS] [and] [PVC]** piping according to ASTM D 2321.
- AA. Install engineered **[controlled-flow] [siphonic]** drain specialties and storm drainage piping in locations indicated.
- BB. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to storm sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.
 2. Install encasement on piping according to ASTM A 674 or AWWA C105.
- CC. Install force mains at elevations indicated.
- DD. Plumbing Specialties:
1. Install backwater valves in storm drainage gravity-flow piping. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."
 2. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
 3. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."
- EE. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- FF. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- GG. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- HH. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."
- II. Cleaning Piping:
1. Place plugs in ends of uncompleted conduit at end of day or whenever work stops.
- JJ. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.
1. Make inspections after lines have been installed and approximately 2' of backfill is in place, and again at completion of Project.
- 3.4 JOINT CONSTRUCTION
- A. Joint Adaptors: Make joints between different types of pipe with standard manufactured adapters and fittings intended for that purpose.

- B. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Wood plugs are not acceptable.
- C. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- D. Hub-and-Spigot, Cast-Iron Soil Piping Caulked Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum caulked joints.
- E. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fittings. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- H. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- I. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.5 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in OD's.
 - 2. In Drainage Piping: **[Unshielded]** **[Shielded]**, nonpressure transition couplings.
 - 3. In Aboveground Force-Main Piping: Fitting-type transition couplings.
 - 4. In Underground Force-Main Piping:
 - a. **NPS 1-1/2 (DN 40)** and Smaller: Fitting-type transition couplings.
 - b. **NPS 2 (DN 50)** and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for [NPS 2 (DN 50)] <Insert pipe size> and Smaller: Use dielectric [nipples] [unions].
3. Dielectric Fittings for [NPS 2-1/2 to NPS 4 (DN 65 to DN 100)] <Insert pipe size range>: Use dielectric [flanges] [flange kits] [nipples].
4. Dielectric Fittings for [NPS 5 (DN 125)] <Insert pipe size> and Larger: Use dielectric flange kits.

3.6 VALVE INSTALLATION

- A. General valve installation requirements are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves: Install shutoff valve on each sump pump discharge.
1. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
 2. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.
- C. Check Valves: Install swing-check valve, between pump and shutoff valve, on each sump pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.
1. Horizontal Piping: Horizontal backwater valves. **[Use normally closed type unless otherwise indicated.]**
 2. Install backwater valves in accessible locations.
 3. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."

3.7 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment".
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
1. Install [carbon-steel] <Insert material> pipe hangers for horizontal piping in noncorrosive environments.
 2. Install [stainless-steel] [fiberglass] pipe hangers for horizontal piping in corrosive environments.
 3. Install [carbon-steel] <Insert material> pipe support clamps for vertical piping in noncorrosive environments.
 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.

5. Vertical Piping: MSS Type 8 or Type 42 clamps.
 6. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
 7. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting [, valve,] and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
 3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
 4. NPS 6 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
 5. NPS 10 and NPS 12 (DN 250 and DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
 6. Spacing for 10-foot (3-m) pipe lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).
- G. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 5. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 7. NPS 6 and NPS 8 (DN 150 and DN 200): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
 8. NPS 10 and NPS 12 (DN 250 and DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.

- I. Install supports for vertical steel piping every **15 feet** (4.5 m).
- J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. **NPS 1-1/4** (DN 32): **72 inches** (1800 mm) with **3/8-inch** (10-mm) rod.
 - 2. **NPS 1-1/2 and NPS 2** (DN 40 and DN 50): **96 inches** (2400 mm) with **3/8-inch** (10-mm) rod.
 - 3. **NPS 2-1/2** (DN 65): **108 inches** (2700 mm) with **1/2-inch** (13-mm) rod.
 - 4. **NPS 3 to NPS 5** (DN 80 to DN 125): **10 feet** (3 m) with **1/2-inch** (13-mm) rod.
 - 5. **NPS 6** (DN 150): **10 feet** (3 m) with **5/8-inch** (16-mm) rod.
 - 6. **NPS 8** (DN 200): **10 feet** (3 m) with **3/4-inch** (19-mm) rod.
- K. Install supports for vertical copper tubing every **10 feet** (3 m).
- L. Install hangers for **[ABS] [and] [PVC]** piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. **NPS 1-1/2 and NPS 2** (DN 40 and DN 50): **48 inches** (1200 mm) with **3/8-inch** (10-mm) rod.
 - 2. **NPS 3** (DN 80): **48 inches** (1200 mm) with **1/2-inch** (13-mm) rod.
 - 3. **NPS 4 and NPS 5** (DN 100 and DN 125): **48 inches** (1200 mm) with **5/8-inch** (16-mm) rod.
 - 4. **NPS 6 and NPS 8** (DN 150 and DN 200): **48 inches** (1200 mm) with **3/4-inch** (19-mm) rod.
 - 5. **NPS 10 and NPS 12** (DN 250 and DN 300): **48 inches** (1200 mm) with **7/8-inch** (22-mm) rod.
- M. Install supports for vertical **[ABS] [and] [PVC]** piping every **48 inches** (1200 mm).
- N. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
 - 1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
 - 2. Install horizontal backwater valves **[with cleanout cover flush with floor] [in pit with pit cover flush with floor]** <Insert description>.
 - 3. Comply with requirements for **[backwater valves] [cleanouts] [and] [drains]** specified in Section 221423 "Storm Drainage Piping Specialties."
- D. Connect force-main piping to the following:

1. Storm Sewer: To exterior force main.
2. Sump Pumps: To sump pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping **NPS 2 (DN 50)** and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping **NPS 2-1/2 (DN 65)** and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.9 IDENTIFICATION OF EXPOSED PIPING

A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.10 BACKFILLING

A. General: Conduct backfill operations of open cut trenches closely following laying, jointing, and bedding of pipe, and after initial inspection and testing are completed. Comply with requirements of Section 312000 "Earth Moving".

B. Flowable Backfill: All piping installed below concrete slabs, aprons or roadways shall be encased in flowable backfill. Refer to Section 033350 "Flowable Backfill Low-Strength Concrete" .

3.11 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction and DEN Project Manager at least 48 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Perform testing of completed piping in accordance with Section 9.00 of the Denver Wastewater Management Division Technical Specifications. Inform DEN Project Manager 48 hours prior to testing and backfilling.
2. Testing shall be witnessed by DEN Mechanical Inspector and DEN Project Manager or Designated Representative.
3. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
4. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. The following tests shall be performed on the piping:

TEST

SYSTEM TYPE

Exfiltration Test	All systems
Infiltration Test	Only in case of excessive ground water
Deflection Test	Only plastic piping

- C. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- D. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- E. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 3. Test Procedure: Test storm drainage piping[, **except outside leaders,**] on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than **10-foot head of water (30 kPa)**. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 5. Prepare reports for tests and required corrective action.
- F. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 2. Cap and subject piping to static-water pressure of **50 psig (345 kPa)** above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 4. Prepare reports for tests and required corrective action.
- G. No piping or joint shall be left untested. All leaks shall be repaired and the piping system shall be re-tested until satisfactory results are obtained.
- H. Repair piping systems which fail required piping test, by disassembly and reinstallation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

3.12 INSPECTION

- A. The storm piping system shall be inspected by the Contractor's Quality Control Inspector. A record of the inspection including any defects deviations from the contract shall be submitted to the DEN Project Manager.

3.13 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.14 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground storm drainage piping [**NPS 6 (DN 150) and smaller**] <Insert pipe size range> shall be[**any of**] the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; [**CISPI,**] [**heavy-duty,**] hubless-piping couplings; and coupled joints.
 - 3. Dissimilar Pipe-Material Couplings: [**Unshielded**] [**Shielded**], nonpressure transition couplings.
- C. Aboveground, storm drainage piping [**NPS 8 (DN 200) and larger**] <Insert pipe size range> shall be[**any of**] the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; [**CISPI,**] [**heavy-duty,**] hubless-piping couplings; and coupled joints.
 - 3. Dissimilar Pipe-Material Couplings: [**Unshielded**] [**Shielded**], nonpressure transition couplings.
- D. Underground storm drainage piping [**NPS 6 (DN 150) and smaller**] <Insert pipe size range> shall be[**any of**] the following:
 - 1. [**Extra Heavy**] [**Service**] class, cast-iron soil pipe and fittings; [**gaskets; and gasketed**] [**caulking materials; and caulked**] joints.
 - 2. Hubless, cast-iron soil pipe and fittings; [**CISPI,**] [**heavy-duty,**] [**cast-iron,**] hubless-piping couplings; and coupled joints.
 - 3. Dissimilar Pipe-Material Couplings: [**Unshielded**] [**Shielded**], nonpressure transition couplings.

- E. Underground, storm drainage piping [**NPS 8 (DN 200) and larger**] <Insert pipe size range> shall be[**any of**] the following:
1. [**Solid-wall**] [**Cellular-core**] PVC pipe, PVC socket fittings, and solvent-cemented joints.
 2. Cellular-core, sewer and drain series, PVC pipe; PVC socket fittings; and solvent-cemented joints.
 3. Dissimilar Pipe-Material Couplings: [**Unshielded**] [**Shielded**], nonpressure transition couplings.
- F. Aboveground storm drainage force mains [**NPS 1-1/2 and NPS 2 (DN 40 and DN 50)**] <Insert pipe size range> shall be[**any of**] the following:
1. Galvanized-steel pipe, pressure fittings, and threaded joints.
- G. Aboveground storm drainage force mains [**NPS 2-1/2 to NPS 6 (DN 65 to DN 150)**] <Insert pipe size range> shall be[**any of**] the following:
1. Galvanized-steel pipe, pressure fittings, and threaded joints.
 2. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
 3. Fitting-type transition couplings if dissimilar pipe materials.
- H. Underground storm drainage force mains [**NPS 4 (DN 100) and smaller**] <Insert pipe size range> shall be[**any of**] the following:
1. Ductile-iron, mechanical-joint piping and mechanical joints.
 2. Ductile-iron, push-on-joint piping and push-on joints.
 3. Ductile-iron, grooved-joint piping and grooved joints.
 4. Fitting-type transition coupling for piping smaller than **NPS 1-1/2 (DN 40)** and pressure transition coupling for **NPS 1-1/2 (DN 40)** and larger if dissimilar pipe materials.
- I. Underground storm drainage force mains [**NPS 5 (DN 125) and larger**] <Insert pipe size range> shall be[**any of**] the following:
1. Ductile-iron, mechanical-joint piping and mechanical joints.
 2. Ductile-iron, push-on-joint piping and push-on joints.
 3. Ductile-iron, grooved-joint piping and grooved joints.
 4. Pressure transition couplings if dissimilar pipe materials.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work

described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 221413

SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Roof drains.
 - 2. Miscellaneous storm drainage piping specialties.
 - 3. Cleanouts.
 - 4. Backwater valves.
 - 5. Trench drains.
 - 6. Channel drainage systems.
 - 7. Through-penetration firestop assemblies.
 - 8. Flashing materials.
- B. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Provide component sizes, rough-in requirements, service sizes, and finishes.
 - 2. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: For fabricated items, indicate dimensions, weights, and placement of openings and holes.

1.4 CLOSEOUT SUBMITTALS

- A. Project record documents:
 - 1. Record actual locations of equipment, cleanouts, backflow preventers.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

- C. Operation and maintenance data:
 - 1. Operation Data: Indicate frequency of treatment required for interceptors.
 - 2. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.5 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Manufacturer: For each product specified, provide components by same manufacturer throughout.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products under provisions of Section 220400 "Basic Plumbing Requirements" and Division 01.
- B. Accept specialties on site in original factory packaging. Inspect for damage.
- C. Remove and perfect installation instructions for inspection.

1.7 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

- A. Cast-Iron, Large-Sump, General-Purpose Roof Drains **<Insert drawing designation if any>**:
 - 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Josam Company.
 - b. Marathon Roofing Products.
 - c. MIFAB, Inc.
 - d. Smith, Jay R. Mfg. Co.
 - e. Tyler Pipe.
 - f. Watts Water Technologies, Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.

- h. **<Insert manufacturer's name>**.
 - i. or approved equal.
2. Standard: ASME A112.6.4, for general-purpose roof drains.
 3. Body Material: [**Lacquered cast iron**] **<Insert material>**.
 4. Dimension of Body: Nominal [**14-inch (357-mm)**] **<Insert dimension>** diameter.
 5. Combination Flashing Ring and Gravel Stop: [**Not required**] [**Required**].
 6. Flow-Control Weirs: [**Not required**] [**Required**].
 7. Outlet: [**Bottom**] [**Side**] **<Insert location>**.
 8. Extension Collars: [**Not required**] [**Required**].
 9. Underdeck Clamp: [**Not required**] [**Required**].
 10. Expansion Joint: [**Not required**] [**Required**].
 11. Sump Receiver Plate: [**Not required**] [**Required**].
 12. Dome Material: [**Aluminum**] [**Cast iron**] [**PE**] [**Stainless steel**] **<Insert material>**.
 13. Perforated Gravel Guard: [**Stainless steel**] [**Not required**].
 14. Vandal-Proof Dome: [**Not required**] [**Required**].
 15. Water Dam: [**Not required**] [**2 inches (51 mm) high**].
 16. **<Insert options>**.

B. Cast-Iron, Medium-Sump, General-Purpose Roof Drains **<Insert drawing designation if any>**:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Josam Company.
 - b. Marathon Roofing Products.
 - c. MIFAB, Inc.
 - d. Portals Plus; Commercial Products Group of Hart & Cooley, Inc.
 - e. Smith, Jay R. Mfg. Co.
 - f. Tyler Pipe.
 - g. Watts Water Technologies, Inc.
 - h. Zurn Plumbing Products Group; Light Commercial Products Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
 - j. **<Insert manufacturer's name>**.
 - k. or approved equal.
2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: [**8- to 12-inch (203- to 305-mm)**] **<Insert dimension>** diameter.
5. Combination Flashing Ring and Gravel Stop: [**Not required**] [**Required**].
6. Flow-Control Weirs: [**Not required**] [**Required**].
7. Outlet: [**Bottom**] [**Side**] **<Insert location>**.
8. Extension Collars: [**Not required**] [**Required**].
9. Underdeck Clamp: [**Not required**] [**Required**].
10. Expansion Joint: [**Not required**] [**Required**].
11. Sump Receiver Plate: [**Not required**] [**Required**].

12. Dome Material: **[Aluminum] [Cast iron] [Copper] [PE] [Stainless steel] <Insert material>**.
13. Wire Mesh: **[Stainless steel or brass over dome] [Not required]**.
14. Perforated Gravel Guard: **[Stainless steel] [Not required]**.
15. Vandal-Proof Dome: **[Not required] [Required]**.
16. Water Dam: **[Not required] [2 inches (51 mm) high]**.
17. **<Insert options>**.

C. Cast-Iron, Small-Sump, General-Purpose Roof Drains **<Insert drawing designation if any>**:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Josam Company.
- b. Marathon Roofing Products.
- c. MIFAB, Inc.
- d. Smith, Jay R. Mfg. Co.
- e. Tyler Pipe.
- f. Watts Water Technologies, Inc.
- g. Zurn Plumbing Products Group; Light Commercial Products Operation.
- h. Zurn Plumbing Products Group; Specification Drainage Operation.
- i. **<Insert manufacturer's name>**.
- j. or approved equal.

2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: Nominal **[8-inch (203-mm)] <Insert dimension>** diameter.
5. Combination Flashing Ring and Gravel Stop: **[Not required] [Required]**.
6. Outlet: **[Bottom] [Side] <Insert location>**.
7. Extension Collars: **[Not required] [Required]**.
8. Underdeck Clamp: **[Not required] [Required]**.
9. Expansion Joint: **[Not required] [Required]**.
10. Sump Receiver Plate: **[Not required] [Required]**.
11. Dome Material: **[Lacquered cast iron] <Insert material>**.
12. Wire Mesh: **[Stainless steel or brass over dome] [Not required]**.
13. Vandal-Proof Dome: **[Not required] [Required]**.
14. **<Insert options>**.

D. Metal, **[Cornice] [and] [Gutter]** Roof Drains **<Insert drawing designation if any>**:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Josam Company.
- b. Marathon Roofing Products.
- c. MIFAB, Inc.
- d. Smith, Jay R. Mfg. Co.
- e. Tyler Pipe.
- f. Watts Water Technologies, Inc.

- g. Zurn Plumbing Products Group; Specification Drainage Operation.
 - h. **<Insert manufacturer's name>**.
 - i. or approved equal.
 2. Standard: ASME A112.6.4, for [**cornice**] [**and**] [**gutter**] roof drains.
 3. Body Material: Lacquered cast iron body with cast iron flashing clamp collar and nickel bronze flat strainer.
 4. Dimension of Body: Nominal **6-inch** (152-mm) diameter.
 5. Outlet: [**Bottom**] [**Side**] [**45-degree angle**].
 6. Dome Material: [**Bronze**] **<Insert material and finish>**.
 7. Vandal-Proof Dome: [**Not required**] [**Required**].
 8. **<Insert options>**.
- E. Metal, Parapet Roof Drains **<Insert drawing designation if any>**:
 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
 2. Standard: ASME A112.6.4, for parapet roof drains.
 3. Body Material: Lacquered cast iron body with flashing clamp collar. **<Insert material>**.
 4. Outlet: [**Back**] [**Angle**] **<Insert location>**.
 5. Grate Material: [**Bronze**] [**Epoxy-coated cast iron**] [**Nickel-bronze alloy**] **<Insert material>**.
 6. Vandal-Proof Grate: [**Not required**] [**Required**].
 7. **<Insert options>**.
- F. Metal, Large-Sump, Promenade Roof Drains **<Insert drawing designation if any>**:
 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
 - f. **<Insert manufacturer's name>**.
 - g. or approved equal.
 2. Standard: ASME A112.6.4, for promenade roof drains.

3. Body Material: Lacquered cast iron body with flashing clamp collar. <Insert material>.
4. Dimension of Body: Nominal [**14-inch (357-mm)**] <Insert dimension> diameter.
5. Dimension of Frame and Grate: Nominal [**14 inches (357 mm)**] <Insert dimension> square.
6. Outlet: Bottom.
7. Grate Material: [**Bronze**] [**Lacquered cast iron**] [**Nickel-bronze alloy**] <Insert material>.
8. Vandal-Proof Grate: [**Not required**] [**Required**].
9. Extension Collars: [**Not required**] [**Required**].
10. Underdeck Clamp: [**Not required**] [**Required**].
11. Expansion Joint: [**Not required**] [**Required**].
12. Sump Receiver Plate: [**Not required**] [**Required**].
13. <Insert options>.

G. Metal, Medium-Sump, Promenade Roof Drains <Insert drawing designation if any>:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
 - f. <Insert manufacturer's name>.
 - g. or approved equal.
2. Standard: ASME A112.6.4, for promenade roof drains.
3. Body Material: Lacquered cast iron body with flashing clamp collar. <Insert material>.
4. Dimension of Body: [**11- to 12-inch (280- to 305-mm)**] <Insert dimension> diameter.
5. Dimension of Frame and Grate: Nominal [**12 inches (305 mm)**] <Insert dimension> square.
6. Outlet: Bottom.
7. Grate Material: [**Bronze**] [**Lacquered cast iron**] [**Nickel-bronze alloy**] <Insert material>.
8. Vandal-Proof Grate: [**Not required**] [**Required**].
9. Extension Collars: [**Not required**] [**Required**].
10. Underdeck Clamp: [**Not required**] [**Required**].
11. Expansion Joint: [**Not required**] [**Required**].
12. Sump Receiver Plate: [**Not required**] [**Required**].
13. <Insert options>.

H. Metal, Small-Sump, Promenade Roof Drains <Insert drawing designation if any>:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Josam Company.
 - b. Smith, Jay R. Mfg. Co.
 - c. Tyler Pipe.
 - d. Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; Light Commercial Products Operation.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
2. Standard: ASME A112.6.4, for promenade roof drains.
 3. Body Material: Lacquered cast iron body with flashing clamp collar. **<Insert material>**.
 4. Dimension of Body: Nominal [**8-inch (203-mm)**] **<Insert dimension>** diameter.
 5. Dimension of Frame and Grate: Nominal [**8 inches (203 mm)**] **<Insert dimension>** square.
 6. Outlet: Bottom.
 7. Grate Material: [**Bronze**] [**Lacquered cast iron**] [**Nickel-bronze alloy**] **<Insert material>**.
 8. Vandal-Proof Grate: [**Not required**] [**Required**].
 9. Extension Collars: [**Not required**] [**Required**].
 10. Underdeck Clamp: [**Not required**] [**Required**].
 11. Expansion Joint: [**Not required**] [**Required**].
 12. Sump Receiver Plate: [**Not required**] [**Required**].
 13. **<Insert options>**.
- I. Metal, Medium-Sump, Deck Roof Drains **<Insert drawing designation if any>**:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
 2. Standard: ASME A112.6.4, for deck roof drains; ASME A112.6.3, for floor drains.
 3. Body Material: Lacquered cast iron body with flashing clamp collar.
 4. Flange: [**Anchor**] [**Anchor with weep holes**] [**Not required**].
 5. Clamping Device: [**Not required**] [**Required**].
 6. Integral Backwater Valve: [**Not required**] [**Required**].
 7. Outlet: [**Bottom**] [**End**] [**Side**] **<Insert location>**.
 8. Grate Material: [**Lacquered cast iron**] **<Insert material>**.
 9. Grate Finish: [**Painted**] [**Not required**] **<Insert finish>**.
 10. Overall Dimension of Frame and Grate: Nominal [**14 inches (357 mm)**] **<Insert dimension>** [**round**] [**square**].
 11. Top-Loading Classification: [**Extra-Heavy Duty**] [**Heavy Duty**].

12. Vandal-Proof Frame and Grate: **[Not required] [Required]**.
13. **<Insert options>**.

J. Metal, Small-Sump, Deck Roof Drains **<Insert drawing designation if any>**:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
2. Standard: ASME A112.6.4, for deck roof drains; ASME A112.6.3, for floor drains.
 3. Body Material: Lacquered cast iron body with flashing clamp collar.
 4. Flange: **[Anchor] [Anchor with weep holes] [Not required]**.
 5. Clamping Device: **[Not required] [Required]**.
 6. Integral Backwater Valve: **[Not required] [Required]**.
 7. Outlet: **[Bottom] [End] [Side] <Insert location>**.
 8. Grate Material: **[Lacquered cast iron] <Insert material>**.
 9. Grate Finish: **[Painted] [Not required] <Insert finish>**.
 10. Overall Dimension of Frame and Grate: Nominal **[8 inches (203 mm)] <Insert dimension> [round] [square]**.
 11. Top-Loading Classification: **[Extra-Heavy Duty] [Heavy Duty] [Light Duty] [Medium Duty]**.
 12. Vandal-Proof Frame and Grate: **[Not required] [Required]**.
 13. **<Insert options>**.

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Downspout Adaptors **<Insert drawing designation if any>**:

1. Description: Manufactured, gray-iron casting, for attaching to horizontal-outlet, parapet roof drain and to exterior, sheet metal downspout.
2. Size: Inlet size to match parapet drain outlet.

B. Downspout Boots **<Insert drawing designation if any>**:

1. Description: Manufactured, ASTM A 48/A 48M, gray-iron casting, with strap or ears for attaching to building; **NPS 4 (DN 100)** outlet; and shop-applied bituminous coating.
2. Size: Inlet size to match downspout and **NPS 4 (DN 100)** outlet.

C. Conductor Nozzles **<Insert drawing designation if any>**:

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

2.3 CLEANOUTS

A. Floor Cleanouts <Insert drawing designation if any>:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Josam Company.
 - b. Oatey.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.
 - e. Tyler Pipe.
 - f. Watts Water Technologies, Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Products Operation.
 - h. Zurn Plumbing Products Group; Specification Drainage Operation.
 - i. <Insert manufacturer's name>.
 - j. or approved equal.
2. Standard: ASME A112.36.2M, for [adjustable housing] [cast-iron soil pipe with cast-iron ferrule] [heavy-duty, adjustable housing] [threaded, adjustable housing] cleanouts.
3. Size: Same as connected branch.
4. Type: [Adjustable housing] [Cast-iron soil pipe with cast-iron ferrule] [Heavy-duty, adjustable housing] [Threaded, adjustable housing].
5. Body or Ferrule Material: [Cast iron] [Stainless steel] <Insert material>.
6. Clamping Device: [Not required] [Required].
7. Outlet Connection: [Inside calk] [Spigot] [Threaded].
8. Closure: [Brass plug with straight threads and gasket] [Brass plug with tapered threads] [Cast-iron plug] [Plastic plug].
9. Adjustable Housing Material: [Cast iron] [Plastic] <Insert material> with [threads] [set-screws or other device].
10. Frame and Cover Material and Finish: [Nickel-bronze, copper alloy] [Painted cast iron] [Polished bronze] [Rough bronze] [Stainless steel] <Insert material and finish>.
11. Frame and Cover Shape: [Round] [Square] <Insert shape>.
12. Top-Loading Classification: [Extra-Heavy Duty] [Heavy Duty] [Light Duty] [Medium Duty].
13. Riser: ASTM A 74, [Extra-Heavy] [Service] class, cast-iron drainage pipe fitting and riser to cleanout.

B. Test Tees <Insert drawing designation if any>:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
2. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
 3. Size: Same as connected drainage piping.
 4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
 5. Closure Plug: **[Countersunk] [or] [raised head], [brass] <Insert material>**.
 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

C. Wall Cleanouts **<Insert drawing designation if any>**:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
2. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
 3. Size: Same as connected drainage piping.
 4. Body Material: **[Hub-and-spigot, cast-iron soil-pipe T-branch] [Hubless, cast-iron soil-pipe test tee]** as required to match connected piping.
 5. Closure: **[Countersunk] [Countersunk or raised-head] [Raised-head], [drilled-and-threaded] [brass] [cast-iron]** plug.
 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 7. Wall Access: Round, **[deep, chrome-plated bronze] [flat, chrome-plated brass or stainless-steel]** cover plate with screw.
 8. Wall Access: **[Round] [Square], [nickel-bronze, copper-alloy, or stainless-steel] <Insert material>** wall-installation frame and cover.
 9. rainage piping.

2.4 BACKWATER VALVES

A. Cast-Iron, Horizontal Backwater Valves **<Insert drawing designation if any>**:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
2. Standard: ASME A112.14.1, for backwater valves.
3. Size: Same as connected piping.
4. Body Material: Cast iron.
5. Cover: Cast iron with **[bolted] [or] [threaded]** access check valve.
6. End Connections: **[Hub and spigot] [or] [hubless]**.
7. Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang **[closed] [open for airflow unless subject to backflow condition]**.
8. Extension: ASTM A 74, Service class; full-size, cast-iron soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Cast-Iron, Drain-Outlet Backwater Valves **<Insert drawing designation if any>**:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Josam Company.
 - b. Smith, Jay R. Mfg. Co.
 - c. Watts Water Technologies, Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
 - e. **<Insert manufacturer's name>**.
 - f. or approved equal.
2. Size: Same as floor drain outlet.
3. Body Material: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
4. Check Valve: Removable ball float.
5. Inlet: Threaded.
6. Outlet: Threaded or spigot.

2.5 TRENCH DRAINS

A. Trench Drains **<Insert drawing designation if any>**:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
2. Standard: ASME A112.6.3, for trench drains.
 3. Body Material: Lacquered cast iron.
 4. Flange: **[Anchor] [Anchor with weep holes] [Not required]**.
 5. Clamping Device: **[Not required] [Required]**.
 6. Outlet: **[Bottom] [End] [Side] <Insert location>**.
 7. Grate Material: **[Ductile iron] [or] [gray iron] [stainless steel] <Insert material>**.
 8. Grate Finish: **[Painted] [Not required] <Insert finish>**.
 9. Dimensions of Frame and Grate: **<Insert dimensions>**.
 10. Top-Loading Classification: **[Extra-Heavy Duty] [Heavy Duty] [Light Duty] [Medium Duty]**.

2.6 CHANNEL DRAINAGE SYSTEMS

A. Narrow, Sloped-Invert, Polymer-Concrete, Channel Drainage Systems **<Insert drawing designation if any>**:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. ABT, Inc.
 - b. ACO USA.
 - c. Mea-Josam Div.; Josam Company.
 - d. MultiDrain Systems.
 - e. Poly-Cast.
 - f. Smith, Jay R. Mfg. Co.
 - g. **<Insert manufacturer's name>**.
 - h. or approved equal.
2. Type: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 - a. Channel Sections: Narrow, interlocking-joint, sloped-invert, polymer-concrete modular units with end caps. Include rounded bottom, with built-in invert slope of 0.6 percent and with outlets in number, sizes, and locations indicated. Include extension sections necessary for required depth.
 - 1) Dimensions: **4-inch (102-mm)** inside width. Include number of units required to form total lengths indicated.

- 2) Frame: **[Galvanized steel or gray iron for grates] [Not required]**.
 - b. Grates: Manufacturer's designation "**[heavy] [medium]** duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.
 - 1) Material: **[Ductile iron] [Fiberglass] [Galvanized steel] [Gray iron] [Stainless steel] <Insert material>**.
 - 2) Locking Mechanism: **[Manufacturer's standard device for securing grates to channel sections] [Not required]**.
 - c. Covers: Solid **[ductile or gray iron] <Insert material>**, of width and thickness that fit recesses in channel sections, and of lengths indicated.
 - d. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.
 - e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
- B. Narrow, Level-Invert, Polymer-Concrete, Channel Drainage Systems **<Insert drawing designation if any>**:
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. ABT, Inc.
 - b. ACO USA.
 - c. Mea-Josam Div.; Josam Company.
 - d. **<Insert manufacturer's name>**.
 - e. or approved equal.
 2. Type: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 - a. Channel Sections: Narrow, interlocking-joint, precast, polymer-concrete modular units with end caps. Include rounded bottom, with level invert and with **NPS 4 (DN 100)** outlets in number and locations indicated.
 - 1) Dimensions: **[5-inch (127-mm)] <Insert dimension>** inside width and **[9-3/4-inch (248-mm)] <Insert dimension>** depth. Include number of units required to form total lengths indicated.
 - 2) Frame: **[Galvanized steel or gray iron for grates] [Not required]**.
 - b. Grates: Manufacturer's designation "**[heavy] [medium]** duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.
 - 1) Material: **[Ductile iron] [Fiberglass] [Galvanized steel] [Gray iron] [Stainless steel] <Insert material>**.
 - 2) Locking Mechanism: **[Manufacturer's standard device for securing grates to channel sections] [Not required]**.

- c. Covers: Solid **[ductile or gray iron]** <Insert material>, of width and thickness that fit recesses in channel sections, and of lengths indicated.
 - d. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.
 - e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
- C. Wide, Level-Invert, Polymer-Concrete, Channel Drainage Systems <Insert drawing designation if any>:
- 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. ABT, Inc.
 - b. ACO USA.
 - c. Mea-Josam Div.; Josam Company.
 - d. Poly-Cast.
 - e. <Insert manufacturer's name>.
 - f. or approved equal.
 - 2. Type: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 - a. Channel Sections: Wide, interlocking-joint, precast, polymer-concrete modular units with end caps. Include flat or rounded bottom, with level invert and with outlets in number, sizes, and locations indicated.
 - 1) Dimensions: **[8-inch (203-mm)]** <Insert dimension> inside width and **[13-3/4-inch (350-mm)]** <Insert dimension> depth. Include number of units required to form total lengths indicated.
 - 2) Frame: **[Galvanized steel or gray iron for grates]** [Not required].
 - b. Grates: Manufacturer's designation "[heavy] [medium] duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.
 - 1) Material: **[Ductile iron] [Fiberglass] [Galvanized steel] [Gray iron] [Stainless steel]** <Insert material>.
 - 2) Locking Mechanism: **[Manufacturer's standard device for securing grates to channel sections]** [Not required].
 - c. Covers: Solid **[ductile or gray iron]** <Insert material>, of width and thickness that fit recesses in channel sections, and of lengths indicated.
 - d. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.
 - e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

2.7 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies <Insert drawing designation if any>:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. ProSet Systems Inc.
 - b. <Insert manufacturer's name>.
 - c. or approved equal.
2. Standard: ASTM E 814, for through-penetration firestop assemblies.
3. Certification and Listing: [Intertek Testing Service NA] <Insert testing agency acceptable to authorities having jurisdiction> for through-penetration firestop assemblies.
4. Size: Same as connected pipe.
5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
7. Special Coating: Corrosion resistant on interior of fittings.

2.8 FLASHING MATERIALS

- A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft. (3.7 kg/sq. m or 0.41-mm thickness).
- B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.
- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- F. Solder: ASTM B 32, lead-free alloy.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.

1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 2. Install expansion joints, if indicated, in roof drain outlets.
 3. Position roof drains for easy access and maintenance.
- B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.
- C. Install downspout boots at grade with top [6 inches (152 mm)] [12 inches (305 mm)] [18 inches (457 mm)] <Insert dimension> above grade. Secure to building wall.
- D. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
- E. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
1. Use cleanouts the same size as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
 2. Locate cleanouts at each change in direction of piping greater than 135 degrees.
 3. Locate cleanouts at minimum intervals of 50 feet (15 m) <Insert dimension> for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
 4. Locate cleanouts at base of each vertical soil and waste stack.
- F. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- G. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- H. Install horizontal backwater valves in floor with cover flush with floor.
- I. Install drain-outlet backwater valves in outlet of drains.
- J. Install test tees in vertical conductors and near floor.
- K. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.
- L. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.
- M. Assemble channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- N. Install through-penetration firestop assemblies in plastic conductors at concrete floor penetrations.
- O. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. (30-kg/sq. m) lead sheets, 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of 4.0-lb/sq. ft. (20-kg/sq. m) lead sheets, 0.0625-inch (1.6-mm) thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of 10 inches (250 mm) and with skirt or flange extending at least 8 inches (200 mm) around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07.
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.
- C. Protect threaded ends of piping at the end of each day or when work stops.

PART 4 - MEASUREMENT

4.1 METHOD OF MEASUREMENT

- A. No separate measurement shall be made for work under this Section.

PART 5 - PAYMENT

5.1 METHOD OF PAYMENT

- A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Lump Sum Contract price.

END OF SECTION 221423

SECTION 221429 - SUMP PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Submersible sump pumps.
 - 2. Wet-pit-volute sump pumps.
 - 3. Sump-pump basins and basin covers.
 - 4. Packaged drainage-pump units.
- B. Related Section:
 - 1. Section 221329 "Sanitary Sewerage Pumps" for effluent and sewage pumps.
- C. Alternates: Refer to Division 01 Section 012300 "Alternates" for description of Work in this Section affected by Alternates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include pump types, construction details, material descriptions, dimensions of individual components and profiles, and connections to other equipment and piping.
 - 2. Include rated capacities, impeller size, operating characteristics, power requirements, electrical characteristics, affected adjacent construction, and furnished specialties and accessories.
 - 3. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
 - 4. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
- C. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.
 - 1. Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- B. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain pumps through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Perform Work in accordance with Denver codes and standards.
- D. Provide pumps with manufacturer's name, model number, and rating/capacity identified.
- E. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:
 - 1. UL Compliance: Comply with UL 778 for motor-operated water pumps.
 - 2. National Electrical Manufacturers' Association (NEMA).
 - 3. DEN's insurance underwriter.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products under provisions of Section 220400 "Basic Plumbing Requirements" and Division 01.
- B. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing.
 - 1. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs. Maintain protective coatings and caps in place until installation.
- C. Store pumps in dry location.
- D. Protect bearings and couplings against damage.
- E. Comply with pump manufacturer's written rigging instructions for handling.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 WARRANTY

- A. Warranty of all equipment described in this Section shall meet warranty requirements of Section 220300 "Basic Mechanical Requirements".

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- 1. Minimum one (1) or 10% of quantity pumps delivered.

- B. Mechanical Seals: **[One (1)]** <Insert number> mechanical seal(s) for each pump.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. Construction waste shall be managed in accordance with provisions of Section 017419 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that Section.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Statically and dynamically balance rotating parts.
- B. Construction to permit complete servicing without breaking piping or motor connections.
- C. Pump connections to be flanged.

2.2 SUBMERSIBLE SUMP PUMPS

- A. Submersible, Fixed-Position, Single-Seal Sump Pumps:
 - 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Barnes; Crane Pumps & Systems.

- b. Bell & Gossett Domestic Pump; ITT Corporation.
 - c. Flo Fab inc.
 - d. Glentronics, Inc.
 - e. Goulds Pumps; ITT Corporation.
 - f. Grundfos Pumps Corp.
 - g. Liberty Pumps.
 - h. Little Giant Pump Co.
 - i. McDonald, A. Y. Mfg. Co.
 - j. Pentair Pump Group; Hydromatic Pumps.
 - k. Pentair Pump Group; Myers.
 - l. Stancor, Inc.
 - m. Sta-Rite Industries, Inc.
 - n. Weil Pump Company, Inc.
 - o. Weinman Division; Crane Pumps & Systems.
 - p. Zoeller Company.
 - q. <Insert manufacturer's name>.
 - r. or approved equal.
2. Description: Factory-assembled and -tested sump-pump unit.
3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
4. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
5. Impeller: Statically and dynamically balanced, [**ASTM A 48/A 48M, Class No. 25 A cast iron**] [**ASTM A 532/A 532M, abrasion-resistant cast iron**] [and] [**ASTM B 584, cast bronze**], [semiopen] <Insert design> design for clear wastewater handling, and keyed and secured to shaft.
6. Pump and Motor Shaft: Stainless steel[or steel], with factory-sealed, grease-lubricated ball bearings.
7. Seal: Mechanical.
8. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - a. Motor Housing Fluid: [Air] [Oil].
9. Controls:
 - a. Enclosure: NEMA 250, [**Type 1**] [**Type 4X**] <Insert type>.
 - b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches** (1500 mm).
 - e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
10. Controls:

- a. Enclosure: NEMA 250, [**Type 1**] [**Type 4X**] <Insert type>; [**pedestal**] [**wall**]-mounted.
- b. Switch Type: [**Mechanical-float**] [**Mercury-float**] [**Pressure**] <Insert type> type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
- c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
- d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with [**mechanical-float, mercury-float, or pressure**] <Insert type> switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

11. Control-Interface Features:

- a. Remote Alarm Contacts: For remote alarm interface.
- b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.

B. Submersible, Fixed-Position, Double-Seal Sump Pumps:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. BJM Pumps, LLC.
 - b. EBARA Fluid Handling.
 - c. ITT Flygt Corporation.
 - d. PACO Pumps; Grundfos Pumps Corporation, U.S.A.
 - e. <Insert manufacturer's name>.
 - f. or approved equal.
2. Description: Factory-assembled and -tested sump-pump unit.
 3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
 4. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
 5. Impeller: Statically and dynamically balanced, [**ASTM A 48/A 48M, Class No. 25 A cast iron**] [**ASTM A 532/A 532M, abrasion-resistant cast iron**] [and] [**ASTM B 584, cast bronze**], [**semiopen**] <Insert design> design for clear wastewater handling, and keyed and secured to shaft.
 6. Pump and Motor Shaft: Stainless steel[**or steel**], with factory-sealed, grease-lubricated ball bearings.
 7. Seals: Mechanical.
 8. Moisture-Sensing Probe: Internal moisture sensor and moisture alarm.
 9. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.

- a. Motor Housing Fluid: **[Air] [Oil]**.

10. Controls:

- a. Enclosure: NEMA 250, **[Type 1] [Type 4X] <Insert type>**.
- b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
- c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
- d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches** (1500 mm).
- e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

11. Controls:

- a. Enclosure: NEMA 250, **[Type 1] [Type 4X] <Insert type>**; **[pedestal] [wall]**-mounted.
- b. Switch Type: **[Mechanical-float] [Mercury-float] [Pressure] <Insert type>** type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
- c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
- d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with **[mechanical-float, mercury-float, or pressure] <Insert type>** switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

12. Control-Interface Features:

- a. Remote Alarm Contacts: For remote alarm interface.
- b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.

2.3 WET-PIT-VOLUTE SUMP PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alyan Pump Company.
2. Armstrong Pumps Inc.
3. Chicago Pump Company; a division of Yeomans Chicago Corporation.
4. Federal Pump Corp.
5. Flo Fab inc.
6. PACO Pumps; Grundfos Pumps Corporation, U.S.A.
7. Peerless Pump, Inc.

8. Pentair Pump Group; Aurora Pump.
 9. Swaby Manufacturing Company.
 10. Tramco Pump Company.
 11. Vertiflo Pump Company.
 12. Weil Pump Company, Inc.
 13. Weinman Division; Crane Pumps & Systems.
 14. Yeomans Chicago Corporation.
 15. **<Insert manufacturer's name>**.
 16. or approved equal.
- B. Description: Factory-assembled and -tested sump-pump unit.
- C. Pump Type: Wet-pit-volute, single-stage, separately-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
- D. Pump Casing: Cast iron, with strainer inlet and threaded connection for **NPS 2 (DN 50)** and smaller and flanged connection for **NPS 2-1/2 (DN 65)** and larger discharge piping.
- E. Impeller: Statically and dynamically balanced, [**ASTM A 48/A 48M, Class No. 25 A cast iron**] [**ASTM A 532/A 532M, abrasion-resistant cast iron**] [and] [**ASTM B 584, cast bronze**], [**semiopen**] **<Insert design>** design for clear wastewater handling, and keyed and secured to shaft.
- F. Sleeve Bearings: Bronze. Include oil-lubricated, intermediate sleeve bearings at **48-inch (1200-mm)** maximum intervals if basin depth is more than **48 inches (1200 mm)**, and grease-lubricated, ball-type thrust bearings.
- G. Pump and Motor Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
- H. Pump Discharge Piping: Factory or field fabricated, [**galvanized, ASTM A 53/A 53M, Schedule 40, steel pipe with ASME B16.1, Class 125, cast-iron flanges and flanged fittings or ASME B16.4, Class 125, gray iron threaded fittings**] **<Insert pipe material>**.
- I. Support Plate: Cast iron or coated steel and strong enough to support pumps, motors, and controls. Refer to Part 2 "Sump-Pump Basins and Basin Covers" Article for requirements.
- J. Shaft Seal: Stuffing box, with graphite-impregnated braided-yarn rings and bronze packing gland.
- K. Motor: Single-speed; grease-lubricated ball bearings and mounting on vertical, cast-iron pedestal.
- L. Controls:
1. Enclosure: NEMA 250, [**Type 1**] [**Type 4X**] **<Insert type>**.
 2. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.

3. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
4. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches** (1500 mm).
5. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

M. Controls:

1. Enclosure: NEMA 250, [**Type 1**] [**Type 4X**] <Insert type>; [**pedestal**] [**wall**]-mounted.
2. Switch Type: [**Mechanical-float**] [**Mercury-float**] [**Pressure**] <Insert type> type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
3. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
4. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with [**mechanical-float, mercury-float, or pressure**] <Insert type> switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

N. Control-Interface Features:

1. Remote Alarm Contacts: For remote alarm interface.
2. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - a. On-off status of pump.
 - b. Alarm status.

2.4 SUMP PUMP CAPACITIES AND CHARACTERISTICS

A. Unit Capacity: <Insert gpm (L/minute)>.

B. Number of Pumps: [**One**] [**Two**] <Insert number>.

C. Each Pump:

1. Capacity: <Insert gpm (L/minute)>.
2. Total Dynamic Head: <Insert feet (kPa)>.
3. Speed: <Insert rpm>.
4. Discharge Size: <Insert NPS (DN)>.
5. Electrical Characteristics:
 - a. Motor Horsepower: <Insert value>.
 - b. Volts: [**120**] [**240**] [**277**] [**480**] <Insert value>.
 - c. Phases: [**Single**] [**Three**].
 - d. Hertz: 60.

D. Unit Electrical Characteristics:

1. Full-Load Amperes: **<Insert value>**.
2. Minimum Circuit Ampacity: **<Insert value>**.
3. Maximum Overcurrent Protection: **<Insert value> A**.

2.5 SUMP-PUMP BASINS AND BASIN COVERS

- A. Basins: Factory-fabricated, watertight, cylindrical, basin sump with top flange and sidewall openings for pipe connections.
1. Material: **[Cast iron] [Fiberglass] [Polyethylene] <Insert material>**.
 2. Reinforcement: Mounting plates for pumps, fittings, and accessories.
 3. Anchor Flange: Same material as or compatible with basin sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.
- B. Basin Covers: Fabricate metal cover with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
1. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.
- C. Capacities and Characteristics:
1. Capacity: **<Insert gal (L)>**.
 2. Diameter: **<Insert inches (mm)>**.
 3. Depth: **<Insert inches (mm)>**.
 4. Inlet No. 1:
 - a. Drainage Pipe Size: **<Insert NPS (DN)>**.
 - b. Bottom of Sump to Centerline: **<Insert inches (mm)>**.
 - c. Type: **[Flanged] [Hubbed] [Threaded]** outside.
 5. Inlet No. 2:
 - a. Drainage Pipe Size: **<Insert NPS (DN)>**.
 - b. Bottom of Sump to Centerline: **<Insert inches (mm)>**.
 - c. Type: **[Flanged] [Hubbed] [Threaded]** outside.
 6. Inlet No. 3:
 - a. Drainage Pipe Size: **<Insert NPS (DN)>**.
 - b. Bottom of Sump to Centerline: **<Insert inches (mm)>**.
 - c. Type: **[Flanged] [Hubbed] [Threaded]** outside.
 7. Sidewall Outlet:
 - a. Discharge Pipe Size: **<Insert NPS (DN)>**.
 - b. Bottom of Sump to Centerline: **<Insert inches (mm)>**.
 - c. Type: **[Hubbed inside] [Hubbed outside] <Insert type>**.

8. Cover Material: **[Cast iron] [Steel with bituminous coating] [Cast iron or steel with bituminous coating] <Insert material>**.
9. Cover Diameter: **<Insert inches (mm)>**, but not less than outside diameter of basin top flange.
10. Manhole Required in Cover: **[Yes] [No]**.
11. Vent Size: **[Not required] <Insert NPS (DN)>**.

2.6 PACKAGED DRAINAGE-PUMP UNITS

A. Packaged Pedestal Drainage-Pump Units:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. AMT; a subsidiary of the Gorman-Rupp Company.
 - b. Goulds Pumps; ITT Corporation.
 - c. Liberty Pumps.
 - d. Little Giant Pump Co.
 - e. Pentair Pump Group; Hydromatic Pumps.
 - f. Pentair Pump Group; Myers.
 - g. Sta-Rite Industries, Inc.
 - h. Zoeller Company.
 - i. **<Insert manufacturer's name>**.
 - j. or approved equal.
2. Description: Factory-assembled and -tested, automatic-operation, freestanding, sump-pump unit.
3. Pump Type: Wet-pit-volute, single-stage, separately-coupled, overhung-impeller centrifugal pump as defined in HI 1.1-1.2 and HI 1.3.
4. Pump Casing: Corrosion-resistant material, with strainer inlet, design that permits flow into impeller, and vertical discharge for piping connection.
5. Impeller: Aluminum, brass, or plastic.
6. Motor: With built-in overload protection and mounted vertically on sump pump column.
7. Power Cord: Three-conductor, waterproof cable of length required but not less than **72 inches (1830 mm)**, with grounding plug and cable-sealing assembly for connection at pump.
8. Control: Float switch.

B. Packaged Submersible Drainage-Pump Units:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. ABS Pumps Inc.
 - b. Bell & Gossett Domestic Pump; ITT Corporation.
 - c. Glentronics, Inc.
 - d. Goulds Pumps; ITT Corporation.
 - e. Grundfos Pumps Corp.

- f. Liberty Pumps.
 - g. Little Giant Pump Co.
 - h. McDonald, A. Y. Mfg. Co.
 - i. Pentair Pump Group; Hydromatic Pumps.
 - j. Pentair Pump Group; Myers.
 - k. Sta-Rite Industries, Inc.
 - l. Zoeller Company.
 - m. **<Insert manufacturer's name>**.
 - n. or approved equal.
2. Description: Factory-assembled and -tested, automatic-operation, basin-mounted, sump-pump unit.
 3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller centrifugal pump as defined in HI 1.1-1.2 and HI 1.3.
 4. Casing: **[Metal]** **<Insert material>**.
 5. Impeller: **[Brass]** **<Insert material>**.
 6. Pump Seal: Mechanical.
 7. Motor: Hermetically sealed, capacitor-start type, with built-in overload protection.
 8. Power Cord: Three-conductor, waterproof cable of length required but not less than **72 inches** (1830 mm), with grounding plug and cable-sealing assembly for connection at pump.
 9. Pump Discharge Piping: Factory or field fabricated, **[galvanized, ASTM A 53/A 53M, Schedule 40, steel pipe with ASME B16.4, Class 125, gray iron threaded fittings]** **<Insert pipe material>**.
 10. Control: Motor-mounted float switch.
 11. Basin: Plastic.

C. Capacity and Characteristics:

1. Capacity: **<Insert gpm (L/minute)>**.
2. Total Dynamic Head: **<Insert feet (kPa)>**.
3. Speed: **<Insert rpm>**.
4. Discharge Pipe Size: **<Insert NPS (DN)>**.
5. Electrical Characteristics:
 - a. Motor Horsepower: **<Insert value>**.
 - b. Volts: **[120] [240] [277] [480]** **<Insert value>**.
 - c. Phases: **[Single] [Three]**.
 - d. Hertz: 60.
 - e. Full-Load Amperes: **<Insert value>**.
 - f. Minimum Circuit Ampacity: **<Insert value>**.
 - g. Maximum Overcurrent Protection: **<Insert value> A**.
6. Basin: Not Required.
7. Basin:
 - a. Capacity: **[2 gal (7.6 L)] [5 gal (18.9 L)]** **<Insert other>** minimum.
 - b. Inlet Connection: **[NPS 1-1/2 (DN 40)]** **<Insert other>** minimum.

2.7 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation and filling are specified in Section 312000 "Earth Moving."

3.2 EXAMINATION

- A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.3 INSTALLATION

- A. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.
- B. Install in accordance with manufacturer's instructions.
- C. Ensure shaft length allows sump pumps to be located minimum 24 inches below lowest invert into sump pit and minimum 6 inches clearance from bottom of sump pit.
- D. Provide air cock and drain connection on horizontal pump casings.
- E. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
- F. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and over.
- G. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- H. Align and verify alignment of base mounted pumps prior to start-up.

3.4 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to assist Contractor and inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Pumps and controls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to assist Contractor and perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. **<Insert startup steps if any>**.

3.7 ADJUSTING

- A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust control set points.